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INVITED LECTURES

INTERNATIONAL TRANSFERS OF TEENAGE AND CHILD PLAYERS

Wladimir Andreff

Abstract

In December 2009, a French newspaper, *Le Monde*[1] was reporting the very sad story of Yannick Abega, a teenage (below 18) soccer player originating from Cameroon who was just sacked by Almeria football club (Spain) where he was playing without having signed any labour contract. In fact, Abega had never signed a contract since his first transfer from Cameroon to Real Majorque in 2006, at the age of 13. Thus, the 'Foot Solidaire' association has lodged a complaint to FIFA contending "child trafficking, child ill-treatment, exploitation, and swindling Abega's parents". This story draws attention on to a typical phenomenon in today's high level sport which is an overall athlete (player) international mobility on the one hand and, on the other hand, on a specific segment of the global market for sporting talent, that is teenage and child international transfers. The problem is that in various sports transferring children and teenagers from outside Europe (basically from developing countries) is not allowed, like in soccer since the 2001 FIFA rules. Then a next issue comes up: how regulate international teenage player transfers in a way that could be more efficient than FIFA rules. Such issue is tackled in this paper. First, we describe the overall picture of international player transfers, and then we focus on outlaw and infamous conditions prevailing in international teenage and child transfers. A last part of the paper suggests to introduce in all sports, not only in soccer, a specific taxation of international player transfers, coined a Coubertobin tax whose merits are compared with FIFA rules.

A global market for player transfers: the "muscle drain"

The first significant international player transfers in soccer can be traced back to the 1950s. In the same decade, an outflow of baseball players from the Dominican Republic towards North American baseball leagues started to become more significant. However, it is globalisation of the labour market for talents that has really boosted athlete international migration, sometimes coined a "muscle drain" (Andreff, 2001) by analogy with the long lasting brain drain in the global economy. Such globalisation was triggered by the Bosman (1995) case in soccer. A similar jurisprudence was extended to different sports and citizens of Central Eastern Europe and CIS countries by Malaja, Kolpak and Simutenkov cases (Andreff, 2006). Then, in 2000, a Cotonou agreement signed by the European Union with 77 African, Caribbean and Pacific countries allowed athlete transfers from the latter area under the qualification of "assimilated Europeans", which means under the same conditions as those players who could claim benefiting from Bosman, Malaja, Kolpak and Simutenkov jurisprudences.

Table 1: Share of foreign players in professional football, pre- and post-Bosman (%)

1st division championship	1995	1996	1999	2005	2006
England	34	34	37	56	55
France	18	18	22	36	36
Germany	19	27	39	50	41
Italy	14	17	33	31	31
Spain	20	29	40	28	32

Source: CIES data base.

[1] Mustapha Kessous, Le parcours d'un jeune Camerounais perdu dans la jungle du foot, *Le Monde*, 22 décembre 2009.

The outcome is a global labour market for player talents. After 1995, the international mobility of football players grew and the percentage of foreign players in European football leagues was on average more than twice higher in 2008 compared with 1996. In particular, an increasing percentage shows up in the five major European football leagues (Table 1) where 38.7% of all players involved in 2006 were foreign, that is, 277 players of which 50.2% had migrated from other European countries.

Table 2: Migrant football players in 2008: thirty major leagues

Home country league	Number of migrant football players	Host country league	Average number of foreign players per club
Brazil	551	England	15,6
France	233	Greece	13,3
Argentina	222	Portugal	13,2
Serbia	192	Russia	12,9
Portugal	121	Germany	12,8
Czech Republic	113	Switzerland	11,5
Croatia	109	Belgium	11,5
Nigeria	94	Italy	10,4
Sweden	94	Scotland	10,2
Germany	92	Turkey	9,5
Bosnia and Herzegovina	91	Spain	9,2
Cameroon	87	Romania	9
Slovakia	76	Ukraine	8,8
Uruguay	71	Norway	8,7
England	70	Austria	8,5
Netherlands	66	Netherlands	8,4
Belgium	64	France	8,3
Spain	62	Denmark	7,8
Denmark	60	Slovakia	6,5
Ivory Coast	59	Bulgaria	6,4
Poland	59	Sweden	6,4
Switzerland	49	Hungary	5,9
Finland	46	Ireland	5,5
Austria	45	Poland	4,9
Senegal	45	Slovenia	4,9
Ghana	44	Finland	4,6
Romania	44	Croatia	3,9
Ireland	41	Island	3,8
Macedonia	41	Czech Republic	3,6
USA	38	Serbia	2,7

Source: CIES data base.

Table 2 provides a snapshot of the global market for football players with regards to the 30 major exporting (home) and 30 major importing (host) countries. It is to be noticed that major European leagues are both exporting and importing, which means that two-way trans-border flows are a characteristics of international athlete migration across major developed market economies. Outside Western Europe, not only some countries appear to be net exporters, first of all Brazil, Argentina and Serbia, but also the Czech Republic, Croatia, Nigeria, Bosnia and Herzegovina, Cameroon, Slovakia, Uruguay, Ivory Coast, Senegal, Ghana and Macedonia, that is, in a nutshell Latin American, Central Eastern European and African countries. Thus, South–North (from developing to more developed countries) athlete mobility is a crucial facet of international athlete migration. Nearly half of foreign players operating in the five major European football leagues are originating from developing countries.

The percentage is even higher if we look at second rank leagues like Belgium or Portugal and second and third division clubs of the big five European football countries. For example, in the French professional football league (*Ligue du Football Professionnel*), 50% of foreign players are from African countries. Southern (and Eastern European) countries usually are net exporters and Northern countries are net importers in player trade with the South (and Eastern Europe). From 1989 to 1997, over 2,000 Brazilian players migrated to European football clubs, and they were still 654 to move in 2002 up to 857 in 2004. Their major host country is Portugal, then other European countries. Hundreds of African and other Latin American football players are transferred to European clubs every year. The same sort of South–North international athlete migration is observed from developing countries to North America. A total of 1,300 players in the Major and Minor Leagues Baseball are citizens from the Dominican Republic, a number of African and Latin American players operate in the National Basketball Association and Czech and Russian superstar players are often hired by National Hockey League teams.

Since the late 1980s, post-communist transition economies from Central Eastern Europe and the former Soviet Union became significant net exporters of athletes so that they could compare – and indeed compete – with developing countries on the global labour market for sporting talents. For example, from 1990 to 1997, over 600 professional football players, 520 ice hockey players, 300 handball and volley ball players, 100 ice skaters and 20 coaches moved abroad from the former USSR (Poupaux & Andreff, 2007). With economic recovery in Russia, nowadays a reverse flow has emerged of importing foreign players in the most performing Russian clubs, like the 2008 UEFA Cup winner, that is, Zenith St. Petersburg.

Table 3: Geographic distribution of domestic team affiliation, African 2002 World Cup players

Domestic team affiliation	Cameroon	Nigeria	Senegal	S. Africa	Tunisia	Total
Home country	-	2	1	7	14	24
Africa	-	-	1	-	-	1
England	4	4	-	3	-	11
France	7	3	20	-	2	32
Germany	1	-	-	2	1	4
Italy	3	-	-	1	3	7
Spain	4	1	-	-	-	5
Other European	3	11	1	10	3	28
Rest of World	1	2	-	-	-	3
Total	23	23	23	23	23	115

Source: Gerrard (2002).

The other side of the coin is the selection of players enrolled abroad in an increasing number of national squads. During the football World Cup 2006 the overall number of players selected in national squads was 736 out of which 392 (53%) were playing abroad. National squads of developing (and transition) countries now comprise of many players whose club affiliations are outside their home domestic league. This is even more clearly exhibited with African national squads participating in the football World Cup final tournament (Table 3). For the five African squads that qualified in 2002, only 21% of players were affiliated to their home domestic league. The extreme case was the Ivory Coast team in which all the players were registered in foreign leagues and clubs.

International transfers of teenage and child players

International teenage player transfers is the most controversial aspect of the muscle drain business, and has been outlawed by FIFA rules adopted in 2001 that forbid transferring from abroad football players below the age of 18. Indeed, such transfers emerged in the late 1980s, but importing teenage players from developing countries was boosted by liberalisation and the resulting globalisation of the football labour market after 1995.

Unheeded teenage player transfers in the 1990s

The worst tendency that accompanies the muscle drain had emerged in October 1991, when Torino football club had recruited three young players, under the age of 17, who had been junior world champions with the national team of Ghana. With the emergence of 15-17 year old player championships in Africa, international transfers had increasingly affected players under 16. In the late nineties, an increasing number of African players under 16 had been transferred to European clubs. Such a tendency has been fuelled in the wake of the Bosman case after which many clubs increasingly looked for a substitute to more mobile European superstar players by recruiting younger and cheaper talents from the Third World. It has created a world unregulated labour market for young and very young talented players.

The issue of international transfers of talented teenage players from developing countries is not a marginal or negligible one. During the 1990s, 4,809 foreign players, aged from six to sixteen, originating from Latin American and African countries were found in Italian football clubs. In Italian football, 2,273 foreign affiliated players over 16 had been imported through illicit channels. A report to the Italian Senate stated that 5,282 non-European players under 16 were employed by amateur football clubs, often subsidiaries of major clubs playing in *Calcio* (Division 1). In the Netherlands, 33 football clubs had been sued by the immigration office for illicit importation of Latin American and African players. Belgian football clubs were – and still are – utilised as "nursery hubs" for training African players before their transfer to major European leagues.

Talented young players imported from developing countries can offer an interesting substitute in the face of rising prices in the European market. For example, in 1996, Georges Mouandjo from Cameroon was transferred to RAEC Mons with a contract stipulating a 6,000 Belgian franc (BF) salary – 150 euro monthly wage while the labour regulation at the moment in Belgium was fixing the minimum wage for football players at 43,000 BF – 1,075 euros per month. The Italian football player union contended that a contract for an Italian talented junior player could amount up to 4.5 million euros whereas the average for an African junior player was roughly 4,500 euros. In particular, young Third World players yielded a better return to the club when they were able to improve (or to contribute to improving) its sport performances in the professional championship and attract more spectators in the stadium. From scattered data, it seems that European professional football clubs that enrolled Latin American and African players in their squads were well-off in terms of both their gate receipts and their rankings in the various European professional championships.

On the other hand, once hired, a talented young player from Africa or Latin America can be sold again, after a while[2], at a higher price on the European labour market by the importing club to another one. For instance, the Guinean teenage player Oularé was recruited by the Belgian club of Genk for 100,000 euros and transferred two years later to a Turkish club for 5.75 million euros. Manchester United apparently had a partnership agreement with the Belgian club of Antwerp according to which the latter was to recruit and train non-European young players, to obtain their Belgian citizenship[3], and then to transfer them to Manchester. A similar agreement linked the Belgian football club Germinal Ekeren to the Dutch club Ajax Amsterdam.

[2] Or even immediately, when a young player has been imported from a developing country – in particular through the underground market, at a dumping price, quite lower than the actual player's value. Thus, investing in a talented young player from the Third World is often an opportunity for a European club to gain some surplus value after a resale. About player trade as a source of finance for European professional clubs, see Andreff & Staudohar (2000). The dumping price most likely appears when it does not even cover the cost invested by the nursery club in the player's education and training, which is quite usual for African and Latin American players transferred to Europe.

[3] Naturalisation – change of citizenship – has also become a big concern, more in Olympic sports than in soccer (Andreff, 2006).

Most young players transferred to European professional clubs eventually did not sign a labour contract and, then, were left aside, cut from their family, their friends, and their home country, with no source of income and no assistance. Often spotted by players agents at the African Cup of Nations teenage players are invited for a trial in European clubs, and recruited when the trial is successful. When a trial is unsuccessful, they are often abandoned by both clubs and players' agents without a labour contract and a return airplane ticket to their home country. Thus they are left *de facto* in a position as illegal migrant workers and, sometimes, are targeted by the police.

Some individual stories had surfaced in the sports news in the 1990s. Sonny Nwachukwu from Nigeria was tested in 1992 by the Belgian football club of Genk and started playing in the professional squad without having signed a contract. Afterwards he was transferred to Germinal Ekeren, and then to Tielen, still without signing any contract, playing there for the minimum wage. Khalilou Fadiga from Senegal (then naturalized Belgian), became a star player in France (FC Auxerre) but he reported to the press that he had been conned once by one players' agent when he was transferred from a club in Liège to a club in Lommel. Serge Nijki Bodo from Cameroon was approached by the Belgian football club La Gantoise (Division 1) when he was 17; he started training with the professional squad even though he had not signed a contract. After a while, the coach asked him to contact Racing de Gand (Division 3) where he signed a sheet of paper (not an official contract) in Flemish - which he could not understand – covering only his accommodation, with no wage. Then he signed an exclusive contract with a players' agent who charged 50% of his forthcoming income. The agent introduced Bodo to FC Malines and to the Denderleeuw club; in both cases, the negotiation did not come out with a signed contract due to an excessively high transfer fee requested by the agent. Finally, in November 2000, 15 young African players lodged a complaint in the Belgian court against professional clubs and players' agents, complaining of "trade and trafficking of human beings" - a case that they eventually won (Tshimanga Bakadiababu, 2001). They have been abandoned by both clubs and players' agents; being minors without a labour contract and without a pre-paid return ticket to their home country, they *de facto* became illegal migrant workers in Belgium.

Unsuccessfully tested by the French club FC Nantes, at the age of 14, Serge Lebri from Ivory Coast was also left without money and return ticket. Then he played for five years, as an amateur player, for some French football clubs until August 1999 when he was controlled without a French ID. He was immediately expelled from France back to Ivory Coast, soon after his 18th birthday. A Guinean player Issiaga Conde was invited to join the Nîmes Olympique squad (French Division 2) in 1998 at the age of 16. Right after his arrival in the club, the team managers confiscated his passport. Nevertheless, he started negotiating with Toulouse FC (Division 1); without success. After an ID control in October 2000, he was put in jail and sentenced to be expelled back home. Then, for the first time in France, an African football player has sued a football club for illegal work and incitement to an irregular stay in France. He was not expelled eventually, due to a personal intervention of Mrs. Buffet, the French Minister for Youth and Sports. She had already been deeply shocked with the previous Lebri story and would not like to face a second one. An official report (Donzel, 1999) has screened that Africa is the first sourcing location abroad for French clubs as regards foreign teenage football players. An update shows that, for the season 1998-1999, 58 non-European young players were under a contract with French clubs, including 50 African citizens; in 1999-2000, they were 108 of which 96 African players.

In Italy, Arezzo football club had been sanctioned for having recruited one player from Ivory Coast and four Argentine players, all below 14, without paying a penny out of the 150 dollars promised to their families. This is only one example of "baby-*calciatore*" or "football children", between 12 and 18, torn by Italian professional clubs from their families in Latin America and Africa. In 1998, only 23 out of 5,282 non-European teenage players benefited from a labour contract signed in due terms.

Until 2001, the (sometimes irregular) international mobility of Third World teenage football players remained unregulated. No money was accruing to either the national football federation or the nursery association with international transfers of teenagers playing in non-affiliated associations in the home developing country. As to transfers of players from affiliated clubs, a dumping price on the European labour market meant a low transfer fee which often did not even cover the education and training cost of the teenage transferred player. On the other hand, the players' agents were usually taking a lion's share in the transaction with a high percentage (in any case higher than 10%) charged on the transfer fee and/or on the first wage bills.

The outcome of prohibition: an international black market for teenage soccer players

In the 2000s, teenage muscle drain has not been eliminated even though it is less publicised now that it is clearly illegal. One can still find some cases reported by the press. Let us mention one of them: by end of 2002, Isa Mohammed (Nigeria) was transferred to a first division Polish nursery club, and his transfer was supposed to be the rocket pad toward his international career in a major European football league. Unfortunately, he was injured, then skipped away from the team and eventually abandoned by the club. Abega story with which we started our introduction is another case in point.

After a decade of controversial teenage transfers, FIFA reacted in 2001 with new regulations, article 19 of which came up with the statement that "international transfer is allowed only if the player is at least eighteen". However, three exceptions (unwillingly) left the door open to regulation being circumvented: teenage transfers were allowed when their parents move abroad for reasons that are not linked to football (how do you demonstrate it?); when it is a transfer across EU countries; and when a teenage player is living close to the border of a foreign country. Thus, international transfers of teenage players now develop partly as a (outlaw or illegal) black market and partly on the (legal) basis of the three exceptions to FIFA article 19. Given the huge amount of money promised by big European clubs to young players, their families and their agents, and the home country's clubs have no means for hindering these international transfers, even if they are hardly compensated, or not compensated at all.

The muscle drain is not without its problems. First, it undermines the sporting substance of developing countries. Second, it diverts the most talented sportsmen and women, those few who have had the opportunity to benefit from the rare domestic coaches and sport facilities. Third, in some cases, it erodes the capacity of the home country to use its most talented athletes in international competition, a fact which partly explains the poor performances of developing countries in world sport events (Andreff *et al.*, 2008). For instance, football players from Africa (namely Cameroon, Nigeria, Ivory Coast) were not released by their (European) professional clubs for selection to their domestic national teams to play in matches of the 22nd African Cup 2000 (177 out of the 352 registered players were playing in European clubs at the moment). The African Cup is nicknamed the "cattle fair" because a number of well known European clubs' managers, coaches and players' agents attend it with the objective of recruiting talented players. At the Sydney Olympics, Cameroon, Nigeria and Morocco have had to compete without some of their star football players, in spite of FIFA rules that are supposed to compel clubs to release players selected for national teams.

Talented teenage players in developing countries are either enrolled in clubs affiliated to the national football federation or can be playing for non-affiliated sporting associations that recruit non-affiliated players in their squads. Affiliated clubs are used to proceed by themselves to the sale of young players after a price bargain with foreign clubs or to rely on a go between who has a good knowledge about foreign (European) labour markets, which is a players' agent. However, affiliated clubs are under the supervision and regulation of the national federation as regards the international transfer of players, whether minor or not. Albeit the club affiliation to a national federation does not secure once and for all – namely in the Third World context – that the transfer will come across through perfectly legal channels, it will diminish the probability of resorting to clandestine or illicit recruiting agents.

On the other hand, when it comes to non-affiliated associations, the only way-out for an international transfer of a talented young player is the underground labour market activated by clandestine networks of players' agents. The great bulk of players transferred from developing countries below 18 come by this illicit market where no legal or administrative rule does protect the players from the possible predatory behaviour of outlaw agents, since neither the non-affiliated sporting associations nor the clandestine players' agents are under the monitoring of a national football federation or a Ministry for Sports. Namely, an exit letter from the football federation is not required any longer, and a teenage player can leave the country simply with a tourist visa. The worst situation emerges when a player, with his family, enters himself in the market as the seller of his talents and is eventually trapped in the network of illegal players' agents connected with some European professional clubs.

Regulating the international mobility of teenage players: a "Coubertobin" tax

In 1978, James Tobin, a winner of the Nobel Prize in Economics, recommended a tax on foreign exchange transactions that "will throw sand in the wheels of international finance" and put a brake on too much swift short-term capital movements on the world financial markets (Tobin, 1978). On the other hand, Pierre de Coubertin wished all the countries of the world to participate on equal footing to the Olympic Games. How is it possible to reconcile this Coubertinian idea with the harshness of budget constraints in developing countries? Outlined below is a solution (not a panacea) which is likely to alleviate, along with some of the financial problems of developing countries, the aforementioned problem of the muscle drain. This is the aim of a so-called "Coubertobin" tax. Since the Tobin tax, as noted by Schulze (2000), is targeted at restricting short-term speculation, it must be redesigned to adapt to our purpose.

Tobin was thinking, in 1978, of a multilateral and uniform tax levied on all short-term foreign exchange transactions. In reducing the return on any foreign investment, the Tobin tax isolates the domestic interest rate from variations of the foreign interest rate. Thus, it enables a country to implement an autonomous monetary policy and slows short-term capital transfers. In more recent presentations (Eichengreen *et al.*, 1995), the Tobin tax is supposed to achieve three tasks: increase the autonomy of monetary policy, diminish the exchange rate volatility, and provide a source of revenues. It has been suggested that these revenues may help Third World countries to redeem their foreign debt. Another purpose could be to use tax income for a sort of Marshall Plan in favour of developing countries. In 1998, Tobin even mentioned that the tax might be a useful protection for still fragile banking systems in emerging (developing) countries. When it comes to protecting the banking system as well as raising income, the tax may well not be uniform. It may be levied with different rates depending on how long the term of the transaction is, including a possible surcharge on the shortest term transactions considered as speculative attacks (Spahn, 1996).

Designing a "Coubertobin" tax

As early as 1999, in a "Play the Game" Conference held in Copenhagen we have suggested to create a so-called Coubertobin tax in order to cure sports underdevelopment in the least developed countries and put a brake on international teenage player transfers from the Third World. This was eventually published (Andreff, 2001), then the tax concept had been elaborated further on (Andreff, 2004), discussed in the context of the English squad not qualifying for the FIFA World Cup final tournament seemingly due to too many imported players in English Premier League (Andreff, 2008) then more specifically in the African context (Andreff, 2010), and finally it is going to be published in a Handbook on sport and migration (Andreff, 2011).

The suggested Coubertobin tax has four purposes of: 1/ slightly covering the education and training cost, for his/her home developing country, of any athlete or player transferred abroad; 2/ providing a stronger disincentive to transfer an athlete or a player from a developing country, the younger he/she is when the transfer takes place; 3/ thus, slowing down the muscle drain from developing countries and toward professional player markets in developed countries; and 4/ accruing revenues to a fund for sports development in the home developing country from the tax levied on every athlete or player transfer abroad. The fund would firstly finance sport facility building and maintenance (thus facilitating a sport for all practice), and secondly physical education programs in schools (in some way, a reimbursement of the sporting education received in their home country by migrant athletes).

The idea is to levy the tax at a 1% rate on all transfer fees and initial wages agreed on in each labour contract signed by players from developing countries with foreign partners (usually foreign professional clubs and/or players' agents). By its very existence, the Coubertobin tax should slowdown the muscle drain, but a windfall benefit may be to slightly reduce the labour cost differential (including the tax) between home developing country's and host developed country's labour markets, thus lowering the (surely still strong) incentive for players to leave their home country. A specifically crucial issue is the one of international transfers of teen age athletes (mainly footballers) from Africa and Latin America, albeit it is not the only one. One can get to grips with such an issue through a differentiated taxation including a surcharge on the transfer fee and initial wage of teen age and very young players. A more detailed proposal may be as follows. Let:

FR stand for the revenues rose through the taxation that are to be placed in a fund for sports development in the home developing country;
Pi stand for the international transfer price (fee) augmented with the first annual wage of the transferred player or athlete (in order to prevent a switch from the fee to the wage offered, or the other way round);
Vl stand for the player's value on the local market in his/her home country;
r stand for the exchange rate between the domestic currency in the home country and the hard currency of the importing host country;
T stand for a Coubertobin tax at a uniform rate of 1% for all transferred players, including those over 18 years old;
s stand for a tax surcharge for players below 18;
a is the player's age at the date of transfer;
a_1 is a first age threshold below which a tax surcharge is to be paid;
a_2 is a second age threshold below which the tax surcharge should be as much deterrent as possible;
a_3 is a third age threshold below which the tax is so heavy that it must have a prohibitive effect on transfers of extremely young players.

For instance, if a_1 = 18 years, a_2 = 14 years, and a_3 = 10 years, we can envisage a tax surcharge such as:

if $a_1 < a < a_2$, the tax surcharge s_1 will be 2% more for each month under the age of 18 at the date of transfer (thus transferring a player of 16 will cost a 48% surcharge),

if $a_2 < a < a_3$, the surcharge s_2 will be 10% more for each month below the age of 14 at the date of transfer (thus transferring a player of 12 will cost a 240% surcharge),

if $a < a_3$, the surcharge s_3 will be a 1000% lump sum tax (for instance $a_3 = 10$).

Thus the full formula of the Coubertin tax will be, under previous assumptions:

$FR = (Pi - r.Vl) . T$, if $a > a_1$ (1)

$FR = (Pi - r.Vl) . [T + s_1 (a - a_1)]$, if $a_1 < a < a_2$ (2)

$FR = (Pi - r.Vl) . [T + s_2 (a - a_2)]$, if $a_2 < a < a_3$ (3)

$FR = (Pi - r.Vl) . (T + s3)$, if $a < a3$ (4)

Needless to say that the tax and surcharge rates as well as the age thresholds are only suggested here as examples and can be adjusted and revised at will. When it comes to the issue of who will pay the Courbertobin tax and possible surcharge, it must be the individual or legal body which pays the bill for the transfer fee and the first year wage, whether it is an affiliated professional club or a players' agent. If two bodies are involved, both will help pay. Of course, no one should be taxed twice, once in the developing home country and a second time in the host country; the tax should only be collected in the former country in order to avoid double taxation. Furthermore, there is a risk of bargaining and corruption surrounding the tax collection in developing countries. This is the reason why we suggest that the collection of the Coubertobin tax should be monitored and supervised by an international organization, either an existing one (UNDP or the World Bank) or an *ad hoc* one to be created (a sort of world agency for the Coubertobin tax, for instance, under the joint auspices of UN and IOC). This international organization would govern the whole process of tax calculation, collection and allocation, and would have to solve any emerging conflict between a player's home country or nursery club and his/her recruiting professional club or players' agent.

How much feasible is the tax and possible hindrances

We could expect the new tax would meet with both hindrance and resistance like those that would be met if the Tobin tax were introduced. First, the Coubertobin tax will not be easy to implement and enforce insofar as it has to be accepted on a worldwide basis. Otherwise, some free riding developed countries (professional clubs) will still transfer teen age players without paying the tax and will concentrate the most talented Third World migrant athletes, while some developing countries will be deprived of the money supposed to reside in their sports development fund. Just like the Tobin tax (Bourguinat, 1987), the Coubertobin tax must be generalized if one wants it to be efficient. There will be some (transaction) cost in levying the tax - a cost that must be borne by the home country - and a cost of supervision - borne by the above mentioned international organization which will receive some determined percentage of the tax revenues. In any case, a co-operation is required between host and home countries, between their Ministries for Sports and their national Olympic committees and sports federations. Since tax evasion would probably be higher than zero, as for the Tobin tax (Baker, 2001), a specific fine should apply if tax evasion were discovered.

It is clear that the Coubertobin tax cannot be introduced without some sort of general agreement joined by all countries involved in athlete transfers (a sort of general agreement on tax and trade of athletes - GATTA). Athlete transfers from countries that had not joined the agreement should be forbidden and fined or nullified when undertaken in a sort of international underground black market for sporting talents from developing countries. Of course, all the professional leagues and clubs all over the world would attempt to resist the new taxation, and the joint efforts of UN, IOC and international associations or federations (like FIFA in football), as well as political will in home and host countries, would be necessary to break through. The international organization in charge of the tax administration should supervise that tax revenues were really spent on sport development in home countries, including for training the most talented players until 18 in order to raise their international market value. Nevertheless, the suggested Coubertobin tax seems no less desirable and feasible than the Tobin tax (Palley, 2001) insofar as transfers of teen age or child players is assessed as a harmful practice, specifically for developing countries.

Comparing the tax with FIFA rules

The Bosman case has removed the former restrictions on the free mobility of foreign players within the European Union (EU) and the European Economic Area (EEA), first of all in football. However, in 1998, the European Commission issued a statement objecting to the rules of the *Fédération Internationale de Football Association* (FIFA) governing international transfers as regards the payment of transfer fees and players being prohibited from terminating their contracts early. A new FIFA transfer regulation (FIFA 2001) came into force on the 1rst of September 2001; it namely contains a number of clauses relating to the protection of minors, training compensation and a solidarity mechanism.

FIFA transfer rules limit the international transfer of minors (under 18). Transfers of minors are prohibited unless the player's family moves for non-football-related reasons. Within the EU-EEA, players under 18 can only move if teams undertake to provide both sporting and academic training. The rules also establish that compensation for training costs incurred between the age of 12 and 21 is payable when the player signs his first professional contract and on each subsequent move to another team up to the age of 23[4]. The first payment of training compensation is distributed on a pro rata basis between the teams contributing to the player's training. The calculation of the training compensation is based on a four-tier categorization of teams to be determined by individual national football associations (federations). Finally, FIFA rules include a solidarity mechanism whereby 5% of all compensation payments for transfers involving players over the age of 23 will be distributed to those teams involved in the training of the player between the age of 12 and 23. FIFA has introduced these rules basically for securing a training compensation to nursery clubs, and for preventing player movement under 18 except unless it is for sporting or academic training, but without any sport development objective for home countries.

However, FIFA regulation is a step forward in the same direction as the suggested Coubertobin tax (Gerrard, 2002). In first analysis, its major advantage is that, being already adopted, it should be more enforceable than the tax, which is no more than a suggestion until now. Although the FIFA rules, when actually enforced, might well be circumvented by host professional clubs, players' agents and teenage players (or their parents). We could imagine naturalizing the player on purpose, football-related moves of the player's family hidden behind apparently non-football-related reasons, false declarations about the player's age (a quite common practice in developing countries), and so on. By its very nature, FIFA regulation is restricted to football only, while the suggested Coubertobin tax is widespread to all professional – team as well as individual – sports. If only for this reason, the tax would have a higher return and a stronger impact on financing sport development in home developing countries. Take the example of the Dominican Republic which exports exactly no one football (soccer) player whereas over 1,300 Dominican citizens are operating in various North American baseball leagues: with FIFA rules, Dominican associations or clubs do not even receive a cent; with the Coubertobin tax, a quite significant inflow of dollars would have helped sport development in the Dominican Republic (Andreff 2002).

A few last remarks open the door to a further and deeper comparative analysis of FIFA regulation and the Coubertobin tax. Levying such a tax would certainly incur a bureaucratic process. Implementing FIFA rules is probably no less bureaucratic but, in addition, it is obviously more cumbersome to calculate the amount of the training compensation than to apply the tax rate on to a declared value *Pi* of the international transfer fee and initial wage. The return of FIFA rules will surely be higher for the transfer of players over 23 (5% for the solidarity mechanism against 1% for the Coubertobin tax) and even for all players over 18, since FIFA regulation applies to all cross-border transfers of a

[4] The idea that backs this rule may be expressed as follows: the surplus value appearing in each player's transfer from a European club to another one must be redistributed, including to the nursery club located in a developing country. It should help football clubs of the Third World to muddle through their deep financial problems (Tshimanga Bakadiababu, 2001).

player whereas the Coubertobin tax is suggested to be levied only on the first transfer from the home developing country. In this respect, the Coubertobin tax mechanism may be improved or adjusted in increasing the basic tax rate *T* up to 5%. On the other hand, the amount of money accruing to the home developing country will not be higher with FIFA regulation than with the Coubertobin tax since all the subsequent transfers (after the first one) of an African or Latin American player usually occur within European and/or North American labour markets, and not back to any Third World country.

When it comes to teenage players below 18, the Coubertobin tax is definitely better performing than FIFA rules. With FIFA regulation, all transfers below 18 are prohibited from non-EU-EEA areas, thus generating not even a cent for the home developing country. On the other hand, FIFA rules absolutely block off any sort of market mechanism and reduce teenage player mobility to exactly nothing. Then, these rules negate the usual economic and social right to labour free mobility and, maybe, the basic human right of human being mobility (as for where a teenage player would like to be educated and trained and his family would live with him, once national migration laws had been taken into account). Therefore, FIFA regulation is neither economically, nor ethically desirable, at least when compared with the Coubertobin tax. Only throwing sand into the wheels of the market, the latter let the market mechanism work up to the moment when it reaches a prohibitive rate of taxation (*s3*) but, even at this point, a club which is very much eager to transfer a player under 10 can accept to pay 1000% of his value. No economic right (to trade) and no human right (to move) are affected there. Moreover, the return of Coubertobin tax is widely higher than with FIFA rules for players below 18 and, in this respect, the former is more likely to favour sport development in home developing countries than the latter. The younger the transferred player, the larger is the gap between the taxation and what FIFA regulation yields (zero below 18).

A prerequisite: tightly supervising the players' agent business

Players' agents are obviously at the core of international transfer business. A number of them have obtained a FIFA permit in order to enter the business. They do consider outlaw agents, entering the business without a FIFA permit, as an unfair competition based on non-transparent transactions. Though FIFA has established an approval procedure for players' agents, reinforced by law in some European countries, illicit transfers develop because European clubs keep on dealing with FIFA unapproved agents, and because some approved agents start up companies that hire and work with unapproved agents. Outlaw agents are more inclined to deal with African and Latin American non-affiliated associations and straight with teenage players themselves (and their parents) insofar as they are crowded out by approved agents from the more profitable market of transactions transferring the most famous European and non-European professional players. We can expect outlaw agents to keep on circumventing the FIFA regulation, namely in falsifying the age of players below 18. The lack of a tight FIFA supervision over all players' agents is detrimental to the whole business. In France, for example, over 200 agents are in the business whereas only 46 hold a FIFA permit; in Belgium, 26 of them are holding a permit out of 200.

FIFA has not yet recognized the right for national associations (federations) and nation states to sue outlaw players' agents involved in dubious transactions. FIFA has launched and made official the profession of players' agents without associating nation states so that no uniform regulation is enforced to avoid confidence tricks in such an unverifiable international business. The fact that FIFA has favored the development of the players' agents business without fixing any sort of juridical penalty and economic sanction in case of illicit transactions is the crux of the matter. Anyone who intends to act as a players' agents must exhibit a clean police record, must not be an attorney in his/her home country and has to submit himself/herself to an interview with his/her domestic national football federation (an interview which is in no way an examination). Players' agents are a source of revenue for FIFA since each of them is required to lay down a guarantee of

200,000 Swiss francs (roughly $ 125,000) in order to obtain the FIFA permit. And that is it: anyone can start up his/her business with no further supervision.

A Conference of the Ministers for Youth and Sports from all French speaking countries was held in December 2000, in Bamako (Mali), and had raised the issue of FIFA *de facto* protecting the players' agents business in spite of many misdeeds. It had suggested giving up the FIFA permit and transferring its allocation to national football federations[5], after a simple FIFA approval. With FIFA rules of September 2001 (article 6, FIFA 2001), a football player who wants to move abroad must obtain an international transfer certificate from the national football federation he intends to leave. National federations are forbidden to raise any emolument or to levy a tax in relation with their delivery of international transfer certificates (article 8). This certificate would not hinder illicit transfers and bribes unless FIFA would incite national and continental federations to adopt restrictive rules forbidding their affiliated clubs to deal with outlaw players' agents and to sanction them otherwise. On the other hand, Tshimanga Bakadiababu (2001) suggests creating an international professional association of players' agents on the model of the Bar – the association of barristers (attorneys) - which will be likely to sanction those guilty of misdeeds in the business. Such players' agents association should define and supervise fees and honorariums earned on international transfers of football players. All legal, administrative and sport authorities together should converge toward the enforcement of clear contracts linking players to a players' agent. This should be binding to stay in the business.

Conclusion

The reader must be aware of the limited scope of the policy recommendations sketched here. By no way a long run solution to the muscle drain of talented teenage players could avoid a policy for sport development – and the issue of the required finance - in developing countries, and could be found without a progress toward self-sustained economic development reducing the wage gap, including the revenue gap of professional sportsmen and women. Unfortunately, the regulation of the international mobility of teenage players can only alleviate the most undesirable consequences of the muscle drain. The suggested Coubertobin tax can put a brake on international transfers of very young players whereas FIFA regulation pretends to abolish them simply by forbidding them. None of these two regulations is likely to be 100% efficient. None is capable to entirely phase out illicit transfers undertaken by outlaw players' agents. We reach here the point at which economic tools must be completed by administrative and legal measures aiming at a control over the players' agent business.

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[5] As a consequence a reform of the players agents status is underway in different EU countries, namely in France (Brocard, 2010).

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LOW BACK PAIN IN YOUNG ADULTS WITH PHYSICAL ACTIVITY AND PREVENTIVE MEASURES

Maja Bučar Pajek

Abstract

This work presents the data about the prevalence of LBP in young adults and its associations with physical activity as a risk factor. The results of published studies are compared to our data, which were gathered with a cross-sectional research on the sample of young adults. The sample was composed of the first year students of the University of Ljubljana at the Faculty of Chemistry and Faculty of Sport. The data were gathered using a questionnaire, which included the Graded Chronic Pain Scale (GCPS) questionnaire, a well validated tool to assess LBP intensity and disability. Results show that LBP during the last 6 months was present in 71.3% of competitive level students and in 59.2% of recreational level students (p=0.06). Even more robust data were found in the subgroup of PE students: the intensity of pain and disability were significantly higher in students engaging in sports at the competitive compared to recreational level (intensity – GCPS points: 37/100 vs. 29/100, p=0.007; disability 21/100 vs. 12/100, p=0.002). In this subgroup the follow-up prevalence of LBP after the first semester showed similar prevalence of LBP as in the beginning of the study year. Our data indicate the association of higher level sport activity with low back pain which is in accordance with some previous reports. Published interventional studies show success of the specific workout programs such as Pilates. These workout programs could be used also for prevention and amelioration of LBP in physically active student population and their implementation should be prospectively studied.

Background

Low back pain (LBP) is a widely prevalent and complex syndrome of regional pain often cited as a major cause of disability and inability to work. It is estimated, that during the course of their lives, 70–85% of individuals will experience low back pain (Andersson, 1999; Deyo & Weinstein, 2001). Despite the earlier observations that majority of LBP cases spontaneously recover in six weeks recent reports state that 5-15% of cases will go on to develop chronic LBP. The total recovery from pain or disability due to LBP may be as low as 25% in the first year after the initial consultation with the physician (Croft, Macfarlane, Papageorgiou, Thomas, & Silman, 1998). Due to significant progression risk into a chronic and disabling disorder the prevalence and risk factors of LBP in the population of young adults should be regarded with special interest.

Back pain is classified into three categories based on the duration of symptoms. Acute back pain is arbitrarily defined as pain that has been present for six weeks or less. Subacute back pain has a six- to 12-week duration and chronic back pain lasts longer than 12 weeks (Carey et al., 1995). Low back pain can be caused by many conditions, both serious and benign. Because of this, the back pain can be grouped into three categories: potentially serious spinal conditions, sciatica and nonspecific back symptoms (Bratton, 1999).

Potentially serious spinal conditions such as spinal tumors, infections, fractures and the cauda equina syndrome are potentially serious causes of acute low back pain. These conditions are suggested by characteristic findings and immediate further work-up and treatment are usually needed by the primary level or higher level medical attendance. These causes are rare in the young adult population. Sciatica – back related lower extremity symptoms suggest nerve root compromise. Sciatica is often debilitating but, in most cases, the pain abates with conservative therapy. Nonspecific back symptoms - some patients have symptoms primarily in the back that suggest neither nerve root compromise nor a serious underlying condition. Mechanical low back pain is in this category. Mechanical causes of acute low back pain include dysfunction of the musculoskeletal and ligamentous structures. Pain can originate from the disc, annulus, facet joints and muscle fibers. Mechanical low back pain generally has a favorable outcome and these patients also usually improve with conservative treatment (Bratton, 1999). Various aspects of this conservative management can fall also in the domain of PE teachers, coaches and sport science in general, since there are several implementations of specific exercises effective in alleviating low back pain and preventing it (see below).

Aims

This work presents the data about the prevalence of LBP in young adults and its associations with physical activity as a risk factor. The results of the studies of LBP in the field of high level gymnastics are also given. Finally, we review the results of interventional studies aimed to treat LBP with specialized workout programs.

Methods

The results of published studies are compared to our data, which were gathered with a cross-sectional research on the sample of young adults. The sample was composed of the first year students of the University of Ljubljana at the Faculty of Chemistry and Faculty of Sport. The data were gathered using a questionnaire, which included the Graded Chronic Pain Scale (GCPS) questionnaire (Von Korff, Ormel, Keefe, & Dworkin, 1992), a well validated tool to assess LBP intensity and disability.

Results

Onset of LBP is expected to occur at the mean age of 30 and peaking in occurrence between the ages of 45 and 60 years (Bratton, 1999). However, recent reports on the prevalence of LBP in the young adult population (variously defined as the age group from 18 to 30 years) show a high prevalence of LBP already in the young adulthood. The prevalence of LBP in various young adult populations is given in the Table 1.

Table 1. The prevalence of LBP in recent reports

study	country, study population, age	prevalence, N (%)
Goubert et al (2004)	Belgium, general population, 17-25 years	6-month prevalence: 85/228 (37,3%)
Brennan et al (2007)	Ireland, students, 20.9±2.7 years	12-month prevalence: 61/188 (32%)
Nyland et al (2003)	Australia, students, 20.3±2.6 years	12-month prevalence: 158/250 (63,2%)
Bučar Pajek (2010)	Slovenia, students, 19.9±2.3 years	6-month prevalence: 178/283 (63%)

(Brennan, Shafat, Mac Donncha, & Vekins, 2007; Goubert, Crombez, & De Bourdeaudhuij, 2004; Nyland & Grimmer, 2003)

It can be seen from table 1 that although the prevalence of LBP is generally high, there are substantial differences in the prevalence in various countries and studies. Our data fall in the highest prevalence range of 63%. It is evident that with such a high prevalence of LBP more data on the etiology and risk factors is needed and that the risk factors may differ from one population to the other. Therefore, specific data for Slovenian young adult population is warranted.

The influence of engagement in physical activity in sports in relation to LBP has been variably reported: it was associated to LBP as a protective factor (Lei, Dempsey, Xu, Ge, & Liang, 2005), in other reports the influence of sport physical activity was not an independent factor of LBP (Jacob, Baras, Zeev, & Epstein, 2004), but other reports showed that higher engagement in sport training is a risk factor for LBP (Brennan, et al., 2007). Even when the studies showing no association of sport activity with the LBP are taken into consideration (Jacob, et al., 2004), it can be seen that nevertheless higher demands in occupational physical activity was associated with low back pain. The possible association of sport activity intensity with LBP is of special importance, since there are possible interventions that may be used during the training and recreational activity for prevention of LBP and important positive public health benefits can be expected with their implementation.

Our data in the sample of chemistry and physical education (PE) students support the trend toward negative influence of higher level of sport activity: LBP during the last 6 months was present in 71,3% of competitive level students and in 59,2% of recreational level students (p=0,06). Even more robust data were found in the subgroup of PE students: the intensity of pain and disability were significantly higher in students engaging in sports at the competitive compared to recreational level (intensity – GCPS points: 37/100 vs. 29/100, p=0,007; disability 21/100 vs. 12/100, p=0,002). In this subgroup the follow-up prevalence of LBP after the finish of first half of the first semester showed similar prevalence of LBP as in the beginning of the study year.

This data in the sample population of young adults is especially important since the follow-up prospective studies published in the last years show that LBP in adolescence or young adulthood predicts LBP later in life. For example, young people from 12 to 22 years of age with persistent LBP during the previous year had an odds ratio of 3.5 for persistent LBP eight years later (Hestbaek, Leboeuf-Yde, & Kyvik, 2006; Hestbaek, Leboeuf-Yde, Kyvik, & Manniche, 2006).

LBP is highly prevalent in top level competitors, especially in sports with hyperextension, flexion and rotational movements such as gymnastics (Caine, Cochrane, Caine, & Zemper, 1989; Goldstein, Berger, Windler, & Jackson, 1991). Specifically, rapid periods of growth and advanced level of training and competitions are associated with a higher risk of injuries, among which acute mechanical LBP is one of the commonest (Caine, et al., 1989). When the pain is chronic and ongoing serious lesions such as spondylolysis and spondylolysthesis must be excluded (Bennett, Nassar, & DeLano, 2006). Spondylolysis is a special form of vertebral injury, where there is a discontinuity in the lateral pars interarticularis of the vertebrae and consequently the stability of the body of the vertebrae is lost. The usual consequence is a forward slippage of the vertebral body, what is known as spondylolysthesis.

Interventional studies published in the last years have shown beneficial effects of specific workout programs such as Pilates (Bučar Pajek & Pajek, 2009; Rydeard, Leger, & Smith, 2006) or other specific lumbar muscle control exercises (Harringe, Nordgren, Arvidsson, & Werner, 2007) for amelioration of LBP. In the study of Rydeard, Leger, & Smith (2006), a randomized controlled trial with pretest-posttest design, a 3-, 6-, and 12-month follow-up was used to investigate the efficacy of a Pilates therapeutic exercise approach in a population with chronic LBP. Thirty-nine physically active subjects between 20 and 55 years old with chronic LBP were randomly assigned to 1 of 2 groups. The specific-exercise-training group participated in a 4-week program consisting of training on specialized (Pilates) exercise equipment, while the control group received the usual care, defined as consultation with a physician and other specialists and healthcare professionals, as necessary. Treatment sessions were designed to train the activation of specific muscles thought to stabilize the lumbar-pelvic region. Functional disability outcomes were measured with The Roland Morris Disability Questionnaire and average pain intensity using a 101-point numerical rating scale. There was a significantly lower level of functional disability (P = 0,023) and average pain intensity (P = 0,002) in the specific-exercise-training group than in the control group following the treatment intervention period. The posttest adjusted mean in functional disability level in the specific-exercise-training group was 2,0 (95% CI, 1,3 to 2,7) points compared to a posttest adjusted mean in the control group of 3,2

(95% CI, 2,5 to 4,0) points. The posttest adjusted mean in pain intensity in the specific-exercise-training group was 18,3 (95% CI, 11,8 to 24,8), as compared to 33,9 (95% CI, 26,9 to 41,0) in the control group. Improved disability scores in the specific-exercise-training group were maintained for up to 12 months following treatment intervention.

Similarly in 2006, the Italian study was published which compared Pilates method and well established back scholl exercise program (Donzelli, Di Domenica, Cova, Galletti, & Giunta, 2006). Both metods gave comparable results in the terms of reduction in pain intensity and disability. The Pilates method group showed better compliance and subjective response to therapeutic exercise.

In the study of Harringe, Nordgren, Arvidsson, & Werner (2007), fifty-one gymnasts, with and without LBP, 11–16 years old, from three top-level gymnastics team participated in the study comprising 12 weeks. Every day the gymnasts answered a questionnaire regarding low back pain. After baseline (4 weeks) the intervention group performed a specific segmental muscle training program. Twenty-four gymnasts (47%) reported low back pain during baseline. Gymnasts in the intervention group reported significantly less number of days with low back pain at completion compared to baseline (P = 0.02). Gymnasts in the control group showed no difference in terms of days with low back pain or intensity of low back pain between baseline and completion. Eight gymnasts (out of 15) with LBP in the intervention group became pain free.

These three examples of interventional studies show that specific exercise programs are successful in decreasing the LBP and consequential morbidity. It would be vise to implement the elements from this program in the training process of those athletes who have problems with repetitive mechanical LBP. If the problem nevertheless evolves into a chronic one, a full medical evaluation should be performed since there are potentially serious spinal conditions which may cause this pain and need specific diagnostic and therapeutic interventions.

Conclusions

In contrast with older beliefs recent reports show relatively high prevalence of LBP already in the young adult population. Our data indicate the association of higher level sport activity with low back pain which is in accordance with some previous reports. LBP is highly prevalent also in the highest level competitors in certain sports, especially gymnastics. Published interventional studies in this groups show success of the specific workout programs such as Pilates. These workout programs could be used also for prevention and amelioration of LBP in physically active student population and their implementation should be prospectively studied. With this point taken, can we regard the relatively high and unchanged prevalence of LBP after the first semester at the Faculty of sport a lost opportunity for PE students to improve their quality of life and to master the effective preventive workout program?

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SPORT FOR DISABLED

Helena Burger

Introduction

In spite using exercises and hydrotherapy since ancient times and some individuals practising different sports in the past, the great development of sport for disabled started after the first and the second world wars. Today elite disabled athletes trained equally as able ones.

Significance and aims of sport for disabled

Sport can be already part of the complex rehabilitation programmes. During rehabilitation we can use sport to improve functioning of a person and to convince him that he can still be active and perform different recreational activities after discharge. Recreational activities have same physiological, psychological and social beneficial effects for all.

Sports for disabled

Disabled persons can participate in sports for able body persons but they may need additional equipment or adaptations. Not all sports are appropriate for all. The American Academy of Orthopaedic Surgeons has developed a "participation possibility chart" which includes some of the major physical disabilities and major sporting activities (Adams 1991). Sport may be recommended for certain disability, appropriate for some but not appropriate for other with the same disability, adapted when almost all need adaptations of equipment or rules or not recommended at all.

There are also sports developed specially for people with certain disability, for example goalball for blind.

Sport competitions and classification

In the past some sportsmen competed at competitions for able bodied. And some have been very successful (world record, Olympic champion), but most were not competitive. That is why in 1984 the Stroke Mandeville Games for the paralysed were founded (Guttman1976). In 1960 they transformed into Paralympic games. This year on Paralympic games in Beijing, China disabled sportsmen will compete in 20 different sports: archery, athletics, boccia, cycling, equestrian, football 5-a-side, football 7-a-side, goalball, judo, power lifting, rowing, sailing, shooting, swimming, table tennis, sitting volleyball, wheelchair basketball, wheelchair fencing, wheelchair rugby and wheelchair tennis.

Due to different functional abilities of subjects with same kind of disability athletes are divided – classified into several groups with similar functional abilities. Today in several sports they try to combine together also athletes with different disabilities but same functional abilities.

Medicine and sport for disabled

Medical doctor working with disabled athletes have to have a good knowledge about disabilities, their peculiarities, classification, sports and sport medicine. Exercise stress testing, prevention, therapy and rehabilitation of sport injuries, nutrition and nutritional supplements became crucial part of sport for disabled.

Conclusion

People with disabilities may perform sport for recreation or on a competition level. Both have positive effect, whereas competition sport may also have some negative effects. Medical doctors working with these people have to be awere of all these effect and try to prevent negative ones.

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CARDIO-METABOLIC SYNDROME IN ADOLESCENTS: AN EARLY PREVENTION BY PHYSICAL EXERCISE

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Abstract

Physical exercise is important in the early prevention of cardio-metabolic syndrome, which is one of the most frequent diseases today. Sedentary life style, surrounded by sophisticated technological achievements, supersedes the time spent in motion in all age groups, from the earliest childhood. Cardio-metabolic syndrome (CMS) is a complex process and one of the most important groups of diseases, presenting a major health problem in developing countries. CMS is an increasing risk for coronary heart disease, stroke and peripheral angiopathy. CMS comprises overweight and abdominal-intraperitoneal apple shape obesity, insulin resistance or glucose intolerance: type 2 diabetes mellitus (some persons are genetically predisposed to insulin resistance), hypertriglyceridemia with low HDL and high LDL cholesterol, accompanied by arterial hypertension. The prevention of metabolic syndrome should start as early as possible: in the period of childhood and adolescence. However, intervention exercise programs should not be limited to younger age groups, but must encompass all age groups within population.

Introduction

The number of persons whose life can be described as sedentary has never been so large. Physical activity is markedly reduced today. Heavy physical work in developed countries recedes in front of mechanization and robotics. The time spent sitting in front of a TV or video becomes longer, as well as the time spent playing video games, sitting, surfing on the Internet etc. Having in mind the generally accepted fact that chronic metabolic and cardiovascular diseases have their source early, in childhood and adolescence, particularly concerning is the increasing prevalence of inactivity during adolescence (McMurray & Hackney, 2005; Volek, Vanheest, & Forsythe, 2005) (K. Hansen, Shriver, & Schoeller, 2005; Mišigoj Durakovič, 2003; Vuori, 2004).

Physical activity

The everyday activities level varies according to age, gender, and other factors (Mišigoj Duraković, Heimer, Matković, Ružić, & Prskalo, 2000). It is higher in boys than in girls of the same chronological age (Finn, Johannsen, & Specker, 2002). Boys spend more time in moderate and intense activities than their female peers. Factors associated with the everyday activity level of preschool children are gender, history of preterm birth, childcare centers and the father's body mass index (BMI) (Finn, et al., 2002). The investigations of the European and North American school children and adolescents have shown that the activity of a school child rises till the early adolescent period, when it starts to decrease. The children's activity significantly decreases during adolescence, what is attributed to biological, environmental and social impacts (Rowland, 2007). The decrease is especially pronounced in the late adolescent phase, particularly in young men who are otherwise more active than girls throughout the whole period of growth and development. The Dutch study by Kemper et al. (1983) showed that during adolescence the decrease is quite observable in the time spent in moderate and high intensity activities, with observably more time devoted to mild intensity activities. Sedentary life style of modern man, surrounded by sophisticated technological achievements, supersedes the time spent in physical activity from the earliest childhood (Oliver, Schofield, & Kolt, 2007).

Cardio-metabolic syndrome

Cardio-metabolic syndrome (CMS) or syndromes such as syndrome X plus, insulin resistance syndrome, obesity syndrome, diabesity, metabolic three-syndrome, big four, quartet of death, plurimetabolic syndrome, or Reaven's syndrome (G.M. Reaven described it in 1988) (1988, 2005) is a complex process and in our time one of the most important group of diseases and a major health problem in developing countries. MS is an increasing risk for coronary heart disease, stroke and peripheral angiopathy (Deka, et al., 2008; Tucak-Zoric, et al., 2008) MS consists of overweight and intraperitoneal apple shape obesity, type 2 diabetes mellitus (some persons are genetically predisposed to insulin resistance), hypertriglyceridemia with low HDL and high LDL cholesterol accompanied by arterial hypertension. It is associated with prothrombotic state with high serum fibrinogen or plasminogen activator inhibitor-1 level, endothelial dysfunction and a pro-inflammatory state with the high level of serum C-reactive protein (Alberti, Zimmet, & Consultation, 1998). An assemblage of risk factors for MS includes age, obesity, history of diabetes mellitus and similar diseases such as polycistic ovarian syndrome with metabolic consequences in women, hormones and reproductive system, etc. (Armstrong, 2006).

Definitions of cardio-metabolic syndrome

The World Health Organization (WHO) definition (Alberti, et al., 1998) requires that individual with CMS have: 1) hyperglycaemia/insulin resistance or fasting glucose level ≥ 6.1 mmol/L and at least two of the following criteria: 2) abdominal or central obesity and WHR (waist to hip ratio) >0.90 in men and >0.85 in women and/or BMI >30 kg/m^2; 3) serum triglyceride level ≥ 1.69 mmol/L and/or HDL cholesterol <0.9 mmol/L in males and <1.00 mmol/L in females; 4) high blood pressure ≥140/90 mmHg or treatment with drugs; 5) microalbuminuria: urinary albumin excretion rate 20 μg/min or urinary albumin/creatinine ratio > 3.5 mg/mmol.

The criteria of the National Institute of Health (Third Report of the National Cholesterol Education Program or NECP, Evaluation, and Treatment of High Blood Cholesterol in Adults, Adult Treatment Panel III or ATP III) ("Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III)," 2001) does not explicitly include insulin resistence of glucose intolerance as required criteria, rather defines the CMS as the co-occurence of three or more of the following five criteria: 1) abdominal obesity-waist circumference >102 cm in men, >88 cm in women; 2) hyperglycaemia: fasting plasma glucose ≥6.1 mmol/L or treatment with antidiabetics; 3) serum triglyceride level >1.69 mmol/L or drug treatment; 4) HDL cholesterol <1.04 mmol/L in men, <1.29 mmol/L in women or drug treatment; 5) high blood pressure ≥130 mmHg systolic and ≥85 mmHg diastolic or drug(s) treatment.

The criteria of *the American Heart Association (AHA) and The National Heart, Lung and Blood Institute* (Grundy, et al., 2005) *(NHLBI)* include: 1) waist circumference the same as ATP III (does not include BMI) and at least two of the following criteria: 2) fasting glucose ≥ 5.6 mmol/L; 3) serum triglycerides the same as WHO; 4) serum HDL cholesterol the same as NCEP/ATP III; 5) blood pressure the same as NCEP/ATP III.

The criteria of *the European group for the study of the insulin resistance* (Balkau & Charles, 1999) *(EGIR)* includes insulin resistance with 2 of the following: fasting plasma glucose level ≥6.1 mmol/L without diabetes mellitus; increased waist circumference ≥94 cm for males and ≥88 cm for females; triglyceride levels 2.0 mmol/L or treatment for elevated triglycerides level, and/or HDL cholesterol levels 1.0 mmol/L or treatment for reduced HDL cholesterol levels; blood pressure ≥140/90 mmHg or treatment for arterial hypertension.

The criteria of *the International Diabetes Federation (IDF*) (Alberti, Zimmet, & Shaw, 2005; Ford, 2005) include: 1) central obesity, i.e. waist circumference in Mediterraneans: ≥94 cm in males, ≥80 cm in females, and at least two of the following criteria: 2) fasting plasma glucose level the same as in ATP III or therapy for type 2 diabetes mellitus; 3) serum triglycerides ≥1.7 mmol/L or therapy for triglyceridemia; and/or 4) HDL-cholesterol level <1.00 mmol/L in males and <1.30 in females; 5) blood pressure as in ATP III and AHA/NHLBI or therapy with antihypertensives.

The criteria of *the International Diabetes Federation (IDF) in adolescents (10-16 years*) (Hirschler, Calcagno, Aranda, Maccallini, & Jadzinsky, 2007; Zimmet, et al., 2007) requires the following: 1) central obesity measured by waist circumference ≥90 percentile for child's age, and at least two of the following criteria: 2) glucose intolerance: glucose level ≥5.6 mmol/L; 3) serum triglyceride level ≥1.7 mmol/L; 4) HDL-cholesterol level <1.03 mmol/L; 5) blood pressure ≥130 or 85 mmHg (table 1). According to IDF (Hirschler, et al., 2007; Zimmet, et al., 2007), it is not possible to diagnose metabolic syndrome in children <10 years. However, in children with abdominal obesity and risk factors: positive family history of CMS, type 2 diabetes mellitus, obesity, hyperlipoproteinemia, cardiovascular diseases including arterial hypertension, further observations and preventive measures have do be done, primarily for weight reduction.

Table 1: Criteria of cardio-metabolic syndrome

Clinical and biochemical parameters	Adults WHO (Alberti, Zimmet, & Consultation, 1998)	NCEP (Executive Summary of The Third Report of The National Cholesterol Education Program, 2001)	AHA/ NHLBI (Grundy, et al., 2005)	EGIR (Balkau, B., & Charles, 1999)	IDF (Alberti, et al, 2005; Ford, 2005)	Adolescents IDF (Hirschler, et al., 2007; Zimmet et al., 2007)
Waist circumference (cm)	-	≥102 m ≥ 88 f	≥102 m ≥ 88 f	≥94 m ≥80 f	≥94 m ≥80 f	≥ 90th percentile
Waist to hip ratio (WHR)	>0.90 m >0.85 f	- -	- -	- -	- -	- -
Glucose (mmol/L)	≥6.1	≥6.1	≥5.6	≥6.1	≥5.6	≥5.6
Insulin resistance	yes	no	no	yes	no	no
Body Mass Index (BMI kg/m^2)	>30	-	-	-	-	-
Triglycerides (mmol/L)	≥1.69	≥1.69	≥1.69	≥2.0	≥1.7	≥1.7
HDL- cholesterol	<0.90 m <1.00 f	<1.04 m <1.29 f	<1.04 m <1.29 f	<1.0 <1.0	<1.03 m <1.30 f	<1.03 -
Blood pressure (mmHg)	≥140/90	≥130/85	≥130/85	≥140/90	≥130/85	≥130/85

In the study of Hirschler et al. (2007) out of 167 children, 11.3% had the CMS and 21.9% among overweight children. Ford and co-workers (Ford, Giles, & Dietz, 2002) have reported the prevalence of 24% in adult U.S. population aged ≥20 yrs, increasing from 6.7% among the participants aged 20 through 29 years to 43.5% and 42.0% for the participants aged 60 through 69 years and aged at least 70 years, respectively. In 2004, Ford and co-workers (Ford, Giles, & Mokdad, 2004) reported an increase in CMS prevalence in U.S. adults aged ≥20 yrs from 24% in NHANES III ("Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III)," 2001) to 27% in

NHANES 1990-2000. Similar prevalence is reported for some European populations (Deka, et al., 2008; Lorenzo, et al., 2003; Sattar, et al., 2003). Bokor et al. (2008) have revealed the high prevalence of CMS among obese European children and adolescents. Recently, a modification of the metabolic syndrome criteria designed for children and adolescents shows that 50 percent of U.S. children who are severely overweight have CMS (Spiotta & Luma, 2008).

The prevention of cardio-metabolic syndrome by physical exercise

The group of known risk factors for the development of chronic metabolic and cardiovascular diseases with high incidence in modern populations (e.g. atherosclerosis, CMS, coronary heart disease, diabetes mellitus, arterial hypertension) comprises obesity, increased fats in blood, elevated arterial blood pressure, low sensitivity to insulin, physical inactivity, cigarette smoking, and in the last two decades the identified group of risk factors for the development of coronary heart disease (CHD), including factors as fibrinogen, homocysteine, C-reactive protein, plasminogen activator inhibitor 1 and endothelial dysfunction. A significant number of young people present at least one risk factor for the development of chronic cardiovascular diseases (Cunnane, 1993). In the prevention of chronic diseases, we are particularly interested in factors which can be already treated in the early age. Parizkova (Parizkova & Hainer, 1990) stated, that "…a genotype characterized by a high level of spontaneous body activity has a significantly higher HDL-C, with the trend of larger body dimensions, less fat reserve, higher energy input by food, higher cardiorespiratory and motor abilities, what is observable already in the pre-school age"**.** The effect of physical exercise in childhood and adolescence upon health in adult age can be viewed through: directly observable benefit, the influence on the child's health and the impact upon the level of physical activity in adulthood (Baror, 1993) , or more precisely, according to Blair et al. (1989), through possible connection between physical activity during childhood and adolescence and health in adult age: 1) the connection of physical activity and health in young age; 2) the connection of physical activity during young age and physical activity in adulthood; and 3) the connection of physical activity during young age and health in adult age.

The investigations of Wilmore & Mcnamara (1974) long ago have confirmed that from the early school age we find in children the factors for the development of CHD. The prevalence of obesity increases with school age. Obesity, along with reduced physical activity, will develop in the case of inadequately high energy intake through food in relation to actual energy expenditure. A significant link between obesity and hours spent in front of a TV has been confirmed in the sample of American children (Gortmaker, et al., 1996). Sedentary habits are also related to increased intake of additional snacks (Gortmaker, et al., 1996). The majority of studies base the estimation of overweight and obesity only upon the measures of body mass and height, mostly by using body mass index. In children, for the definition of overweight and obesity are used respective cutoff points of the 85. and 95. percentile of referent BMI values for a particular age (Rennie & Jebb, 2003). Nowadays, the estimations are more and more based on the body composition analysis, the portion of body fat and its distribution (Gultekin, Akin, & Ozer, 2005; S. E. Hansen, Hasselstrom, Gronfeldt, Froberg, & Andersen, 2005; Orden & Oyhenart, 2006; Poplawska, Dmitruk, & Wilczewski, 2006; Ribeiro, et al., 2004). In a five-year period we have registered the trend of changes in the body composition in Croatian preschool children with the increase of body fat portion, without changes in BMI, along with the substantial reduction of non-fat mass portion in girls, particularly on the account of muscle mass in upper extremities (Horvat, Misigoj-Durakovic, & Prskalo, 2009). The causes of such changes we have sought in nutritional habits and physical exercise. In population of Croatian school children, overweight is present in about 11% of children aged 7-14 yrs, and among them 5.2% are obese (Kuzman, Pejnović-Franelić, & Pavić-Šimetin, 2004).

Obesity endangers health and negatively impacts the ability of mastering motor tasks. According to Vanhala et al. (Vanhala, Vanhala, Kumpusalo, Halonen, & Takala, 1998), obesity in adult age is more harmful for health if it lasts since childhood, because of coronary heart disease, arterial hypertension, diabetes mellitus, hyperlipoproteinemia, liver diseases and some malignant diseases more frequently occurring in obese people.

Fat tissue (particularly its visceral component) is not only "ballast" mass but hormonally extremely active tissue (Wong, Janssen, & Ross, 2003). Many factors secreted in adipose tissue participate in the pathogenesis of metabolic diseases. Thus, the excessive accumulation of fat tissue is regarded as an independent metabolic risk (Vanhala, et al., 1998). The body fat accumulation of the central abdominal type (android or apple-like type) is a substantially greater metabolic risk than other types of body fat accumulation (gynoid or pear-like, and intermediary type). Thus, today the measures of waist circumference and the ratio of waist and hip circumference are considered to be important predictors of metabolic risk and risk for some chronic diseases, independent from overweight estimated by the body mass index. Visceral fat is a strong predictor of insulin resistance and glucose intolerance. It is related to the increased level of triglycerides and decreased level of high-density lipoproteins (HDL-cholesterol) (Wong, et al., 2003).

Physical exercise plays an important role in the body mass regulation and in the prevention of obesity in children and adults (Fogelholm, Stallknecht, & Van Baak, 2006; K. Hansen, et al., 2005; Hills, King, & Armstrong, 2007; McMurray & Hackney, 2005; Parizkova & Hainer, 1990; Volek, et al., 2005; Vuori, 2004). It influences both sides of energy balance. Physical exercise is considered as one of the key links between hormonal modulators of energy metabolism (K. Hansen, et al., 2005). Sympathetic nervous system and catecholamine affecting adipose metabolism directly and through the impact on hormones influencing the fat metabolism play the major role in enhancing the lipolysis during exercise (McMurray & Hackney, 2005). The amount of fat oxidized during exercise and post-exercise period depends on a number of factors. The type of exercise, its intensity and duration, energy expenditure during exercise, gender and individual fitness level are some of the factors influencing the amount of oxidized fat (K. Hansen, et al., 2005).

A number of studies show lower levels of arterial blood pressure and other cardiovascular risk factors in children with better functional capacities (Boreham, et al., 2001; Hurtig-Wennlof, Ruiz, Harro, & Sjostorm, 2007). The study by Boreham et al. (2001) has showed that in 15-yr-old boys physical activity was beneficially associated with systolic blood pressure, lipid profile, and cardiorespiratory fitness. In 15-yr-old girls, sport participation was beneficially associated with fatness and cardiorespiratory fitness. Obese children often have higher levels of blood pressure. Examining the independence of the relationship between the cardiovascular risk factors and both body fatness and cardiorespiratory fitness in adolescents, Boreham et al. (2001) have revealed that the relationships between fitness and cardiovascular risk status in adolescents are mediated by fatness. Similar results have been recently shown by Tomas et al. (Thomas, Cooper, Williams, Baker, & Davies, 2007). The results stress the importance of early prevention of overweight and obesity.

Studies of the correlation of activity levels or cardiovascular fitness and risk factors for the development of cardiovascular diseases in the young have confirmed significant positive correlation between HDL-C level and aerobic endurance, as well as higher HDL-C level and lower triglyceride level in active children (Thomas, Baker, & Davies, 2003). A certain number of studies have investigated the possible correlation of cardiovascular disease risk factors, such as homocysteine, fibrinogen, C-reactive protein, plasminogen activator inhibitor I, thrombin-antithrombin complex and endothelial function with the level of physical activity in children and adolescents (Abbott, Harkness, & Davies, 2002; Nienaber, Pieters, Kruger, Stonehouse, & Vorster, 2008).

In children, the type of relationship and levels of minimal daily physical activity indispensable for the prevention of risk factors for CMS are less known than in adults. Speaking about adults, there is a consensus on general recommendations for minimal duration, frequency and intensity of physical activity aimed at health protection and prevention of chronic diseases ("Physical activity and cardiovascular health. NIH Consensus Development Panel on Physical Activity and Cardiovascular Health," 1996), as well as special recommendations for the prevention and treatment of obesity (Fogelholm, et al., 2006; Hills, et al., 2007). For school children, the attitudes are not homogenous. For the purpose of health protection, the majority argue for the minimum of 60 minutes of moderate to intense activity daily, adjusted to age. It develops cardiovascular endurance and muscle strength, simultaneously includes “carrying one’s own body mass” (what contributes to bone density) (Strong, et al., 2005), and diminishes the time of sedentary daily activities in front of the TV, PC, video games, telephone, etc. Canadian authors recommend increase in the daily amount of physical activity for another 30 minutes (Canada, 2004). Andersen et al. (2006) consider the recommended minimum of 60 minutes insufficient and suggest more activities, but varied according to age. Approach based on recommendations for restricting time spent in sedentary activities is not simple and requires change in numerous environmental factors which will facilitate more safe and free motion of children and adolescents (Fogelholm, et al., 2006).

Health protection and primary prevention of obesity and CMS, the syndrome of growing prevalence, should be started as early as possible with special attention paid to adoption of correct nutritional habits and physical activities from preschool to school age. Ensuring safe moving of children in everyday comings to and goings from school on foot or on bikes, as well as availability of equipped and safe playgrounds, will enable increased level of physical activity during free time. It is important to include parents in encouraging and directing a child to activities, along with the crucial role of school through physical education, which is needed daily, and further promotion of school sports, restriction of time the children spend sitting at school daily and weekly, as well as by prolonging breaks during which children may practice physical activities.

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THE IMPORTANCE OF PHYSICAL ACTIVITY FOR CHIDHOOD HEALTH

Karsten Froberg & Lars Bo Andersen

Abstract

A sedentary lifestyle is common among adults and is associated with a higher mortality rate and rates of common diseases. Except obesity these problems are not manifest in children, but it may be anticipated that it becomes increasingly difficult to change to a more physically active lifestyle with higher age. There could therefore be good reasons to promote a physically active lifestyle in early life. Primary prevention as early as possible should always be preferred instead of prevention at a time where irreversible pathological changes have occurred. The latter may especially be related to metabolic diseases such as cardiovascular disease and type 2 diabetes. Obesity is increasing in Europe, but large geographical and social differences exist. The Northern and eastern European countries have less obese children than the Southern part of Europe, and obesity is more prevalent among the lower socio-economical classes. There is a rationale for primary prevention in relation to CVD, obesity and health promotion in children if the following hypotheses are true: a) a large percentage of children have a lifestyle which is so sedentary that it may increase the risk of developing obesity, atherosclerosis and other diseases prematurely; b) a sedentary lifestyle causes increased levels in disease risk factors, which is known to increase risk of premature death; c) CVD risk factors, obesity and sedentary behaviour track during childhood into adulthood; d) interventions including increased physical activity in children at risk are efficient to decrease risk factor levels and change behaviour to a more physically active lifestyle. This talk will elucidate the evidence showing that the above criteria are met, and also that there is a large potential for primary prevention of CVD and obesity in European children. Lifestyle changes should be initiated and increased physical activity should be one of the key actions.

Introduction

A sedentary lifestyle is common among adults and is associated with a higher mortality rate and rates of common diseases such as cardiovascular disease (CVD), diabetes and some cancers in adults. These diseases are usually not manifest in children, but it may be anticipated that it becomes increasingly difficult to change to a more physically active lifestyle with higher age. Therefore, it is necessary to promote a healthy lifestyle in early life. Primary prevention as early as possible should always be preferred instead of prevention at a time where irreversible pathological changes have occurred. The latter may especially be related to metabolic diseases such as cardiovascular disease and type 2 diabetes.

Recommendations

Physical activity should be a normal part of daily living habits for young people. Throughout the lifespan, physical activity plays a key part in young people's physical, social and mental development. All forms of activity have a part to play over the years, whether informal play, 'free' range' activity and games, physical education, sport, walking and cycling as transport, or more formal 'exercise'. Babies learn and develop physical capabilities through play; toddlers develop key social skills through games with others; and young people develop basic skills and an understanding of rules and team membership through sport and physical education. Therefore people in physical education also claims that 'the pre-eminence of skill should be regarded as a main educational objective in physical education' (Arnold, 1991). Another very important reason for supporting an increasing the amount of physical activity, physical education and sport in childhood is given by Trudeau and Shephard (2008). In their review of quasi-experimental and cross sectional studies they found that additional emphasis on physical education may result in small absolute gains in academic grade point average as well as a positive association between academic performance and PA. They also found a positive influence of PA on concentration, memory and classroom behaviour as well as a positive relationship between PA and intellectual performance. This has been verified by Åberg MAI et.al. in relation to male youngsters (2009). In a cohort study following Swedish men born in 1950 through 1976 who were enlisted for military service at age 18 (n =1.221.727 including 1432 monozygotic twin pairs), they found a positive association between cardiovascular fitness and intelligence after adjusting for relevant confounders, and of crucial importance, this was also obtained by the monozygotic twin pairs. The associations was primarily explained by individual specific, non-shared environmental influences (>80%), whereas heritability explained less than 15% of the co-variation. It was also demonstrated that cardiovascular fitness at age 18 years predicted educational achievements later in life. The data substantiate that physical exercise can be an important instrument in public health initiatives to optimize educational achievements and cognitive performance at the society level.

In addition to this, a physically active lifestyle has direct and indirect health benefits for young people, particularly through the possible prevention of overweight and obesity, the promotion of good mental health and the establishment of healthy lifestyles that may be continued into adulthood. Many young people do take part in regular physical activity and sport. However, there is increasing evidence to suggest that large numbers of young people across the EU are not taking part in physical activity to a level recommended to benefit their health. The provision of physical education in schools appears to be declining, and opportunities to be active in daily life are tending to be marginalized due to the increasingly popularity of the car as mode of transport, and the computer and/or TV screen as mode of recreation (Dietz, 2001). This justifies recommendations to address this key issue. Physical inactivity harms current and future health. There is now strong evidence to support the relationship between physical activity and many aspects of adult health. Physical activity reduces morbidity and mortality from many of the leading causes of ill health, notably coronary heart disease, as well as having positive effects on aspects of health including body fat and weight control, and depression and anxiety (Blair et al., 1996; Paffenbarger, 1993).

The established causal links between health status and CVD risk factors has not yet been confirmed in children, but behavioral, physiological and genetic risk factors for CVD can be identified in children and young people. Lifestyle related risk factors such as low physical activity (PA) and physical fitness (PF) has been independently linked to risk factors for CVD mortality in men and women, and furthermore related to CVD risk factors such as elevated blood pressure and unfavourable blood lipids at an early stage in children (Katzmarzyk, Malina, & Bouchard, 1999). It is biologically plausible that PA improves the metabolic health profile - also in children, and it has been shown that objectively measured PA is inversely related to clustering of risk factors related to the metabolic syndrome (Andersen et al., 2006).

In young people the main morbidities which affect adults, and which are caused at least in part by a sedentary lifestyle, have not had long enough time to develop. The main exception to this is childhood obesity, which has been referred to as a global epidemic , and can be considered a health problem in its own right (Cali, & Caprio, 2008). But exposure to physical inactivity through childhood can, as said, serve as a critical risk factor for the early origin of CVD in adulthood. Several prospective cohort studies have documented that sedentary adults, as compared to their physically active counterparts, are at considerable risk for various CVD (Haskell et al., 2007). These studies have laid the foundation for physical activity recommendations presented by public health authorities. In contrast, very limited evidence exists based on prospective research for the current physical activity recommendations in children and adolescents. Thus, very little is known about the long term negative effects of physical inactivity during the period of childhood.

According to expert opinion and empirical evidence the current recommendations suggest that children and adolescents should participate in physical activity of at least moderate intensity for at least 1 hour per day with 20 minutes of physical activity being more intensive a couple of times per week (Strong et al., 2005). This recommendation is primarily based on intervention studies of highly selected participants (such as obese children) and cross sectional studies associating self-reported physical activity to various health parameters.

The Canadian Society for Exercise Physiology, in partnership with the Public Health Agency of Canada, has recently initiated a review of their physical activity guidelines to promote healthy active living for Canadian children, youth, adults and older adults. Comprehensive systematic reviews were completed to ensure a rigorous evaluation of evidence informing the revision of physical activity guidelines for the different populations. Using an independent expert panel to review the background materials and systematic reviews, a paper has been published representing their interpretation of the evidence (Kesaniemi, Riddoch, Reeder, Blair, & Sorensen, 2010). The paper includes their recommendations for evidence-informed physical activity guidelines. They made three recommendations for school-age children and youth, which should stimulate sound growth and development and confer protection against known risk factors for adult chronic disease.

Recommendation 1

Children and youth aged 5-19 years of age should accumulate at least 1 hour and up to several hours of at least moderate-intensity PA on a daily basis to achieve most of the health benefits associated with PA. Some health benefits can be achieved through 30 minutes/day of moderate-intensity PA, and this should be used as a "stepping stone" for currently sedentary children.

Recommendation 2

Vigorous-intensity activities should be incorporated or added when possible, including activities that strengthen muscle and bone.

Recommendation 3

Aerobic activities should make up the majority of the daily PA. Muscle- and bone-strengthening activities should be incorporated on at least 3 days of the week.

Recently cross sectional data based on objective measures of physical activity from the European Youth Heart Study (EYHS) has been published showing, that physical activity levels should be higher than the current international guidelines of at least 1 hour per day of physical activity of at least moderate intensity to prevent clustering of CVD risk factors (Andersen et al., 2006). At least 90 minutes of MVPA was recommended. But clearly, further research is highly warranted to validate and qualify the current recommendations for children and adolescents.

Principally, the difficulty in elucidating the influence of physical activity during youth on the risk of CVD in adulthood is inherent to the difficulty of estimating habitual physical activity in children and adolescents and to the considerable lag time between exposure to a risk factor and manifestation of a cardiovascular event. A lot of resources have in recent years been investigated in developing methods to measure physical activity objectively by utilizing accelerometry and software development to quantify habitual physical activity objectively (Brage et al., 2004; Ekelund et al., 2001). Furthermore, methods has been developed analyzing CVD risk factors as a composite risk score without dichotomizing their continuous nature rendering it a better measure of cardiovascular health in younger populations (Andersen et al., 2006; Brage et al., 2004). Now it is also possible to measure early structural and functional changes of large vessels using non-invasive measurement techniques and this represents novel means of studying the initiation and progress of arterial disease during the important early years of life. Thus, arterial properties such as Carotid intima-media thickness (IMT), arterial stiffness and endothelial function can be determined by high-resolution ultrasound imaging. Both IMT, arterial stiffness and endothelial function predicts the development of CVD independent of conventional risk factors and clustering of conventional risk factors is a very strong condition predicting future CVD (Conroy et al., 2004). Together with obesity measures, these measures serve as attractive end-points in epidemiological studies of the early origins of CVD.

So, the importance of physical activity during childhood is for sure accepted, also because the obesity rates escalate and the onset of chronic disease appears at earlier stages of the life course, but more research using randomized trials as well as the newest methods regarding both activity and the manifestation of a cardiovascular event are essential before any concluding evidence can be made for physical activity recommendations for children and youth.

We now know that CVD risk factors cluster in children, and clustering is associated independently with obesity, low physical activity and fitness. These observations can be accounted for by defined physiological mechanisms that are thought to be at the origin of the risk factor clustering.

What can be done?

Increase in physical activity may be achieved in different ways, and the most effective way in a specific population may depend on many factors including the culture. A key issue is how sedentary children are reached. Increasing physical activity in the most active children may reveal limited health gain while an increase among the sedentary children may be much more important in the prevention of future disease. Some arenas where sedentary children could be targeted are schools and in interventions targeting everyday living such as active transport. In many countries there are strong associations promoting organized sport. These organizations may have the resources to promote sport, but as the main goal in the organizations is to improve performance and develop elite athletes, they very often lack initiatives to include children who are not successful in sports.

In countries where physical education is compulsory, school based interventions is a possible way to reach sedentary children. Dobbins et al. recently reviewed the effects of school based intervention to increase physical activity and improve health (2009). Studies showed positive effects of interventions on physical activity behaviour and a number of health outcomes. It is possible to improve physical fitness and blood lipid profile, but most studies did not find any effect on blood pressure and only few found an effect on BMI. However, an effect of increased physical activity may be increased muscle mass, and studies where only BMI and not body composition is assessed, may not be able to detect an improvement in fat mass. An interesting analysis was performed in the study of Resaland et al., who performed a two-year intervention in a rural city in Norway (2009). They found a substantial increase of 9% in cardio respiratory fitness in the intervention group compared to the control group. However, in a posthoc analysis where they stratified subjects into quartiles according to their baseline fitness level, they found a 13% increase in the least fit quartile and a 3% increase in the most fit quartile compared to the corresponding quartiles in the control group. This is interesting from a health perspective, because metabolic risk factors tend to cluster in the least fit children (Anderssen et al., 2007). In general, it is necessary that the intervention include a substantial increase in physical activity if health gains shall be achieved. Small effect sizes have been found with an increase from two to four physical education lessons, but studies including 60 minutes of physical activity every school day have shown substantial health effects. The 60 minutes need not to be physical education lessons, but can be arranged as play in the school yard as long as some intensity is achieved.

Another setting which may be promising is active transport. There are no randomized trials looking at the effect of walking or cycling to school in children, but some observational studies have shown that cycling to school may result in improved health. The European Youth Heart Study analyzed changes in fitness from the age of 9 to 15 years in children who did not cycle at baseline. Some of these children changed to cycling while others were non-cyclists at the age of 15 years, and in children starting cycling a 9% higher fitness was observed at the age of 15 years (Cooper et al., 2008). Beside improved fitness an improvement was found in metabolic risk factors (Andersen et al., 2010).

Potentially interventions can be targeted at the general population of children or at children at risk such as overweight and obese children. Intervention studies in obese youths show that favorable changes in insulin sensitivity, lipid profile, indices of inflammation, endothelial function, cardiac parasympathetic activity, and carotid IMT are produced by moderate-vigorous physical activity doses of 150-180 minutes/week (Balagopal et al., 2005; Kang et al., 2002; Meyer, Kundt, Steiner, Schuff-Werner, & Kienast, 2006). However, for nonobese youths, intervention studies suggest that such doses are not effective; higher moderate-vigorous physical activity doses of 300 minutes/week seem necessary (Barbeau et al., 2007).

Conclusions

A sedentary lifestyle in children is associated with increased levels in disease risk factors, which are known to increase risk of premature death, and the prevalence of clustered cardiovascular risk is more common in sedentary children. Further, a large percentage of European children have a lifestyle sedentary to a degree that it may increase the risk of developing atherosclerosis and lifestyle diseases such as CVD and type II diabetes prematurely. It has also been verified that both risk factors and sedentary behaviour track during childhood and into adulthood, and there is therefore a rationale for early prevention. Interventions including increased physical activity in children at risk are efficient to decrease risk factor levels and change behaviour to a more physically active lifestyle.

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W(H)ITHER PHYSICAL EDUCATION?: THE FUTURE AIN'T WHAT IT USED TO BE!

Ken Hardman

Abstract

Despite a range of intergovernmental, governmental and non-governmental agencies' advocacy, actions and initiatives as well as national educational reforms of systems and curricula to improve provision in and for Physical Education in schools over the last decade, there is a 'mixed message' scenario: hope for a secure and positive future of this unique school subject is juxtaposed with continuing disquiet and widespread concern about its current situation and future sustainability. The disquiet is manifested *inter alia* in perceived incidences of marginalisation, reduced curriculum presence, and inappropriate curricula not aligned with the life-style needs and practices out of, and beyond, school. A concern is that school physical education is 'withering', that is, is in terminal decline. Thus, with the future in mind, the question arises: 'whither' physical education?; that is, which direction is it going or do we wish it to go? Is the 'whither' in the direction of a 'Meat Loafesque' world of dark and insecure gloom and doom or is it a sustainably positive 'blue sky' world in which problem resolution has been secured. With the intention of provoking reflective thought, this paper particularly draws from surveys' and research literature evidence on the quality and relevance of physical education curricula. It addresses a number of issues, which may challenge some well established orthodoxies and progresses to suggestions for some directions to sustain a secure future for physical education as a life-long learning and lifestyle-enhancing enterprise. They are suggestions, which embrace physical education curriculum re-conceptualisation, improvements in quality and relevance with provision and delivery an involved wider community partnership imperative.

Introduction

A decade ago, the Final Report of the first Worldwide Survey of Physical Education in schools concluded that in many countries, "physical education has been pushed into a defensive position" and was suffering from "decreasing curriculum time allocation..., inadequate financial, material and personnel resources, low subject status and esteem...as well as marginalisation and under-valuation by authorities" (Hardman & Marshall, 2000, p.66). Preliminary findings of the Survey were presented at the Berlin World PE Summit in 1999, since when there has been a range of inter-governmental (UNESCO, WHO), governmental and non-governmental (ICSSPE, EUPEA, ENGSO, NASPE) agencies' advocacy, actions and initiatives as well as national educational reforms of systems and curricula to improve provision in, and for, Physical Education in schools. Perhaps (and certainly in the European region of the world), the most significant initiative related to Physical Education was the 2007 European Parliament's *Resolution on the Role of Sport in Education* (2007/2086NI), in which physical education was accorded a distinctive profile with unique characteristics as "the only school subject, which seeks to prepare children for a healthy lifestyle and focuses on their overall physical and mental development, as well as imparting important social values such as fairness, self-discipline, solidarity, team spirit, tolerance and fair play…".

Present situation of school physical education: indicative issues

Collectively, the post-Berlin PE Summit advocacy and action initiatives were demonstrative of broad-spread political will and international consensus that issues surrounding physical education in schools deserve serious consideration in problem resolution. Indeed, there is evidence to suggest that national and, where relevant, autonomous regional governments have committed themselves through either, or both, legislation and policies to improving provision for physical education. Almost paradoxically, however, there is widespread continuing disquiet about its current situation and future sustainability. There is a sense of *déjà vu* about this 'mixed messages' situation, because ten years on from the Worldwide School Physical Education Survey I Final Report, the Second Worldwide School Physical Education Survey concluded that "in too many schools in too many countries children are being denied the opportunities that will transform their lives" (Hardman & Marshall, 2009, p.128). Such denial of opportunities is inconsistent with the policy principles of the 1978 UNESCO and 2001 revised Council of Europe 'Sport for All' Charters and does bring into question the effectiveness of the Charters as appropriate standard-setting instruments. Generally, recent Worldwide and regional surveys' (e.g. European Parliament Survey, 2006-2007) 'reality checks' reveal several areas of unease: deficiencies in curriculum time allocation; inadequacies in facility and equipment supply (a related issue in the facility-equipment concern is insufficient funding); personnel supply embracing insufficiency in numbers and inadequacy of appropriately qualified physical education/sport teachers; quality and relevance of the physical education curriculum, which have particular resonance because of accrued potential negative consequences; perceived inferior subject status; barriers to equal provision and access opportunities for all remain despite some recent improvements in inclusion (related to gender and disability) policy and practice; falling fitness standards of young people; and high youth drop-out rates from physical/sporting activity engagement, exacerbated in some countries by insufficient and/or inadequate school-community co-ordination physical activity participation pathway links.

The concerns articulated in the recent international Surveys are succinctly summed up in a central European physical education academic's statement:

> PE in (recent years) has gone through intensive development and many changes. In spite of attempts by PE professionals, PE teachers, pupils and parents still struggle, sometimes more, sometimes less successfully with a range of problems: decreasing amount of compulsory PE; often decreasing quality of education; large PE class sizes and increasing pupils' behavioural problems; growing numbers of non-participating and 'excused' pupils from PE lessons; stagnating physical fitness and performance of youth; care of pupils with disability; inadequacies in provision and lack of PE facilities; increase in PE teachers' average age and low interest of young graduates to work in the field of PE; inadequate social and financial reward of PE teachers, low work ethic of PE teachers that results from insufficient evaluation of their work; low representation of PE teachers in schools' management positions; absence of monitoring of PE teaching – there is a limited number of inspectors; monitoring by school directors is non-existent; weak organisation (professional associations) of PE teachers; *s*hortages in pre-graduate teachers' preparation; unfinished system of lifelong PE teachers' education; lack of financial resources for science (research) in the field of physical education and sport.

The adverse practice shortcomings and continuing threats to physical education persist beyond the central European situation as portrayed in a recent United Kingdom magazine headline "Future of PE is at risk, claims afPE" (Cordell, 2009) and as intimated by a failure to escape the consequences of the global financial and economic crisis of 2008-2009: in California, "Gov. Arnold Schwarzenegger has proposed trimming state money for physical education classes leaving athletic programs at the two-year schools in doubt… Schwarzenegger's proposal comes as he tries to cut billions from the state budget" (Krupnick, 2009); and in Portland, Oregon State, USA, "in an effort to reduce their budget by $19 million, the Public School Board is considering the elimination of a significant portion of their physical education programs" (Aahperd, 2010).

As indicated earlier, of the concerns articulated, the quality and relevance of physical education curricula are significant. Media headlines, as exemplified in the USA and the UK, draw attention to questionable quality in physical education practice:

> So just how bad is your child's gym class? PE programs often poorly run, provide few health benefits. Experts Dissatisfied With PE Classes (The Associated Press, Jan. 17, 2005)
>
> Call for Scottish PE overhaul after damning report (Ferguson, 2009).

There are many examples testifying to negative experiences and impacts, lack of commitment to teaching and pedagogical and didactical inadequacies. The failure of teachers to provide meaningful experiences is underpinned by an individual's commentary on physical education in school:

> Our society seems to have forgotten that PE is a daily dose of physical and emotional torture. At least it was for kids like me, anyway… When I was in school, I'd have given anything - my two front teeth, my "Dirty Dancing" cassette tape, absolutely anything - to get out of PE for a single day. Year after year I suffered through having to play the same games, like Run the Mile Even Though it's August and You Could Die of Heat Stroke, Lay on Your Back and Kick at a Giant Canvas Ball While Everyone Can See Down Your Shorts, and, my personal favorite, Hold Out Your Thigh to be Pinched by the Body-Fat Percentage Counter (McGaughey, 2006).

The issue of relevance of the physical education curriculum manifest in the discrepancy between what the school offers and what the pupils are looking for is not untypical in many countries: the traditional content of physical education and/or sports activity has little relevance to their life-style context. In many schools across the world, the PE curriculum merely serves to reinforce achievement-oriented competition performance sport. As I commented in my paper presented two years ago in Ljubljana, "this is a narrow and unjustifiable conception of the role of physical education" and for many pupils limits "participatory options rather than expand horizons" (Hardman, 2008, p.4). Such orientation runs counter to societal trends outside of school and raises issues surrounding meaning and relevance to young people as well as quality issues of programmes provided. It is not surprising "that pupil interest in physical education declines throughout the school years and youngsters become less active in later school years" (Hardman, 2008, p.4). As Alderman (2008) observed, "... Competitive sports may be where exercise becomes 'fun' for children who are good at it, but for those who are less talented, it is where exercise becomes not only physically demanding but also emotionally painful and socially humiliating" (p.5). Collectively, the experiences acquired from unwilling engagement in competitive sport-related physical education are a 'turn-off'. It would appear that this goes beyond those who have traditionally been either put off by, or not enjoyed, physical education. In some instances, there appears to be a much deeper rejection of physical education as a legitimate school activity. At this point let me emphasise that whilst I recognise the importance of competitive sport for some children and partnership links etc. to foster talented children, my primary concern is with PE for All and not PE for Some.

By way of specific preparation for my presentation here in Ljubljana, I sought informed opinion from academic experts in countries across Europe on the direction that school PE is, or might be taking, and what PE might look like in each respective country in 10-20 years time, that is a crystal ball view of the future of PE. The opinions expressed add to the disquiet already mentioned earlier:

> Decision-makers decide based on their personal feelings/beliefs and politicians (can be) deceptive. A top politician has alleged that "sport is not well-supported in 'A'

because the majority of the MP politicians sitting in the Parliament don't like sport". Most officers working in the Ministry of Education have a negative attitude towards PE; they do not criticise maths or physics because they did not like the subject or the teacher. According to conservative professionals, teaching should be almost exclusively based on the "old-fashioned" curricula, concentrating on traditional sports, such as athletics, gymnastics, and swimming). The level of inactivity is reaching shocking heights, which is becoming the complementary phenomenon of the negative attitude towards physical activity. The current number of PE lessons is low.

Recent developments (reductions in teacher supply and increase in class sizes) in 'B' will be detrimental to PE quality of weekly number of PE classes in senior grades, and the introduction of a new subject *Selected sport*, which is a separate subject, exclusively dedicated to training and improvement of certain technical and tactical elements of sport indicates a tendency view schools as bases for creation of future elite athletes. The Ministry of Sport and the Youth has made more government sector initiatives than the Ministry of Education. The contents of swimming, gymnastic, track and field syllabuses in the majority of schools are not realized.

In 'C', primary school teachers are not sufficiently trained for teaching PE and probably never they will be, even with the new school reform. Teacher status will become problematic: the average age of PE teachers is about 50/55 years old; in ten years time, the majority of Physical Education teachers will be retired and most of Physical Education tradition will be lost. Increasing school educational autonomy will produce local school curricula, which might result in a decrease of Physical Education in some schools to provide time for other schools subjects or projects considered more important.

School sports in 'D' have suffered a marked deterioration in their social and educational consideration, and the practice in free time has been replaced by other types of activities and learning such as languages, computing, art, etc. There is no connection between school physical education teachers and those who run school sports programmes, and there is no coordination between intra- and extra-curricular programmes. This model will be maintained in the future and contribute to the demise of the school sport concept.

The economic crisis in 'E' will have serious consequences on the education system that wasn't perfect in the first place.

In country 'F', PE is under threat.

In 'G' PE is rather marginalized. Team ball games pre-dominate and health promotion is neglected. PE lessons are mainly influenced by the lack of facilities and equipment. Inflated grades seem to be a reality and a mismatch between intentions and practice is evident.

Physical Education: Wither or Whither?

There is a gap between "hope and happening" (Lundgren, 1983), which is occurring at a time when there are reported widespread increases in obesity epitomised in the media headline, "Obesity Up, Phys Ed Down" (Turner, 2005), and sedentary lifestyle-related illnesses and associated rising health care costs, especially in economically developed countries. An overall concern is that school physical education is 'withering', that is, is in terminal decline. Thus, with the future in mind, the question arises: 'whither' physical education?; that is, which direction is it going or do we wish it to go? Is the 'whither' in the direction of a 'Meat Loafesque' world of dark and insecure gloom and doom or is it a sustainably positive 'blue sky' world in which problem resolution has been secured. In the American National Association for Sport and Physical Education sponsored "PE2020" initiative on the vision for the professional future, views are being solicited teachers on what lies ahead for physical education and what should physical education look like in 2020. Bi-polar scenarios are being offered, typical of which are: "Eliminate high school physical education and sign students up at a local health club instead. They'd get more exercise and it would save schools money"; and "PE should be completely personalized so that students can choose what they want to do".

The 'elimination' scenario is indicative of "wither" and the 'complete personalisation' is indicative of "whither". Need I say that neither of these scenarios is particularly attractive.

All the concerns expressed suggest that today the physical education profession faces issues that threaten physical education's very school existence; certainly physical education classes have become convenient targets for reductions. So what is to be done? Whatever, it is, there is urgency for all of us who care about the future of physical education to reflect on what is needed in these changing times: physical education has to change with the times. We need to re-examine the concept and context of physical education and more effectively communicate what it should look like now and in tomorrow's schools. For socialisation into physical activity engagement, there is a need to encourage thinking about physical education in new ways, for which there are a number of fundamental questions, for example:

- How can physical education better serve the needs of pupils and society in a dynamic, ever changing world?
- What should we be teaching in physical education?
- How can teachers structure class experiences in a more effective format?
- What changes need to be made in schools and wider community settings and professional preparation programmes?
- What new challenges might we face in the future?

However, it is important to acknowledge Martin and Segal's (2004) fundamental point that changing behaviour and practice is problematic, since the essential driver for many societies is to maintain stability and create a safe, coherent and as far as possible predictable environment. Hence, the desire to maintain the *status quo* and reduce the possibility of chaos actually militates against change.

The importance of physical education for the development of life-long physical activity habits and health promotion and the importance of participation in physical education in the development of social skills needed by modern societies, as well as the importance of physical education in the development of cognitive function have not been well communicated or understood or articulated beyond the community of physical educators. The attention devoted to increasing levels of obesity and a perceived association with physical inactivity might appear to bode well for physical education and it is tempting for physical educators to see their subject matter as the solution to children's obesity. But the attention may prove to be a mixed blessing because arguably there is a risk of ignoring many of the most beneficial outcomes of quality physical education if the subject matter is reduced to simply being a means to countering the obesity problem. The evidence is clear: physical educators and what we have been doing in physical education for the past 30 years have failed to prevent the rise in obesity. Proposing ourselves as tomorrow's solution seems to me a dangerous course. Failure will simply fuel those who would like to see school physical education eliminated. The problem of obesity is too complex to be solved by physical educators alone. Everyone knows that today's youth are eating too much and doing too little. Somehow, as a society we have to improve children's eating habits and get them to be more physically active. Because for many children physical education classes are their only regular physical activity, it is inevitable that solving obesity will require school-based solutions. Hence school physical education deserves to be the main act not a bit part. Justifying physical education as a way to solve today's obesity woes is an insult to its true value. This is not to suggest that physical educators should not try to stimulate young people's activity engagement, and help them to understand the value of physical activity and healthy eating. Inactive lifestyles and unhealthy diets ignored by families, communities, media, and some kind of legislation, mean that the best efforts of the physical education profession to turn the tide of obesity will not succeed.

The very essence of physical education involves movement. In turn, movement education in the form of physical education makes a unique contribution to the education of all through the development of 'physical literacy' and is key in sowing the seeds in the formation of the physically educated person. *Physically educated persons* might be described as being physically literate, having acquired culturally normative skills enabling engagement in a variety of physical activities, which can help to maintain healthy well-being throughout the full life-span; they participate regularly in physical activity because it is enjoyable; and they understand and value physical activity and its contribution to a healthy lifestyle. The knowledge, skills and understanding acquired through school physical education prepare us for life. Physical education stimulates physical and mental development and through the physical education process we learn about the world and ourselves, learn how to play and to respect others, how to cooperate and compete, and the differences between success and failure, what is fair and unfair, ethical and dishonest. The same knowledge and skills are necessary to perform a variety of physical activities, maintain physical fitness, and to value, as well as enjoy, physical activity, which is in itself an essential pre-requisite for enhancement of quality of life and good health over the full lifespan. Motor activity in physical education, sport and physical activity is an important irreplaceable phenomenon in physical, cognitive, functional, sensory-motor, psycho-social development, in wellness development of all age groups and especially of children and youth. It is a springboard for involvement in sport and physical activities throughout life. It is also a source of inter-personal communication and, in addition, can involve an appreciation of the natural environment as well contribute to moral and aesthetic education and development. Physical movement education is the only educational experience where the focus is on the body, its movement and physical development, and it helps children and young people to learn to respect and value their own bodies and abilities, and those of others. Its aim is systematically to develop physical competence so that people can move efficiently, effectively and safely and understand what, why and how they are doing. Its outcomes embrace commitment, confidence, willing participation, knowledge and understanding and acquisition of generic and specific skills, positive attitudes, active lifestyle and activity enjoyment etc.

It is widely acknowledged that physical activity can positively influence physical and psycho-social health and hence, is important at <u>all</u> stages in the life-cycle from childhood to old age. Therefore, it seems logical to suggest that socialisation into, and through physical activity, should occur from 'womb' to 'tomb' i.e. a physical education over the full life span. If physical education is to sustain its presence both in formal and informal educational and socio-cultural settings, and continue to have a positive role as an instrument of socialisation, then issues have to be confronted. Education in general, and physical education in particular, should respond to the needs of optimally developing individuals' capabilities and provide opportunities for personal fulfilment and social interactions, essential in human co-existence. With the knowledge that educational experiences have a propensity to facilitate and help enhancement of life-span welfare and well-being, physical education should be focally involved with the process of personal fulfilment in the future. It is worth remembering, however, that it is not the activity, but the reason for taking part that sustains participation. I would add that its role embraces the often overlooked intrinsic value of the 'sheer joy of participation in physical/sporting activity'.

Movement competence enables individuals to participate effectively in multiple contexts or social fields, which contribute to an overall successful life for individuals and to a well-functioning society. It is a part of health care and disease prevention. It is connected not only with sport and recreation but also with everyday life activities and only secondarily with specific sports skills. Movement should be properly coordinated in order that everyone becomes both able to accommodate and capable of accommodating changing human and ecological environments and managing active lifestyles and risks. Movement competence is acquired and developed throughout the full lifespan. It can be learned, taught and developed (both indirectly and directly) in a range of institutions and other settings (educational, social and cultural public, private, commercial and voluntary systems and sub-systems).

If children are to be brought back from the virtual reality of cyberspace, or persuaded to abandon the 'potato couch' and attracted into lifelong physical activity engagement, then any re-conceptualisation of physical education, needs to be accompanied by improvements to teacher education preparatory training. Today, teachers now face new situations, in which individual development, inclusion, evaluation as well as management of pupils raised in changed and changing socio-political environments are key features. Physical education teachers are faced with a variety of tasks, which encompass overt and discrete contributions to young people's learning as well as facilitation, co-ordination and management of experiences available to young people in physical education through sources internal and external to the school. The need for more adaptable teachers is clear and physical education teachers must be no less adaptable than others. It is evident that their roles are changing and if they are to be empowered to teach effectively, they will need to develop academic and professional competencies within a range of contexts, which may be subject to change.

Significantly a number of teachers have negative attitudes often connected with lifestyle trends in values and behaviours. Indeed, some changes have been met with teacher resistance, a form of defence mechanism triggered by insecurities of competence and in some cases exacerbated by slow responses of PETE providers to curricular developments and societal changes. The societal changes, developments and trends invoke demands for appropriate innovative approaches to teacher training. The demands of physical education in contemporary and ever changing school and wider community settings pose a challenge to teacher education institutions in equipping teachers, responsible for physical education, with the necessary competence to deliver relevant, quality physical education programmes, which provide meaningful experiences and, which attract young people to the joy and pleasure of physical activity and so foster an 'active life-style' philosophy with a focus on relevance and understanding. Initial and in-service training/further professional development should properly address pedagogical and didactical developments and social and cultural shifts and so help to enhance the physical education experience of children and consequently contribute to the development of physically educated persons.

As teachers are agents of change, they require not only subject and people knowledge and understanding but also the ability to manage change. One consequence is that PETE providers should be instrumental in developing and fostering such agents through programmes designed to produce the 'model teacher' as: (i) competently knowledgeable (e.g. familiar with the content of the requirements of the PE curriculum subject matter for the age-range studied; this includes acquisition of a subject content knowledge base, including key concepts and skills that provide the material to be taught and the ability to employ a range of teaching styles and methods within a variety of contexts); (ii) analytically reflective, that is critically thinking (e.g. able to critically evaluate own practice in relation to these issues and to synthesise and apply knowledge and understanding to the critical analysis and evaluation of physical education theory research and practice); and (iii) professionally effective (e.g. show an active commitment to the provision of equal opportunities for all pupils in physical education and able to communicate and work co-operatively with colleagues, parents and others in negotiating the curriculum and overall provision for, and care of, children in school).

A school's role extends to encouraging young people to continue participation in physical activity, through the provision of links and co-ordinated opportunities for all young people at all levels and by developing partnerships with the wider community to extend and improve the opportunities available for them to remain physically active. Hence, there is a need for wider community-based partnerships. The principle of partnerships embracing multi-sectoral policies is an essential feature of the World Health Organisation's (Waxman, 2004) *Global strategy on diet, physical activity and health* policy framework as well as the European Parliament's 2007 *Resolution*. With less than two hours per week time allocation (in many countries, it is frequently less), physical education cannot itself satisfy physical activity needs of young people or address activity shortfalls let alone achieve other significant outcomes. Bridges do need to be built, especially to stimulate young people to participate in physical activity during their leisure time. Many children are not made aware of, and how to negotiate, the multifarious pathways to out-of-school and beyond school opportunities.

Physical education teacher education programmes should address these facilitation and intermediary roles of the physical education teacher. Thus, at the very least, their professional preparation should embrace familiarisation with pathways for participation in wider community multi-sector provision and the achievement of personal excellence. Support is fundamental to the realisation of such ideals. It can be achieved through the collaborative, co-operative partnership approach involving other professionals and committed, dedicated and properly mentored volunteer individual and group enthusiasts. Personnel functioning in partner institutions should have appropriate skills and competences, which might be acquired through some special training. In response to concepts of active life styles in life-long learning contexts, the development of partnerships is essential in any redefinition of purpose and function processes to accommodate broader life-long educational outcomes including healthy well-being and links with personal and social development.

Concluding Comments

While physical education proponents have been vigorously and justifiably addressing risks to its position in the educational system, it is advisable to move beyond debates such as the gap between political promises and professional reality and grasp the significance of the bigger picture. The need for PE to understand the nature of socio-political change remains a key element of professional debate. However, whilst it is important to understand the nature of change and both exciting and challenging to consider options for the future, history is replete with examples of predicted trends that never materialised or plans that were derailed by unforeseen circumstances, so a degree of caution is appropriate. PE does have a number of tensions to deal with both from a general systemic point of view as Klein (2004) pointed out, as well as trying to meet the demands of strong established communities of practice such as sport, not to mention fighting for a place in the crowded and congested place that the curriculum has become (Penney, 2008).

Whilst the competitive sport discourse still pre-dominates in many physical education curricula, in recent years there has been an apparent slow but gradual shift in physical education to a broader, more balanced approach. Physical education curricula need to be based on the vision that the knowledge, skills and understanding acquired should benefit students throughout their lives and help them thrive in an ever-changing world by enabling them to acquire physical and health literacy, and to develop the comprehension, capacity and commitment needed to lead healthy, active lives and to promote the benefits of healthy active living. Physical literacy (the ability to move with competence in a variety of physical activities) and health literacy (the skills needed to obtain, understand and use the information to make good decisions for health) are key in curriculum development: the curriculum is about helping students develop the necessary skills to make healthy choices!

Quality physical education providing all students with the skills, knowledge, understanding and attitudes necessary to lead a healthy active lifestyle is an important component of a school physical activity programme. As American commentators have noted: (i) "... Our kids are not getting fat and out-of-shape because they are not getting PE (or 'bad' lunches) at school. Just follow them home. They don't go outside to play; they instead sit at computers, play video games or text their friend while drinking sugar soda and eating salty snacks" (Hunt, 2010); and (ii) "With less activity physically in school and more time at the remote and the mouse, kids are generally becoming... less and less healthy," (DiBianco, 2010). These are features, which are pervasive across the world, for many children and young people have low activity levels outside of school hence, they do not compensate or make up for any low activity levels in schools and/or classes, therefore, at the very least, increased physical activity time within school physical education should be a key goal and so contribute to evidence-based daily physical activity recommendations for all children.

In some schools in some countries, there is a mismatch between what we know, and what we do, that urgently needs to be resolved. Schools can, and do, make a difference and every politician and policy-maker should ensure that schools provide comprehensive quality physical education programmes that partner with out-of-school agencies as the foundation of development amongst young people of knowledge, skills and confidence to be physically active over the full life span. Young people should be able to look back on their school physical education programmes as a pleasurable experience because of the use of appropriate practices in classes taught by teachers no longer characterized as insensitive, uncaring, taskmasters as has sometimes been/was the case in earlier times.

If policy-makers, decision-takers, administrators and practitioners are to be persuaded or continue to be persuaded of an essential presence of physical education in schools' curricula, commitment to re-conceptualisation, reconstruction and delivery of a relevant quality curriculum by appropriately qualified teaching personnel will in themselves be insufficient. Sustained application of political skills and argument of the case at local, through national, to international levels are required. The value of communication to ALL components of society, teachers, parents, and government officials cannot be over-estimated. The growing body of medical and other scientific research evidence and positive statements support a potentially compelling case for physical education in providing life-long benefits directly related to preventing disease and to maintaining an enhanced quality of life. The available evidence does suggest that increased levels of physical education do not interfere with achievement in other subjects and in some sub-groups may be associated with improved academic performance. The research evidence on the relationship between physical activity and cognitive functioning, especially when sustained over a long period of time is clear. These research findings on cognitive function are interesting because with the increase in the importance of literacy and numeracy as indicators of 'academic achievement', the role of physical activity in the enhancement of these, plus academic function, becomes significantly important. The existing accumulated evidence needs to be presented clearly and concisely and in a language that can be understood to convince all 'enterprise' partners and especially significant others such as politicians and policy-makers that physical education is, indeed, an authentic and indispensable sphere of activity. This is particularly pertinent in persuasion of politicians and policy-makers who should be 'schooled' into making more and better informed decisions on research-based evidence derived from non-political agenda scholars, practitioners and professionals rather than on financial/economic or political expediency grounds. Essentially, it is an issue of 'changing minds' and, thereby, 'winning bodies'!

In Europe, the European Parliament's 2007 *Resolution* represents a significant political step forward in policy guidance in the domain of physical education. Noteworthy is its call on Member States to consider, and implement changes in the orientation of physical education as a subject, taking into account children's health and social needs and expectations, to make physical education compulsory in primary and secondary schools with a guaranteed principle of at least three physical education lessons per week, a principle, which is widely advocated including regional professional organisations such as EUPEA (Europe) and the National Association for Sport and Physical Education (NASPE) in the USA, and intergovernmental agencies such as the World Health Organisation. It is an agenda, which UNESCO is also actively pursuing as it attempts to formulate quality physical education policy principles, which can be suitably adapted by Member States to 'local' circumstances and conditions. With such inter-governmental commitments to policy principles and action advocacy, a secure and sustainable 'blue sky' future for physical education appears to be realisable (Hardman, & Marshall, 2009).

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AEROBIC ENDURANCE TRAINING FOR CHILDREN

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Abstract

Endurance is the ability to sustain a prolonged stressful effort or activity. When considering training for children one must respect individual physical and psychological characteristics of children at a certain biological and chronological age. Many researchers have various opinion about energy systems development with children. Some think that children can achieve relatively higher aerobic intensity than adults and some that they cannot effectively develop aerobic capacities. When researching effects of aerobic training, several studies showed relatively small possibilities for development. They reported increase of maximal oxygen uptake from 10 to 14%. In meta-analysis with 23 researches Payne and Morrow reported 5% average increase of VO_2max. From 1995 to 2001 several researches on effects of aerobic training with children were done. Even though training programs were optimally designed (HR=160-170 b/min, 8-15 weeks, 2-3 times per week), most of the researches reported 0-10% increases. Very few authors reported larger increase after training programs of 72 and 28 weeks, with greater training volume (up to 6 times per week). In the last few years both scientists and coaches believe in effectiveness of intermittent training for development of aerobic abilities. Although this method was believed to be appropriate for adolescents and adults, many researches showed positive effects with children. When comparing effects of continuous and intermittent training some authors reported significant change with both, but with larger gains with continuous group. When considering adaptability of child organism it is important fact that children show less individual variability then adults when comparing aerobic training effects. It can be concluded that research on aerobic endurance training effects shows consistent results, but nevertheless leaves room for further investigation of different aerobic training methods. Continuous methods are proven to be extremely effective and energy systems used in these methods seem to be appropriate considering children's characteristics. When implementing long-term programming it is important to use continuous methods before intermittent in order to achieve greater long-term effects.

Introduction

Endurance is the ability to sustain a prolonged stressful effort or activity. When considering training for children one must respect individual physical and psychological characteristics of children at a certain biological and chronological age.

Many researchers have various opinions about energy systems development with children. Some think that children can achieve relatively higher aerobic intensity than adults and some that they cannot effectively develop aerobic capacities. When researching effects of aerobic training, several studies showed relatively small possibilities for development (Pate et al., 1990, Payne, 1993., Rowland, 1985, Rowland, 1997, Rowland, 2005). They reported increase of maximal oxygen uptake from 10 to 14%. In meta-analysis with 23 researches Payne and Morrow reported 5% average increase of VO_2max. From 1995 to 2001 several researches on effects of aerobic training with children were done. As seen in table 1 (Rowland, 2005), even though training programs were optimally designed (HR=160-170 b/min, 8-15 weeks, 2-3 times per week), most of the researches reported 0-10% increases. Only Yoshizawa (1997) and Mobert (1997) reported larger increase after training programs of 72 and 28 weeks, with greater training volume (up to 6 times per week).

In last few years both scientists and coaches believe in effectiveness of intermittent training for development of aerobic abilities. Although this method was believed to be appropriate for adolescents and adults, many researches showed positive effects with children (Mcmanus et al., 1997, Welsman et al., 1997, Williams et al., 2000, Mandigout et al., 2001, Obert et al., 2001, according to Baquet et al., 2004). When comparing effects of continuous and intermittent training, Baquet (2010) reported significant change with both, but with larger gains with continuous group (8.7/6.4) as seen in table 1. When considering adaptability of child organism it is important fact that children show less individual variability then adults when comparing aerobic training effects (Rowland 2005).

Table 1: Children aerobic endurance training effects researches

Research	n	Age	Sex	Duration (weeks)	% change VO_2max
Eliakim et al. (1990)	20	9	F	5	9.5
Ignico and Mahon (1995)	18	8-11	M, F	10	NS
Rowland and Boyajian (1995)	37	10-12	M, F	12	6.7
Williford et al. (1996)	12	12	M	15	10.3
Rowland et al. (1996)	31	10-12	M, F	13	5.4
McManus et al. (1997)	12	9.6	F	8	7.8
Welsman et al. (1997)	17	10	F	8	NS
Yoshizawa et al. (1997)	8	4-6	F	72	18.9
Mobert et al. (1997)	12	13	M	28	12.2
Shore and Shephard (1998)	15	10	M, F	12	NS
Tolfrey et al. (1998)	12	10	M	12	NS
Tolfrey et al. (1998)	14	10	F	12	7.9
Williams et al. (2000)	13	10	M	8	NS
Mandigout et al. (2001)	28	10-11	M	13	4.6
Mandigout et al. (2001)	22	10-11	F	13	9.1
Baquet et al. (2002)	23	10	M, F	7	9.6
Baquet et al. (2010)	C22/I22	10	M, F	7	CTG8.7/ITG6.4

NS = change not significant

It can be concluded that research on aerobic endurance training effects shows consistent results, but nevertheless leaves room for further investigation of different aerobic training methods. Continuous methods are proven to be extremely effective and energy systems used in these methods seem to be appropriate considering children's characteristics. When implementing long-term programming it is important to use continuous methods before intermittent in order to achieve greater long-term effects (Drabik, 1996).

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BACK TO THE FUTURE OF PE

Gregor Jurak & Marjeta Kovač

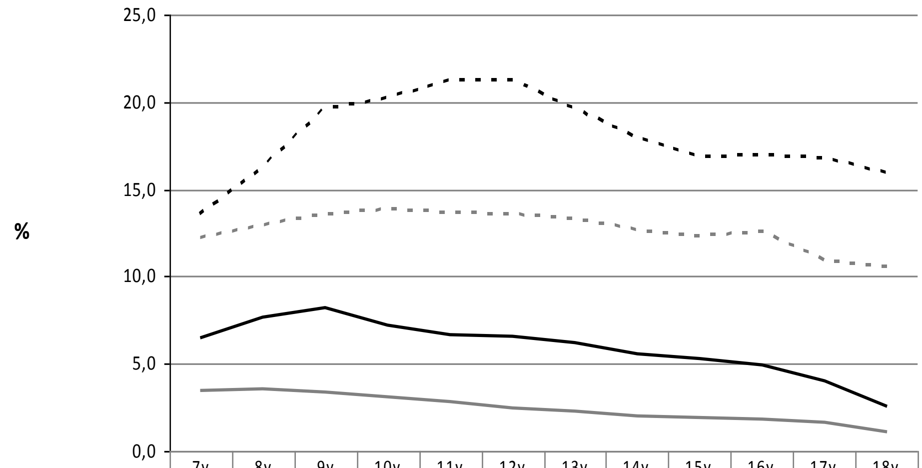
Abstract

Media and information technology which offer easy and immediate fulfilment of human's needs for entertainment and communication are important factors of nowadays lifestyles of young people in developed countries. Many of young people live in half-virtual world of web social networks, far away from climbing on the trees and ripping trousers. In connection with some other risk factors a sedentary lifestyle is common among young people (Ferreira et al., 2006; Strel, Kovač & Jurak, 2007; Armstrong, 2007). These changes are manifesting themselves in decreased physical fitness of young people (Ferreira et al., 2006; Wedderkopp et al., 2004). It seems like battle is lost since also political decisions on state and local level which influence on their physical activity (Kovač & Jurak, 2010) are not in young people's favour. This paper addresses to challenge how to take advantage from modern lifestyles of youth and their parent's in PE teaching. It presents concept of acquiring sufficient data for student's feedback through efficient use of ICT in a future school gymnasium as appropriate learning environment. Augmented feedback given to student is one of the basis to successful PE teaching and student' understanding of contents of PE classes. There are suggestions about the role of PE teachers, students, other school subject teachers, parents, coaches and school physicians in such environment. With the help of modern technology integrated in gymnasium come back to origins of PE can be done: more physical movement, sweating, adequate motor control of movement, playing, socializing, comprising with peers etc.

Introduction

Media and information technology which offer easy and immediate fulfilment of human's needs for entertainment and communication are important factors of nowadays lifestyles of young people in developed countries (Jurak, Kovač, & Strel, 2002).

Figure 1: Increasing proportion of overweight and obese Slovenian young people in past decade



	7y	8y	9y	10y	11y	12y	13y	14y	15y	16y	17y	18y
overweight 1991	12,3	13,0	13,6	13,9	13,7	13,6	13,3	12,7	12,3	12,6	11,0	10,6
overweight 2009	13,6	16,3	19,6	20,3	21,3	21,3	19,6	18,0	16,9	17,0	16,8	16,0
obese 1991	3,5	3,6	3,4	3,1	2,8	2,5	2,3	2,1	1,9	1,9	1,6	1,1
obese 2009	6,5	7,7	8,2	7,3	6,7	6,6	6,3	5,6	5,3	4,9	4,0	2,6

Source: Kovač & Jurak, 2010

Many of young people live in half-virtual world of web social networks, far away from climbing on the trees and ripping trousers. Also they decide to participate in physical activities less often than they use to (Brettschneider et al., 2004; Strel, Kovač, & Jurak, 2007). In connection with some other trends (sheltering praxis of parents, individualisation) a sedentary lifestyle is common among young people (Ferreira et al., 2006; Jurak, 2006; Strel, et al., 2007; Armstrong, 2007). According to the findings of transverse studies, it can be concluded that changes in the lifestyles of young people in developed countries are manifesting themselves in increased fat skin (Strel, et al., 2007), a higher proportion of the overweight population (Strauss & Pollack, 2001; Wedderkopp, et al., 2004; Currie, et al., 2004; Strel, et al., 2007) and in the deterioration of their physical fitness, mainly endurance and strength (Beunen et al., 1992; Strel, et al., 2007). Therefore, the findings also demonstrate a decline of results in activities which require young people's body movement (Wedderkopp, et al., 2004; Strel et al., 2007). It seems like battle is lost since also political decisions which influence on their physical activity (Kovač & Jurak, 2010) are not in young people' favour.

Significant changes in the environment, where young people grow up, and their consequences on motor competency of young people require different approaches to teaching. This paper therefore addresses to challenge how to take advantage from modern lifestyles of youth and their parent's in PE teaching.

Back to the future of PE

Research data indicate that physical education teachers cannot compensate the long hours of sedentary life in children and youth with common teaching practices. With quick technological advance and its effects, it is a challenge for children and youth to create basic motor patterns, control their movement and acquire lifelong motor knowledge that will encourage a free time physical activity, similarly to that in past. Namely, only then a necessary consumption of energy will be achieved. The answer to the challenge might lie in creation of different learning environment and all its elements.

ICT as one of key competence for lifelong learning

The European Council has in 2000 emphasised that people are the main goods of Europe and the main measure in a response of Europe to globalisation and move to knowledge economy. On the basis of this and various other recommendations of EU political bodies, the European Parliament and the EU Council have on December 12 2006 passed a recommendation about the key competencies for lifelong learning (Official Journal of the EU, no. 394/06). Key competences for lifelong learning are a combination of knowledge, skills and attitudes appropriate to the context. They are particularly necessary for personal fulfilment and development, social inclusion, active citizenship and employment. They are allowing people to adapt more quickly to constant changes in an increasingly interconnected world. They are also a major factor in innovation, productivity and competitiveness, and they contribute to the motivation and satisfaction of people and the quality of work. This framework defines eight key competences:

- communication in the mother tongue
- communication in foreign languages
- mathematical competence and basic competences in science and technology
- digital competence
- learning to learn
- social and civic competences
- sense of initiative and entrepreneurship
- cultural awareness and expression.

These key competences are all interdependent, and the emphasis in each case is on critical thinking, creativity, initiative, problem solving, risk assessment, decision taking, and constructive management of feelings.

Digital competence involves the confident and critical use of information society technology (IST) and thus basic skills in information and communication technology (ICT). It is also fundamental basis for learning. Learning to learn supports all activities. It is the ability to pursue and organise one's own learning, either individually or in groups, in accordance with one's own needs, and awareness of methods and opportunities. This competence means gaining, processing and assimilating new knowledge and skills. Therefore digital competence is needed. Skills connected include the ability to search, collect and process information and use it in a critical and systematic way, assessing relevance and distinguishing the real from the virtual while recognising the links. Individuals should have skills to use tools to produce, present and understand complex information and the ability to access, search and use Internet-based services. Individuals should also be able use IST to support critical thinking, creativity, and innovation (after: Key competences for lifelong learning – European reference framework, 2006).

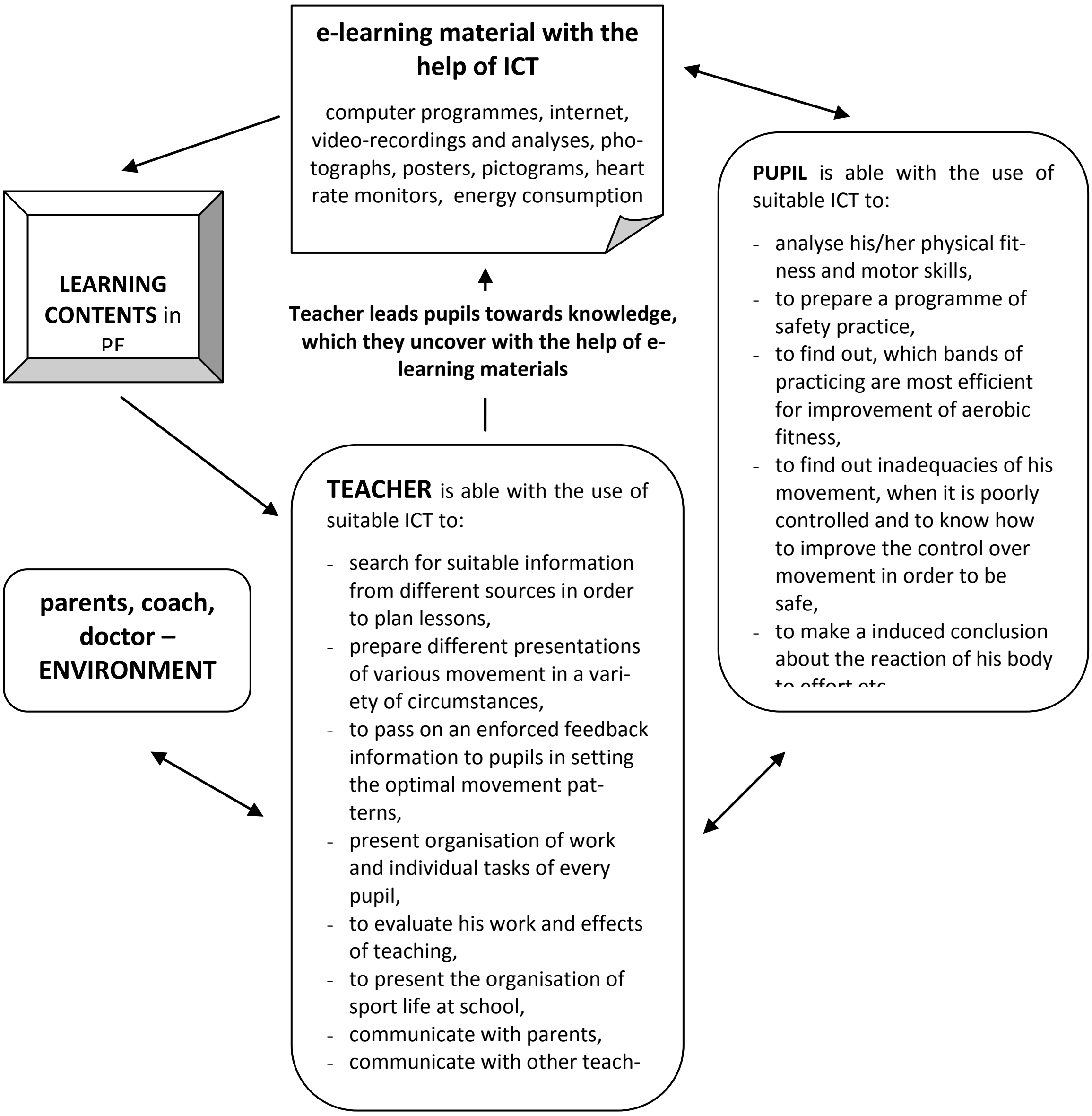
Lifelong learning includes the period from pre-school age to post-retirement years. As such, all key competencies are intended for both pupil and teacher. The following chart presents the importance of ICT in physical education lessons.

Nowadays, physical education represents a counter-balance to ever increasing sedentary lifestyle, which is prompted particularly by the development of new technologies; therefore many physical education teachers fight the inclusion of ICT in physical education. Computer and video-technology have been present in physical education for a period of time; however Slovenian physical education teachers use them at lessons mostly in indirect way (writing teaching plans, analyses, communication, promotional activities) and do not include directly into the teaching process (Štihec & Leskošek, 2004; Markun Puhan, et. al, 2007; Sitar, 2010). From the point of view of maintaining the sufficient volume and intensity of motor encouragement in physical education lessons this is understandable, on the other hand modern technologies provide important visual and mental feedback information in learning of new movements and improved control of movement in various circumstances. This is particularly true when the feedback information is provided via a suitable e-material with the use of video-clips, video analysis, computer simulated movement etc.

Research studies on motivation have shown that enhancement of human values in sport and education, also physical education, is closely related to, and dependent on, using intrinsic causes for achieving goals (Duda & Nicholls, 1992; Papaioannou, 2000). In physical education lessons this is particularly noticeable in motivation of older pupils to overcome effort or to conceptualise the contents. Namely, with age the positive attitude toward sport activity decreases, especially for physically more demanding contents and the satisfaction and degree of effort of young people (intrinsic motivation) in physical education lessons; in addition, older pupils feel less competent at physical education (Škof, Tomažin, & Dolenec, 2000). Consequently, cooperation in physical education lessons decreases with age (Jurak, Kovač, Strel, & Starc, 2005) and participation in sport out of school hours is smaller (Strel, et al., 2007).

Pupils who know more about a physical activity are more likely to take an active approach to it (Birtwistle & Brodie, 1992; Bocket, 1994; Hunt, 1995). As these findings indicate, the primary role of the school and PE teachers should be to make physical activities meaningful and focus on promoting knowledge about physical activity and healthy lifestyle in order to increase a pupil's motivation, normally reflected in a wish to seek out and overcome challenges. In order for the learning process to be effective, we need to create such conditions for physical activities that the performers want to progress, learn more about their interests, or perform better. This approach promotes active involvement of pupils in the process of acquiring knowledge and skills (Kolb, 1984). In such approach augmented feedback given to pupil is important to successful learning. Pupils become actively engaged in the process of acquiring motor skills and improving control of movement. Also, such practice develops their intrinsic motivation for own progress and, consequently, adds meaning to several stamina exercises which pupils otherwise tend to avoid as they see no benefit in them for their own development.

Figure 2: The role of ICT in PE classes through the prism of learning to learn and digital competence



ICT is most often used in the sport hall in order to provide feedback information about the movement of a practicing person; it can also be used to present theoretical information, related to the importance of physical activity and healthy lifestyle (see Figure 2). When using the ICT, physical education teacher faces several obstacles.

- Presentation of information with the use of ICT about safe and suitable exercise should not be static. Theoretical contents can be presented together with practical exercises, in this way resulting in better understanding. Similarly, learning of certain practical contents, which are uninteresting for some groups of children (e.g. endurance activities, exercises for correct posture, flexibility etc.), can be brought closer to pupils.

- The use of ICT should not reduce intensity of physical activities. A poor example of ICT use is organisation of PE lesson as a frontal type of video analysis, where all the pupils watch an analysis of everyone else, as this is very time wasting in relation to the limited number of PE lessons.
- Exaggerated or unnecessary use of various ICT media. The point of using the ICT is for pupils to learn curriculum faster and better. Therefore, teacher has to know, which goals are being fulfilled with the use of ICT, as its use for a sole purpose of entertainment of children, is inappropriate.
- Preparation of media. Less experienced user can quickly have a bad day, thus it is sensible to check the functioning of media prior to their use in lessons. Furthermore, it is wise to use same technology in different classes.

Physical education teacher should plan lessons, so the use of ICT facilitates better utilisation of time and technology. One of the group organised teaching methods (e.g. work on stations, work with complementary and supplementary tasks) is appropriate for analyses, where teacher can concentrate on an individual pupil (as coordinator of work; pupils work on all stations and teacher uses one of them for individual analyses). For simple and regular use of ICT in PE lessons it is important to adequately position technology in sport hall.

Cross-curriculum approaches

A necessary approach to teaching today requires cross-curriculum approach from the teacher. This is a curriculum design, which prepares pupils for lifelong learning. Its core is in bringing together goals and contents of various subjects within the curriculum as well as wider concepts at different levels and volumes. At the same time, the integrity of individual disciplines and maintenance and preservation of adequate balance is an important issue.

Many teachers do not feel the need for cross-curricular approach, which points to possessive attitude towards the chosen subject and unfamiliarity with curricula of other subjects as well as poor communication with other teachers. Unnecessary fragmentation of information between individual subjects almost always results in piling up of data, which pupils (and unfortunately teachers too) cannot bring together in a coherent unit or else cannot attribute a usable value to numerous information.

As such, pupils remain at the lower levels of knowledge (memorising, recognition, reproduction of knowledge) and are not so strong in understanding, individual analysing and creative knowledge. Particularly in developing this type of knowledge, cross-curricular approach can be extremely efficient tool. The most important aspect is that by developing various strategies and connection of knowledge, the quality and durability of acquired knowledge increase.

Cross-curricular approach should be understood as a process and not as a product. The world today is rich with information and pupils have to be taught how to choose and compartment acquired information adequately, connect them and thus enable them a critical view on events and phenomena from different aspects. If the pupils will be more active in all phases of learning process, more they will find lessons interesting and the knowledge more long lasting.

Monitoring of physical fitness

One of the central purposes of physical activity is formation of a healthy lifestyle, which particularly includes a positive effect on physical ability of children and youth. This depends on physical characteristics (mainly body volume) and degree of development of motor and functional abilities. Suitable physical characteristics (proportion between body height, body mass and body fat) and development of motor abilities contribute to more efficient and more controlled movement. At the same time, basic motor patterns should be formed already at a youngest age (walking, running, crawling, jumping, throwing, hanging, supporting…), as they are a prerequisite of coordinated everyday movement. They also facilitate future acquisition of elements in various sports and sports activities, which an individual can later include in his /her free time activity.

Teacher should monitor development of children and provide adequate feedback information to children and parents; the information is also extremely important for his own pedagogic work (planning and evaluation). Different European and international institutions recommend in their declarations regular monitoring of physical and motor development of children (Council of Europe, 2002). Numerous countries carry out monitoring of schooling population for quite some time (USA, Australia, countries using EUROFIT data base tests, Slovenia – SLOFIT).

Experimental environment Elan fit-me

In past, the primary role of school gymnasium was to provide covered practicing area in bad weather conditions. In Slovenia, the materialistic provision of schools is satisfactory from the quantitative point of view (Jurak, 2010); however, the quality aspect of learning environment sometimes becomes questionable. This includes solutions, related to the demands of learning environment in physical education. Nowadays, the described lifestyle of children and youth with its consequences as well as changes in teaching methods, require more than just a mere gymnasium. It is important what possibilities a gymnasium offers in connection with the knowledge of teachers.

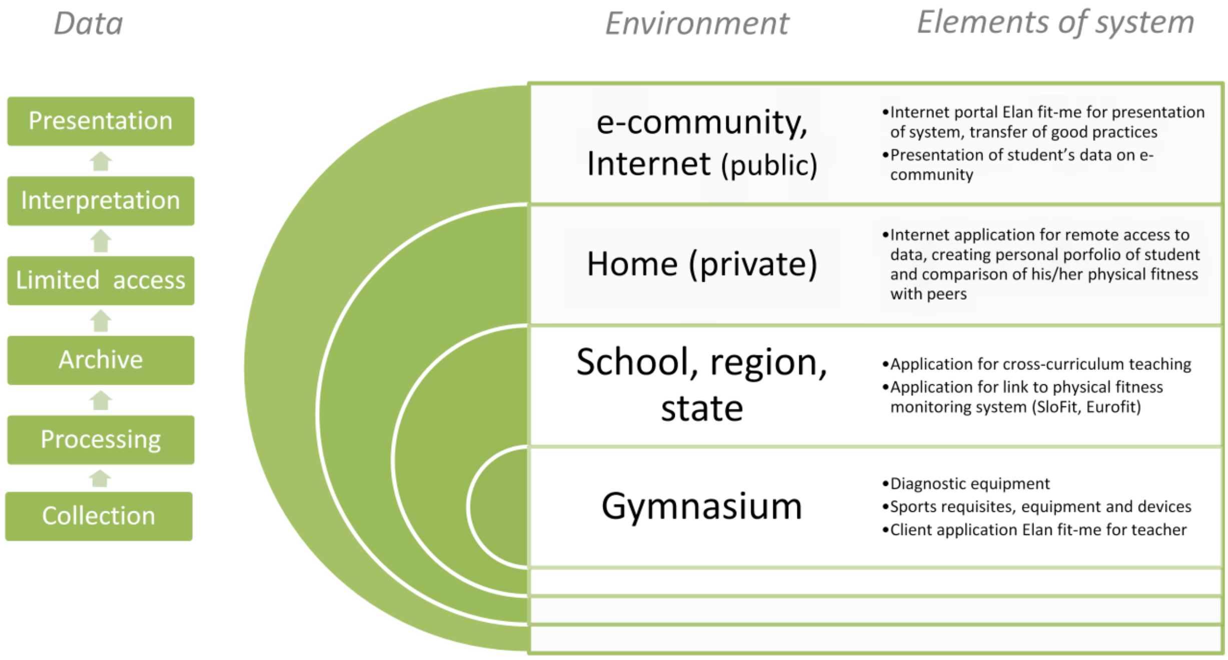
Environment changes fast under the influence of modern technologies. In order to utilise the technology and conceptualise physical education in social context of future times, a concept of e- gymnasium for the future has been developed together with a business partner (Elan Inventa d.o.o.). Its working title is Elan fit-me. The aim of experimental project is to develop and implement a new, professionally unique concept of acquiring diagnostic data through efficient use of ICT in a school gymnasium.

Augmented feedback given to performers of physical activities is important to evaluation of movement in PE and sport. Such feedback can be effectively transferred via ICT. Combining various diagnostic-based technology services in a school gymnasium with e-learning materials will establish a system that will make it easier for PE teachers to prepare for lesson and also enable the students, and all persons with whom the students will wish to share the information to see the diagnostic results. Thus, the system will ensure the information required for further use in effective PE and sports practice, as indicated in the acronym of the project.

The Elan fit-me concept is made up of a software environment for teachers (client application) which allows central management of the diagnostic equipment system in the gymnasium (combination of the existing equipment from other manufacturers and newly developed equipment, an RFID system, an interface to store diagnostic data by individual codes, integration of all ICT equipment into the school gym facilities) and a web portal that enables exchange of diagnostic and other data between users of the system (teachers, pupils, parents, coaches, doctors, etc.). From the content view concept is divided in 3 stages:

- Gymnasium environment (client application in school gym for PE teacher and students)
- School environment (application for cross-curriculum teaching)
- Web environment (web portal for presentation of system, transfer of good practices, remote access to student's data)

Figure 3: Diagram of the Elan fit-me processes

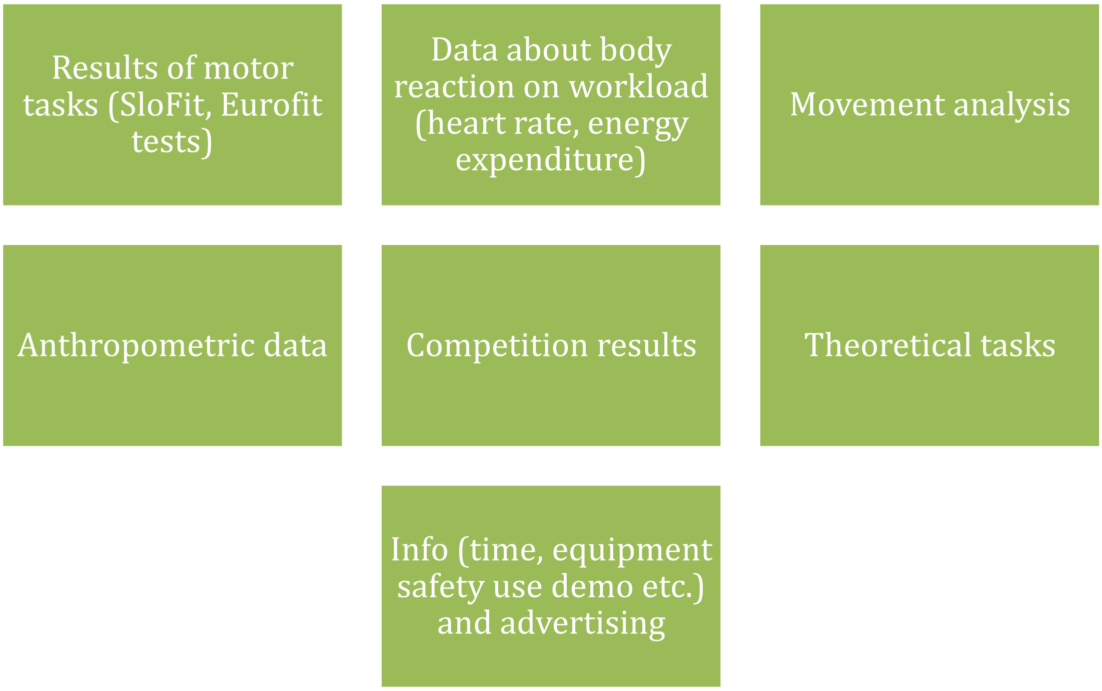


In client application teachers will be able to make advance plans for using ICT in a gymnasium; the plans will include the use of various types of diagnostic-based and education technology (e.g. demonstration of a pupil's movement with a delay or in slow motion, video recording, heart beat and energy use monitoring, results of specific motor tests, presentation of data on worksheets). Using the software tool that will be developed in the course of the project, the teachers will be able to access and run all the software and hardware needed for the lesson plan via a central medium, instantly arranging the gymnasium to the planned physical activities. Also, this concept will enable simple collection of data on the physical and motor development of children (e.g. SloFit, Eurofit).

Through the use of RFID technology, pupils will be identified at each station and diagnostic data will be stored to a data field in the gym. The data, such as a digital video of the movement or the heart beat frequency, will be immediately available for viewing inside the gym. At home or in the course of another subject (e.g. cross-curricular approaches – PE data used in a physics class) pupils will be able to access the data archive which will have been transferred to a web-based environment, and create their own portfolios. In the course of the project, appropriate software environment will be created to prepare, process, analyse and store data. It will enable the pupils to compare their physical (body height, weight, BMI, skin-folds) and motor development (endurance, strength, flexibility, speed, coordination) against their peers from the same school and other schools (SloFit) or to analyse their movement with optimal performance during the PE lesson with their teacher, or at home with their parents, coach, or physician. The web portal will also bring the users presentations of the ELAN fit-me system, transfer of good practice (system applications) and links to other useful web portals (e.g. theoretical background on movement enhancement). After all, pupils will be able to publish their data on e-social networks.

The project will bring a new level to the quality of e-learning/teaching in PE and sports where teachers and coaches are otherwise limited as the primary focus of the lesson is physical activities. Gymnasiums with an integrated IT system will provide for easier combination of different types of modern ICT equipment to acquire diagnostic data, create diagnostic databases (in particular, physical fitness data), which will facilitate comparing the results for a specific pupil with those of his/her peers, cross-curricular cooperation, establish regular communication via current media between the PE teachers and parents regarding the execution of PE classes and activities; potential cooperation between PE teachers and the school doctor on planning the physical activities for pupils with heath issues; a web portal for exchange of diagnostic data; one-stop-shop (web) for pictorial and word information on the performance of movements by a participant, learning these movements and the role of these in other school subjects (fields) and life. In such learning environment PE teacher is not only transmitter of knowledge but also teaches students to gain knowledge with the usage of e-learning materials and ICT by themselves. With such approach come back to origins of PE can be done: more physical movement, sweating, motor skills acquiring, playing, socializing, comprising with peers etc.

Figure 4: Augmented feedback and other information collected in the gymnasium using the model



Case scenario: Basketball

The aim of the lesson is to check the knowledge and motor skills in basketball: the tactical elements of top of the ball defence, jumping ability and referee rules. The teacher organizes the lesson in stations.

Using the Elan fit-me software, the teacher determines the ICT equipment to be used:

- A camera is used to make RF ID based skill performance recordings in a part of the gymnasium; the teacher defines the data acquisition method (automatic – time delay between identification and action; or manual by prior confirmation – in case there are several performances of the skill and the teacher only wishes to record one)
- RF ID based video recording played in slow motion on the LCD screen
- RF ID based quiz testing (e-learning material) the knowledge of situations in basketball game is performed on the LCD screen (the teacher chooses from a selection of questions or creates new questions and answers)

At the start of the lesson, the teacher explains the purpose and organization of the lesson to the students. The students put on their RF ID bracelets and perform identification by software. The work is carried out at the following stations:

1. Zone defence: Top of Ball Side. The teacher sets up a work station for zone defence drill in the part of the gymnasium that is covered by cameras. When a student in the group gets close enough to the LCD screen, the RF identification starts. The LCD screen displays the name and surname of the student along with the instructions for recording the actual performance. The group performs the task and the video of the student's performance is stored under his/her ID. Then, another student triggers the RF identification, and the group repeats the drill with the student taking different roles/zones. The task is repeated so many times that each of the students takes on all the roles.
2. Defence Performance Analysis. Together with their teacher, the student analyse their defence performance at the LCD-equipped work station. On the basis of the RF identification, the Elan fit-me software finds a certain student's defence performance video(s).
3. Three-on-three Half Court Defence. Three points are awarded for a shot that ends in a defence.
4. Jump Ability Test. When the student approaches the work station, the LCD screen displays his or her name and the protocol for performing the jump. The Optojump measuring device measures the jump and enters the result under the student's ID.
5. Situations in basketball game. The student approaches the work station and performs identification. The screen displays a quiz testing the pupil's knowledge of proper player reaction in basketball game. The student completes the quiz, and the screen displays the score and correct answers.

Students pass from station to station in the teacher-designated order. The teacher also defines the time interval needed for each station and coordinates all the other activities in the gymnasium.

Conclusion

Learning environment is an important factor of teaching and learning. Poorer conditions require adaptation of teacher in his work; nevertheless, even excellent conditions cannot replace a teacher. It is crucial that the competencies of teachers change in line with the changes in learning environment, which is presented in the paper. On the basis of findings of studies on Slovenian PE teachers (Štihec & Leskošek, 2004; Kovač, Sloan, & Starc, 2008; Sitar, 2010) it can be concluded that the competence of PE teacher for work with ICT is one of the important elements in improvement of their teaching. Teachers state to have lower than desired competence for ICT work in PE (Kovač, et al., 2010). At the same time, teachers obviously consider the use of ICT in PE more in indirect connection and not for direct inclusion into lessons. The answers of teachers, revealing that they do not require ICT for presentation of curriculum and additional motivation, could indicate that teachers feel threatened in their two traditional roles in PE lessons: demonstration of skills and the motivation of pupils for PE and sport. Obviously a combination of improvement of materialistic conditions and the necessity of use of ICT (e.g. compulsory sending of data about physical fitness) will be required for a transition to higher level of accepting of ICT in PE; the thesis is confirmed with the fact that teachers, who have already been forced into such kind of work (external examination in PE at the end of primary school), are more familiar with e-learning material (Sitar, 2010).

Learning environment should not be considered in a too narrow light, merely as an ICT. Social changes influence the perception of school as a whole; therefore, entirely conceptual questions about the further education of young people are being considered. In some countries, in line with the "d.school" concept (http://dschool.stanford.edu) and the experience of ambient, a different picture of school environment has been designed with an aim of bringing school as a learning environment closer to modern lifestyle of children and youth. This context also includes a gymnasium as a learning environment of physical education. As such, physical education teachers will have architecturally position a gymnasium through interdisciplinary cooperation into such school and also produce a conceptual image of its concepts.

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YOUNG ATHLETES' COACHES – A PROFILE

Tanja Kajtna

Abstract

A coach is an important figure in an athlete's life – for most athletes, he or she represents the way to reach their goals, the one person, who can enable realizations of dreams. Sport is a playground not just for developing and realizing success, but also for developing social skills, discipline, learning to function well under stress, to cope with opponents, problems… Thus coaches are expected to be able to give all that to their athletes and to enable them to learn all of this. We wanted to find if the coaches, who work with young athletes in Slovenia, differ from coaches, who work mainly with older athletes. 275 Slovene coaches participated in the research, coaches of younger athletes were defined as coaches, who mainly work with athletes up to 16 years of age – we found coaches of older athletes to be older (M_{age} = 42,72 years, SD = 9, 46), younger athlete's coaches were 35,60 years old in average (SD = 9,24) – the differences were significant (F = 38,52 and sig (F) = 0,00). We tested the personality and leadership characteristics, their social skills, emotional intelligence and their attitudes toward sport. We found coaches of younger athletes to be more emotional, they engage in whatever is happening at the moment more than coaches of older athletes. As a result, they sometimes have more problems with controlling their emotions – externally they might even sometimes appear emotionally unstable. We found better social and communication skills in coaches of older athletes, which seems to be the result of longer careers and thus more time to practice and develop these skills. Older coaches also demonstrate more leadership behaviour, which is oriented into practice and teaching – we believe the reason for that lies in the increasing demands for technical and tactical perfection in top sports. This result could be partially explained also by the fact that frequently coaches need to correct the mistakes of previous coaches – in Slovenia, many coaches who work with younger athletes, have far from sufficient education and far from enough knowledge to work in sport. But the prevailing opinion seems to be, that everyone with a bit of spare time on their hands, can work with younger athletes. An opinion which is by our judgement completely wrong.

Introduction

Many authors define the coach as the leading character in developing an athlete's career (Tušak & Tušak, 2001; Krevsel, 2001; Martens, 1990; Gummerson, 1992; Sabock, 1985), while Solomon (2001) states, that only the coach's evaluation of the athlete's confidence can predict the success on the oncoming competition. Dick (1997) defines coaching as »more an art form than a science« and Everd and Selman (1989, in Popper & Lipshitz, 1992) say that coaching is a process of creating a culture of development and an atmosphere of teaching. A coach is thus clearly an important figure in the process of achieving athletic success – a complex approach by Tušak and Tušak (2001) defines 6 areas of the coach's functioning:

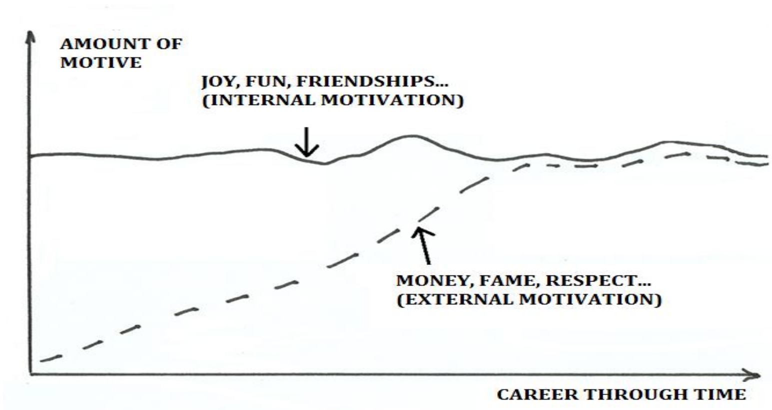
- *Practice planning* – this is the most demanding part of the coach's work, it requires an insight into several areas surrounding sport, such as biomechanics, psychological knowledge, sports medicine…); a coach need not be an expert in all these areas, but he has to know them well enough to be willing to include such experts into his work and to know what to expect from them;
- *Practice execution* – this is actually the most obvious part of the coach's work, it involves the execution of strength and endurance practice, technique and tactical practice… Practice is a process of delivering such information to

the athlete that he will be able to understand it - he also needs to explain the goals of practice to his *athletes.*

- *Practice success control* – a coach should supply steady and regular feedback to his athletes – this is important both for enabling them to work well and constantly correct their mistakes and also from the motivational point of view; feedback also enables comparison with rivals.
- *All-round care for the athlete* – the coach should structure the athlete's environment in such a fashion, that they will be able to do their best at practice or competition – enable positive mood states and disposition by making sure that all is taken care of during travelling, that they will have all the professional support they need, by checking the conditions of the competition, taking into account individual requests of the athletes… It also includes being able to control the athlete's emotions and states on the site of the competition, which also includes the coach's own emotional control.
- *Counselling* - a coach should be able to help the athlete both in the matters of practice and competing as well as in private affairs (school, partner and parent relationships…)
- *Competition aspect* – a coach has to be aware that he is first and foremost a role – model for the athlete – ha has to approach the competition seriously, stay positive in all situations, be realistic, he can help the athlete with his pre-start routine, he should have a positive influence on the athlete's emotions and confidence and has to provide a thorough and objective analysis of the event afterwards.

Authors researched the characteristics of coaches also from the point of view of stress at work and found that coaches frequently experience large amounts of stress and frequently experience burnout (Caccese & Mayerberg, 1984, in Dale & Weinberg, 1989). Within dimensions of burnout Cape, Sisely, and Desetrain (1987, in Dale & Weinberg, 1989) found that conflict of roles causes emotional exhaustion, indistinctiveness of roles is connected with stronger feelings of depersonalisation, less experience as a head coach causes decreased self-confidence. The environment is also a major factor in experiencing burnout. Coaches who spend a lot of time taking care of the athletes seem to experience burnout more often than other coaches - Dale & Weinberg (1989) explaining that great amounts of energy spent by emotional involvement and care for the athletes cause the coaches to pay less attention to their own needs.

Figure 1: Motivational characteristics of an athlete’s career (Kajtna, 2006)



Working with young athletes is especially difficult, since a coach functions as a role model and needs to adapt the practice to the developmental needs of an athlete, also, he needs to pay attention to the motivational characteristics of a young athlete – arousing too much external motivation in a young athlete can cause great damage to the engagement of that athlete (Kajtna, 2006), as can be seen from Figure 1.

Dick (1997) emphasizes, that children learn through play and that sport should be fun for them, thus sustaining high levels of internal motivation, similar recommendations come from Roberts and Treasure (1993), who state the importance of setting short – term goals. High internal motivation can thus also be expected from their coaches (Frederick & Morrison, 1999; Gilbert & Trudel,2004).

Athletes stay young at least till senior categories and it is wrong to believe that they are adults just because they compete with adults, as is often the case – we should be aware that it is impossible to speak of adulthood before at least 18 years, according to some authors even far later, as late as 25 years of age (Marjanovič Umek & Zupančič, 2004).

The goal of our research was to compare coaches of younger and older athletes in their psychological characteristics (personality traits, leadership styles, social skills, emotional intelligence, achievement motivation and attitudes toward coaching) According to our goal we set the following hypothesis: H1 – »There are differences between younger and older athletes' coaches in their psychological characteristics. «

Method

Participants

275 Slovene coaches participated in the research, 237 of them were male and 37 female, one coach did not answer this question. The average age of the coaches was 38, 87 years let (SD = 10, 01), the youngest was 21 and the oldest 64 years old. Their average in years of coaching experience was 17, 47 years (SD = 10, 34).

There were significant age differences between younger and older athletes' coaches – older athletes' coaches were older - their mean age was 42,72 years (SD = 9, 46), younger athletes' coaches mean age was 35,60 years (SD = 9,24) (F = 38,52; sig (F) = 0,00). Older athletes' coaches were more experienced, they had 4,23 years longer careers – again, the difference was significant (F = 11,34; sig (F) = 0,00).

All coaches, who work mainly with seniors or who coach seniors, were taken as older athletes' coaches, whilst those coaches, who coach only juniors or younger athletes were assigned to the group of younger athletes' coaches.

Instruments

The instruments used in the research were as follows:

- ***Big Five Questionnaire – Slovene version (BFQ)*** – Caprara, Barbaranelli, Borgogni, Bucik and Boben (1997); The questionnaire measures five main personality dimensions (energy, agreeability, conscientiousness, emotional stability and openness) and contains a social desirability scale. Reliability analysis for the questionnaire reveals α coefficients between 0,63 and 0,82 and has a stable factor structure.
- ***Social skills inventory (SSI)*** – Riggio in Trockmorton (1986, in Lamovec, 1994); the inventory contains 7 dimensions (emotional expression, emotional sensibility, emotional control, social expression, social sensibility, social control and social manipulation). Authors report high test – retest reliability and high internal consistency of inventory's dimensions (between 0, 81 and 0, 96).
- ***Achievement motivation questionnaire*** - Costello (1967, in Lamovec, 1988); two dimensions pertain the questionnaire, they are the need for achieving success, based on our own work and effort and the need for achieving success regardless of our effort. Split half reliability for the test varies between 0, 73 and 0, 82.

- ***Self – motivation Inventory (SMI) -*** Dishman, Ickes and Morgan (1980, in Tušak, 1997) – it measures internal motivation and has high reliability coefficients.
- ***Leadership scale for sports (LSS)*** – Chelladurai and Saleh (1980); the scale is composed of five dimensions (training and instruction, democratic behaviour, autocratic behaviour, social support an positive feedback), authors report test – retest reliability coefficient between 0, 72 and 0, 82.
- ***Emotional competence questionnaire (VEK 45)*** - Taksič (1998); the shorter version of emotional intelligence questionnaire contains 45 items, which converge in 3 dimensions (ability to recognize and understand emotions, ability to express and name emotions and ability to manage emotions) and is based on the Mayer - Salovey – Caruso's concept of emotional intelligence. First two dimensions have high reliability (α = 0, 84 and 0, 89 consecutively), the third dimensions is slightly less reliable (α = 0, 67).
- ***Leader effectiveness and adaptability Description (LEAD)*** – Hersey and Blanchard, (1988); the instrument consists from 12 problem situations and measures 4 styles (telling, selling, participating and delegating) and adaptability of leadership. It is normally used for individual consulting, a research reveals fairly low reliability (α coefficients range from 0, 26 to 0, 36, except for the style of telling – α = 0, 65) (Kajtna, 2006). The instrument was used with the approval of the company Biro Praxis.
- ***Attitude inventory for coaches (Vprašalnik stališč za trenerje) –*** Kajtna and Hvalec (2006, in Kajtna & Tušak, 2007)**;** the inventory measures some important attitudes in sport and has 3 dimensions (development, achievement and problems). Its α coefficients range from 0, 69 to 0, 72 for three dimensions.

Procedure

The results were gathered within the scope of the project of the Slovene Ministry of sport and education called »Leadership styles in Slovene coaches«, the participants were tested during October 2004 and September 2005, the majority of them were tested individually.

Results

We found coaches of younger athletes to be more emotional – they have lower emotional control, lower impulse control and lower emotional stability, we found better social and communication skills in coaches of older athletes, they also demonstrate more leadership behaviour, which is oriented into practice and Older athlete’s coaches are also more self – motivated, better in social control and emotional recognition as well as expression. Younger athletes’ coaches are better in social sensibility, as can be seen from Table 1.

Table 1: Comparison of younger and older athlete's coaches

	Younger athletes’ coaches	Older athletes’ coaches	A - nova	
	M	M	F	Sig (F)
Emotional control	39,53	41,07	3,77	0,05
Impulse control	35,78	37,51	5,24	0,02
Emotional stability	75,31	78,58	5,45	0,02
Training & teaching	4,29	4,40	6,48	0,01
Self - motivation	155,53	160,95	6,95	0,01
Social sensibility	79,48	73,35	10,27	0,00
Social control	90,26	95,89	8,96	0,00
Emotional recognition	56,92	58,72	3,78	0,05
Emotional expression	46,12	48,06	5,01	0,03

Legend: M – mean

Discussion

Coaches have an extremely important role in the development of an athlete's career, as many authors agree (Lee, 1993; Sabock, 1985; Byrne, 1993). Our two groups of coaches seem to differ in several psychological characteristics, personality testing has shown, that young athletes' coaches are lower in emotional control and impulse control, thus giving them a lower level of emotional stability. This would suggest a higher level of emotional engagement of young athletes' coaches and lower control might not be the best indicator for the coaches' performance on a competition – a coach should act as a model and with low emotional control that could be difficult. On the other hand, younger athletes do not engage in high level competitions, as do older athletes and their coaches don't have to deal with that much stress.

Also, high emotional engagement might prove to be useful from another perspective – it is an almost parental role, when coaches emotionally engage with their athletes and from the point of directing the child into sport, high levels of engagement might even appear to be useful. High emotional engagement with children will enable the coaches to individualize their work and focus on each child's own progress, rather than compare them to others – that would enhance the internal motivation of the children (Kajtna, 2006) and it is exactly individual progress that is stressed as one of the most important aspects of a young athlete's career (Martens, 1990; Lee, 1993; Stropnik, 2006; Tušak, Tušak & Tušak, 2003; Bon, 2002). And since young athletes' coaches are educators, emotional engagement is useful.

Leadership testing has shown us more practice and training oriented behaviour in older athletes' coaches – we can say that older athletes' coaches more frequently teach their athletes, deal with tactical and technical issues, teach new approaches and correct more mistakes, encourage hard work and deal with coordinating different aspects of their athletes' careers. This result surprised us somewhat, since we expected it to be the other way around – young athletes have less knowledge about technique, practice, tactics... and we would expect their coaches to show more of such behaviour. Our result has some parallels with other researchers – similar findings were obtained also by Case (1987). Black and Weiss (1992) explain this by coaches focusing on giving positive feedback previously, thus focusing less on practice and teaching. But still, we believe this to be the result of a »fault in the system« - frequently, coaches of younger athletes are less educated and when older coaches get to work with athletes, they first need to teach them technical and tactical approaches, since top athletic accomplishments can nowadays only be achieved through perfection and excellence in technique and tactics...

We still need to get a lot of work done on breaking the stereotype that »everyone with five minutes of spare time on their hands can work with beginners in sport«. It is the other way around – only coaches with good knowledge and a lot of knowledge should be allowed to work with beginners. It is true, that top athletes prefer leadership that focuses on teaching and practice (Chelladurai, 1984; Chelladurai & Carron, 1983; Terry & Howe, 1984; Serpa, Pataco & Santos, 1991), but such leadership should start earlier, not only at top levels of athletic engagement.

Older athletes' coaches are also more motivated – they are higher in self – motivation, which is an indicator of high achievement motivation, which is internally based – they are motivated by satisfaction, progress and excellence rather than money and fame. This is of course very good information, since then it is easy to teach athletes to be motivated by the same things, but it is concerning that younger athletes' coaches are lower in internal motivation – since children should learn through fun (Dick, 1997), it might be difficult to keep this motivation if their coaches focus on success and results. Roberts & Treasure (1993) suggest using short – term goals in such situations. We should perhaps ask ourselves how well the coaches know the developmental characteristics of younger athletes and whether they perhaps just take them as »small adults« - such an approach to practice would of course be gravely mistaken. In such a way, coaches would only function as »talent scouts« instead of offering what the sport can give to any child – discipline, friends, ability to perform under pressure, readiness to work hard...

Younger athletes' coaches are higher in social sensibility, which means that they are able to function in accordance with social norms of an environment and are adaptable and can act appropriate to the situation, which is necessary from the perspective, in which they still need to make a place for themselves and establish themselves as coaches, but it could also lead to high levels of cautiousness, which might inhibit their social interaction (Lamovec, 1994) – too much focus on themselves might lead to lower focus on the children. Also, good social skills in coaches will get the children to take them as role models, so young athletes' coaches should be highly socially skilled – a situation, which was not present in our study.

Older athletes' coaches have better social control, which means that are good at role play, are socially skilled and can present themselves in the desired manner, appear to be confident and can influence the course of social events – they can use these social skills both in leading and directing the athlete and the team of experts, who work in sport. This is for them more important than for younger athletes' coaches, since they usually don't have a team of experts working with an athlete. Also emotional recognition and emotional expression as components of emotional intelligence are higher in the group of older athletes' coaches, which could amplify the statement, that social skills and emotional intelligence are learned – older athletes' coaches are both more experienced and older and have had more opportunities to practice and develop these skills.

At this point we should mention the dilemma of distributing the coaches into the two groups – the licensing system in Slovenia is unclear and many coaches work with both younger and older athletes and distinguishing between both groups of coaches is difficult – there were 40% of such coaches, where categories overlap. Similar problems were found also by Hvalec (2005) and Gilbert and Trudel (2004), who found, that young athletes' coaches roles are often unclear. Future studies should thus clarify the distinction between these groups of coaches and extend the study to beginners' coaches, which would help us clarify the profiles of different groups of coaches.

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FUNDAMENTAL MOTOR PATTERNS IN CHILDREN AGED 4 – 7 YEARS

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Abstract

The aim of the study is to determine and analyze the presence of the selected fundamental motor patterns (FMP) – walking, running, crawling, climbing and jumping – in 107 healthy Slovenian children aged 4 to 6 years. On the basis of the chosen battery of tests and with the aid of modern instruments, we performed the complete kinematic evaluation of FMP; analysis of peculiarities of measured FMP; adaptation and interdependencies among different FMP and other children aharactersitcs (posture, flat footness, fat and muscle mass, muscle strength); analysis of the impact of the morphological characteristics on FMP adaptation; and comparison between analyzed FMP and life styles of measured subjects. The children are being longitudinally monitored throughout three test sessions - October 2009, 2010 and 2011, beginning at the age of 4. Preliminary data on FMP of the children aged 4 were analyzed qualitatively and quantitatively. All statistical data analysis was performed with ANOVA and the Pearson correlation coefficient (significance was accepted at $p < 0.05$). Statistical data suggest some significant differences between and among chidren at the age of 4. The results show that coordination (inter-muscular, intra-muscular and inter-segmental) is probably of primary importance in the performance of FMP at this age. After our three-year follow-up study is completed, we can expect to derive a much broader understanding of the processes in early child motor development, especially as regards FMP.

Introduction

Motor development is a process in which children achieve motor skills and patterns in interaction with inheritative and environmental factors (Latash, 2008). Inherited factors are determinative for nervous and muscle development, morphological characteristics, physiological characteristics and physical growth (Malina, Bouchard and Bar-Or, 2004). Amongst environmental factors the most influential are motor experiences and motor learning. Motor competencies development is a very important and continuous process where children could experience periods of stagnation (Pišot and Planinšec, 2005). Some motor competencies are achieved sooner than others. In early childhood children develop certain motor competencies very quickly (such as: speed, coordination) while the others are much slower (such as: balance, strength, flexibility and endurance) (Malina et al. 2004). High inter child differences are very common for this age during which children have their own development frequency, determined by their »biological clocks« (Gallahue and Ozmun, 2006).

Different parts of a child's body grow at different rates. Large-muscle development occurs earliest, so gross-motor skills, such as reaching, waving arms and legs, crawling or walking, tend to appear first. Most 3- and 4-year-old children actively use their large muscles in running, wiggling and jumping. Pre-schoolers have a relatively higher center of gravity than adults. This means that they are more prone to falls because the legs and body are not yet developed in proportion to the upper body region. By the age of 6, the child's body proportions are more like an adult's, with the centre of gravity more centrally located to help them achieve greater physical balance. Since the large muscles develop first, providing opportunities for outdoor play and exercise or indoor running around is important. It is very important that parents, child-care programs and schools provide children with a variety of large-muscle activities to give the children a chance to develop and exercise large-muscle skills. Usually we are not aware enough that coordinated early development of the fundamental motor patterns (FMP) is a significant step towards ensuring a lifelong, healthy and safe involvement in physical activity. Healthy and consistent muscle, tendon and bone growth in children, which is influenced by a number of conditions, including inherited tendencies, nutrition and physical activity, and metabolic and endocrine functions, ensures fewer risks of problems in adults. Problems in any specific or combined areas can lead to degenerative diseases of the locomotor system in children.

Those important facts in early child motor development on one hand, and the alarming increase in the number of injuries of the skeleton (Bilban & Djomba; 2007), inflammatory and degenerative diseases of bones and joints, spinal diseases and injuries, all certainly connected with inactive lifestyles (Andrew, 2007) or inadequate adaptations and developmental irregularities of the FMP that cause motor deformations on the other, have encouraged us to direct our research into investigating FMP using a population of healthy children. The purpose and main goals of our study are: accordance analysis of the FMP with complete kinematic evaluation; analysis of possible causes for inadequate adaptation of FMP and its relevance to physical and motor development; longitudinal assessment of the FMP adaptation in children aged from 4 to 7 years; analysis of the adaptation interdependencies between different FMP; analysis of the impact of the morphological characteristics on FMP adaptation; and analysis of the influence of the life style of children that participated in the study and their parents on the consistent development of FMP.

As incorrect functioning of the skeleton-muscular system can have numerous negative consequences reflected in an individual's work, life, and predominantly in their health, we supposed that inadequately developed FMP could have a negative effect on the upgrade of motor stereotypes and consequently on inadequate and irregular motor efficiency in adulthood as well. Recent research (Walkley et al., 1993) has come to the conclusion that the current level of development of FMP during children's formative years is inadequate. Without competence in skills such as running, leaping, balancing, rolling, catching, and throwing, students are less likely to access the range of options available to establish an active lifestyle. Research indicates that the improvement in self esteem and confidence in movement that accompanies the acquisition of FMP has a flow-on effect to all other areas of a child's early development. In Slovenia there has been no such study conducted so far. The preliminary data of the first year results of the ongoing three-year follow up study of FMP in Slovene children aged 4 to 6 are presented.

Methods

Sample

The sample consisted of 107 4-year old children (52 boys). The study was part of a wide basic research project "Analysis of fundamental motor patterns - skeletal and muscular adaptation to specific sedentary lifestyle factors in children aged 4 – 7 years", conducted by the Institute for Kinesiology Research, Science and Research Centre of the University of Primorska. Children's parents gave their written consent prior the beginning of the study. All testing procedures conformed to the 1964 Declaration of Helsinki and were approved by the Slovenian National Medical Ethics Committee. The research was financially supported by the Slovenian Research Agency.

Table 1: Descriptive data of the children.

	Boys	Girls
N	40	48
Body mass (kg)	18.8 ± 2.6	18.5 ± 2.7
Body height (cm)	108.3 ± 4.4	108.2 ± 4.4

A number of different and demanding measurements were performed on the children. They were additionally motivated by the story of astronauts travelling in the space, filling in a cartoon of a rocket with labels on every measurement station. If a child did not want to complete all the tests despite the encouragement, he/she was not forced to do so. 88 children (40 boys) completed all the tests (Table 1).

Variables and data analyses

The most common fundamental motor patterns (FMP) – walking, running, crawling, climbing and jumping – were analysed as follows:

- Analysis of walking and running – each child was equipped with markers necessary for a video analysis. The pressure and video tests were performed on a treadmill (80 x 180 cm), equipped with 10,240 pressure sensors in its podium, one at each 7 mm. The child walked and ran at 0.6 m/s and 1.2 m/s, respectively. After the adaptation phase, the child's performance was recorded for 30 seconds by the pressure sensors and by two high-frequency cameras in the 3D calibrated video space (model GIG-E) with the sampling frequency of 200 Hz. Electromyographic analysis of walking and running were performed separately (off the treadmill) with an 8-channel telemetric system NORAXON TeleMyo 2400 G2 (Noraxon USA Inc., Scottsdale, USA). The measured muscles were rectus femoris (RF), biceps femoris (BF), tibialis anterior (TA) and soleus (SOL) on both legs. Respecting the SENIAM recommendations (Hermens et al., 1999), pairs of self-adhesive single-use surface EMG electrodes (NORAXON Dual Ag/AgCl, 10 mm diameter, 20 mm inter-electrode distance) were stuck on the muscles. For the purpose of gait-cycle triggering and averaging of the signals, two foot switch sensors were applied to the left and right foot, respectively. The EMG analyses were performed with the WiseCoach software (Wise Technologies, Slovenia). The signals were band-pass filtered and rectified.
- Analysis of crawling - the adequacy of crawling was tested qualitatively on an 8 meter long surface. Children repeated the test twice and the best performance was further analysed. Moreover, a 3D kinematic analysis on the treadmill was also acquired; however, the data has not yet been analysed.
- Analysis of climbing – for the purpose of this research project, we have constructed a 230 cm high wooden ladder, which makes distance alteration between single ladders (15 cm, 30 cm and 45 cm between two ladders) and a whole ladder slope (45 and 90 degrees). We had the children participate in 5 different climbing tasks varying in the slope of and distance between single ladders. Each climbing task was also separated into ascent and descent. The child's performances were evaluated by the following patterns, which children used during climbing: direction sight, ways of holding the bars, sequence of moving limbs, connectedness of climbing while completing a climbing task and the use of the pattern of diagonal skeletal muscle activation. A descriptive video analysis of climbing was used in the evaluation. Apart from the descriptive evaluation, connections were sought with results of static strength tests and body posture, measured with kinematics analysis.
- Analysis of jumping – children performed countermovement vertical jumps with and without hands. Three jumps were video recorded and performed on a force plate (AMTI, Watertown, USA) with the electromyographic response from eight selected muscles (the same as described in analysis of walking/running). The best performance (the highest jump, calculated from flight time) was further analysed for both jumping techniques.
- Additionally we conducted:

- Anthropometric measurements (longitudinal dimensionality, voluminosity) and bioimpedance body composition.
- Measuring the posture in a static environment. The child was positioned in 3D calibrated video space (CONTEMPLAS GmbH, Kempten, Germany). Force distribution on pressure sensors were measured on a platform (80 x 180 cm), equipped with 10,240 pressure sensors in its podium, one at each 7 mm. Thus two dimensional information on the distribution of body weight against the surface was obtained, data on lengths of individual body segments and the alignments of body anthropometric points.
- Saliva was collected for monitoring the metabolic parameters to define the metabolic risk for children's obesity development - markers of inflammation, such as C-reactive protein (CRP) presence was measured in 3ml saliva samples taken from the child after an overnight fast.
- The quantity and the intensity of physical activity were measured with an accelerometer (ACTIGRAPH, Pensacola, USA). Thus an accurate evaluation of the quantity and intensity of children's physical activity was provided. The children's parents were also invited to take part in this part of the study in order to obtain the possibility of comparison of the quantity and intensity of physical activity between the children and their parents. A consecutive five days of monitoring (8 am to 8 pm) was collected for a representative sample.
- Analysis of the foot was performed on a foot scanner and with 2D picture analysis of the Achilles tendon angle. Flat foot was defined as the Clark angle, below 42 degrees. Valgus and varus of the ankle and knee joint were calculated from 2D photography, with the joint alignments representing 0 degress.
- Analysis of calf skeletal muscles (SO and gastrocnemius medialis) and Achilles tendon geometry and architecture were performed with two ultrasound scans. The same method was also used for fat thickness measurements for electromyographic signal normalisation. An average of the fat thickness was taken for further analysis.
- Analysis of maximal voluntary force was performed with torque dynamometers (Wise Technologies, Slovenia) adjusted for use on children of that age. Three tests were repeated and maximal performance further analysed.
- Analysis of the life style – questionnaire and half structured interview with the children and parents were additionally conducted.
- To get a holistic insight in children early motor development, the Movement ABC analysis (S., E., Henderson & D. A. Sugden, 1992), which identifies and evaluates the movement problems that can determine a child's motor efficiency and his social adjustment at school and to plan programmes for remediation and management was conducted.

All the measurements took place in the laboratory of the Institute for Kinesiology Research, Science and Research Centre of the University of Primorska, Slovenia, which is located in the Orthopedic Hospital Valdoltra, Slovenia.

Statistical analysis

Descriptive statistical analysis is presented with means and standard deviations. All tests were controlled for repeatability and performed in order to assure good validity. SPSS 17.0 (SPSS Inc., Chicago, USA) was used for statistical hypothesis testing. The Shapiro-Wilk test was used to test normality of the distribution and the logarithmic transformation was used if needed to assure data normality. Furthermore, ANOVA was used to compare the differences in the means of the data.

Results

Results obtained were arranged into a single database. So far, cross sectional analyses have been performed, while longitudinal analyses will be performed after longitudinal data collection and project completion (in 2012).

Anthropometry

There are statistically significant differences in muscle mass (P <0.001) and fat mass (P = .0002) between boys and girls, while body weight, body height and body mass index (BMI) do not differ significantly (table 2).

Table 2: Analysis of body weight, height and body composition.

	Boys	Girls	All	Sig.
N	52	55	107	
Body weight (kg)	18.5 ± 2.5	18.5 ± 2.7	18.5 ± 2.6	n.s.
Body height (cm)	107.5 ± 4.7	108.1 ± 4.3	107.8 ± 4.5	n.s.
Body mass index (kg/m^2)	16.0 ± 1.5	15.8 ± 1.5	15.9 ± 1.5	n.s.
Muscle mass (kg)	5.8 ± 0.8	5.1 ± 0.8	5.5 ± 0.9	*0.000*
Fat mass (%)	15.0 ± 2.8	16.7 ± 2.7	15.9 ± 2.9	*0.002*
Fat free mass (%)	85.0 ± 2.8	83.3 ± 2.7	84.1 ± 2.9	*0.002*
Overweight children (%)	17.3	18.2	17.7	

ns – non significant

Posture analysis

Discrepancy was found in the sagittal changes of body segments (Table 3). Statistical differences between the sexes were not found.

Table 3: Body posture parameters

	Boys	Girls	All	Sig.
N	42	48	90	
Translation in knee position (mm)	-25 ± 15	-26 ± 14	-26 ± 15	n.s.
Translation in hip position (mm)	12 ± 22	13 ± 19	13 ± 21	n.s.
Translation in shoulder position (mm)	-3 ± 22	-7 ± 22	-5 ± 22	n.s.
Translation in head position (mm)	10 ± 14	8 ± 19	9 ± 17	n.s.
Valgus/varus angle (°)	0.2 ± 3.2	-0.3 ± 3.1	0.0 ± 3.1	n.s.
Very flat feet (%)	8	10	9	
Flat feet (%)	29	11	20	

Clarke angle <32 degrees - very flat foot, 32 ≤ Clarke angle <42 degrees - flat foot; Clarke angle ≥ 42 degrees - a healthy foot. Sig. - Statistical significance, ns – non significant

Table 4: Analysis of self selected speed of walking and maximal speed of running.

	Boys	Girls	All	Sig.
N	41	45	86	
Walking (m/s)	1.1 ± 0.2	1.1 ± 0.1	1.1 ± 0.2	n.s.
Runing (m/s)	3.0 ± 0.4	2.9 ± 0.3	3.0 ± 0.3	n.s.

Sig. - Statistical significance, ns – non significant

Walking and running characteristics

This analysis was primarily done for the purpose of EMG measurement and no statistically significant differences were found between the sexes in the self selected speed of walking and maximal speed of running (Table 4). (Figure 1 – 2)

For psychological reasons, the acquisition of the EMG signals was only possible in 76 out of the 107 invited children. The results enabled us to precisely describe the average inter-muscular activation patterns. There were no statistically significant contra-lateral differences observed for any of the muscles (p>0.05). However, significant differences among muscles as well as between gait and run ($p<0.01$) were observed for variability measures of the single muscle EMG patterns.

Figure 1: EMG signal

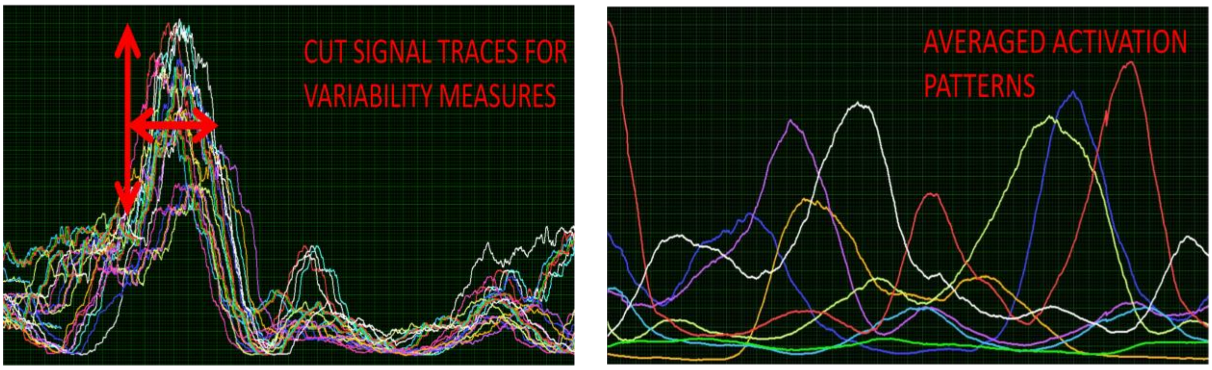


Figure 2: EMG measurement at various movements

There were no statistically significant contra-lateral differences observed for any of the muscles ($p>0.05$). However, significant differences among muscles as well as between gait and run ($p<0.01$) was observed for variability measures of the single muscle EMG patterns.

Crawling

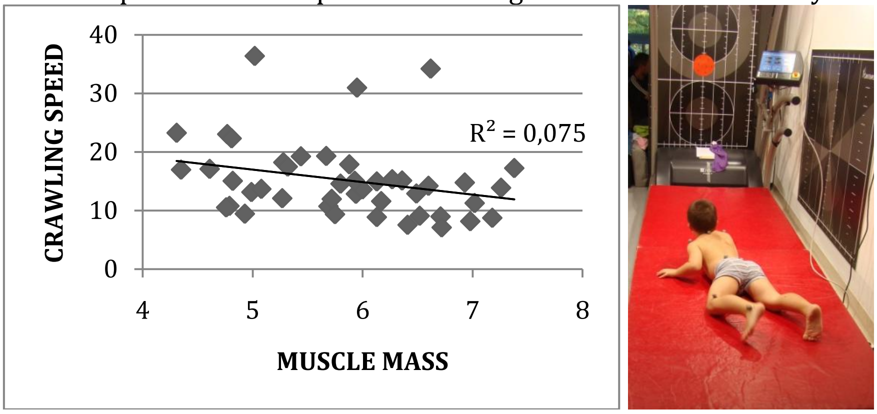
Table 5: Analysis of maximal speed and coordination of crawling

	Boys	Girls	All	Sig.
N	49	47	96	
Crawling time (sec)	15.1 ± 6.6	20.3 ±11.8	17.7 ± 9.9	*0.008*
Coordinated crawling %	57.5	55.1	55.8	

Sig. - Statistical significance, ns – non significant

Boys on average crawled faster than girls ($p<0.05$) (Table 5). A statistically significant relationship between the speed of crawling and muscle mass was observed (Figure 3). As determined from measurements of body composition, boys had statistically more muscle and less fat.

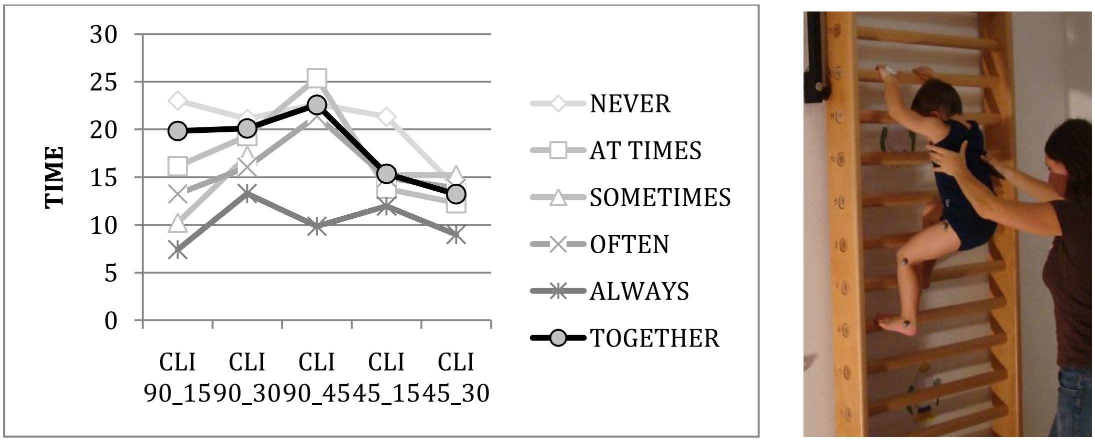
Figure 3: Relationship between the speed of crawling and muscle mass in boys



Climbing

Although there were no statistically significant gender differences in the speed of climbing, the results suggest that 4 year old boys are faster climbers, except in task climbing with angle 90° and the distance between bars 45 cm. We have also separated a climbing task into ascent and descent, but there was also no statistically significant differences in ascent/descent time of climbing between genders. For better insight into climbing efficiency we have strictly evaluated the different ways of climbing and we have found that motion coherence and coordination have a more important effect on performance and speed of climbing. The child's performance was evaluated with qualitative analysis of video snaps of climbing. In analysis we have included several climbing patterns like direction sight, way of holding bars and also patterns of diagonal skeletal muscle activation of upper and lower limbs (diagonal synergy and reciprocity within muscle activation) in climbing (Figure 4).

Figure 4: Relationship between the speed of climbing and pattern of diagonal skeletal muscle activation



CLI X Y cm – time of climbing (sec) in different angle 90° or 45° and distance between bars

From figure 4 we can comprehend the relation between the speed of climbing and the pattern of diagonal skeletal muscle activation, which is important for the accuracy of climbing. Children who climbed in a coordinated way and used the pattern of diagonal skeletal muscle activation (hands and legs – reciprocity and synergy) were the fastest climbers in all five tasks (see the bottom line in Figure 4). They strongly deviate from the average time of climbing.

Table 6: Correlation between the speed of climbing and body composition

CLIMBING		ASCENT					DESCENT				
		90_15	*90_30*	*90_45*	*45_15*	*45_30*	*90_15*	*90_30*	*90_45*	*45_15*	*45_30*
BOYS	BW		-.462**				-.302*	-.322*		-.369*	
	BH						-.313*	-.465**		-.375*	
	MM		-.543**				-.371*	-.387*		-.409**	-.329*
GIRLS	FM			.347*						.352*	.356*
	FFM			-.347*						-.352*	-.356*

BW – body weight, BH – body height, MM – muscle mass, FM – fat mass, FFM – fat free mass

Relationship of body composition variables with variables of speed of climbing shows significant differences between boys and girls. While with boys variables of climbing speed correlate importantly with body weight, height and muscle mass, with girls only fat mass and free fat mass have a correlation with climbing speed.

Jumping

The height of both performed counter-movement jumps (CMJ) (with hands action accompanied and without hands excluded from the actin, CNJ-H and CMJ-HE, respectively) of boys did not differ statistically from those of girls (Table 6). However, CMJ-H was significantly higher than CMJ-HE in more than half of the analyzed parameters. Time parameters were not significantly different between both types of the CMJ, while the differences in jump height, force impulses and power/energy parameters reached a statistically significant level (Table 7).

Table 6: Vertical counter-movement jump (CMJ) - with normal hands function and with hands fixed

	Boys	Girls	All	Sig.
N	50	47	97	
With hands action accompanied - H (cm)	9.1 ± 3.1	9.0 ± 2.6	9.0 ± 2.8	n.s.
Hands excluded from action – HE (cm)	10.3 ± 3.4	9.7 ± 2.8	10.0 ± 3.1	n.s.
Diff (%) = 100%·(H-HE)/HE	14.2 ± 18.1	8.9 ± 19.7	11.7 ± 18.5	n.s.

Table 7: Average standard deviations for all the analyzed parameters of the CMJ-HE and CMJ-HA.

PARAMETER	UNIT	CMJ-HE	CMJ-HA	*p* (t-test)
T	s	0.714 ± 0.267	0.684 ± 0.242	0.131
T^-	s	0.329 ± 0.140	0.315 ± 0.152	0.244
T^+	s	0.385 ± 0.172	0.369 ± 0.160	0.093
T_d	s	0.146 ± 0.094	0.137 ± 0.113	0.142
T_a	s	0.568 ± 0.211	0.547 ± 0.193	0.188
$T_{G=0}$	s	0.552 ± 0.237	0.523 ± 0.220	0.126
P_{max}	W/kg	33.3 ± 7.0	35.9 ± 7.3	0.000 **
W	J/kg	5.22 ± 2.03	5.65 ± 1.94	0.000 **
P_{50}	W/kg	0.647 ± 0.640	0.831 ± 0.687	0.004 *
G^-	-kgm/s	9.68 ± 4.50	10.7 ± 4.2	0.010 *
G^+	kgm/s	33.1 ± 8.7	35.5 ± 9.0	0.000 **
G_1	kgm/s	18.5 ± 6.3	21.4 ± 6.0	0.000 **
G_2	kgm/s	15.1 ± 6.8	14.6 ± 6.9	0.214
$G_{\%}$	%	101.7 ± 95.8	76.5 ± 55.1	0.000 *
H_G	m	0.084 ± 0.043	0.093 ± 0.041	0.000 **
H_{FT}	m	0.088 ± 0.027	0.099 ± 0.031	0.000 **
F_{max}	N	21.4 ± 3.18	22.2 ± 3.2	0.002 *

T- time between T0 and T2; T- time between T0 and T1; T-time between T1 and T2; Td duration of deceleration; Ta -duration of acceleration; TG=0- time between T0 and T1/2; Fmax - body weight normalized maximal force; Pmax - body weight normalized maximal power output; W - body weight normalized common energy; P50 - start power in he initial 50 ms from the T1 on; G - force impulse for the T0-T1 time sequence; G+ - force impulse for the T1-T2 time sequence; G1 - force impulse for the T1-T1/2 time sequence; G2 - force impulse for the T1/2-T1 time sequence; G% - ratio between G2 and G1 (G% = G2 / G1); HG - jump height calculated from the force impulse; HFT - jump height calculated from the flight time (T2-T3); Values of t-test statistical significance are highlighted with * (p < 0.05) and ** (p < 0.001), respectively.

The correlations between static strength tests and CMJ-H parameters were additionally checked (Table 8).

Table 8: Pearson correlation coefficients between static strength tests and CMJ-HA parameters

	T	T^-	T^+	T_d	T_a	$T_{G=0}$	P_{max}	W	P_{50}	G^-	G^+	G_1	G_2	$G_{\%}$	H_G	H_{FT}	F_{max}
KE	-0.257	-0.136	-0.258	-0.250	-0.175	-0.264	0.208	0.081	0.127	-0.309	0.146	0.304	-0.102	-0.186	-0.010	0.063	0.148
KF	-0.071	0.078	-0.182	-0.199	0.027	-0.073	0.235	0.148	0.059	-0.142	0.185	0.280	-0.032	-0.162	0.164	0.103	0.106
AF	-0.240	-0.062	-0.304	-0.285	-0.134	-0.230	0.453	0.120	0.268	-0.231	0.263	0.339	0.010	-0.094	0.244	0.344	0.359
EF	-0.045	0.133	-0.194	-0.215	0.069	-0.047	0.185	0.110	0.176	-0.004	0.020	0.169	-0.132	-0.094	0.152	0.141	0.163
HG	0.138	0.315	-0.092	-0.175	0.274	0.142	0.241	0.164	0.005	0.084	0.193	0.157	0.093	-0.004	0.302	0.279	0.097

Knee extension (KE), knee flexion (KF), ankle plantar flexion (AF), elbow flexion (EF),hand grip force (HG); Statistically significant values are underlined (p < 0.05).

Less than half of comparisons reached the level of statistical significance. G1 and Pmax were significantly correlated with all the leg strength tests (P max also with HG).

Analysis of the quantity and intensity of physical activity

An accelerometer (Actigraph) was used to obtain the data on quantity and intensity of physical activity in both children and their parents. The data are in the process of evaluation.

Analysis of the selected children and their parents life style

The parents of all 107 children that participated in the survey were invited to participate in semi-structured interviews. The response of 67 parents was obtained, so 61 interviews were conducted between April and mid July, 2010. An expanded questionnaire containing questions that were part of the semi-structured interviews was sent to the parents that did not participate in the semi-structured interviews. 17 questionnaires out of 40 were returned. Thus, the parents' respond rate was 72% (61 plus 17 = 78).

Additional information about the parents and children's living environments and lifestyles in general, family and surroundings - with an emphasis on children's motor features (such as basic demographic information about the family, the amount of physical activity, information about the living environment, family, the attitudes and behaviour of parents in establishing a healthy lifestyle) – were obtained. The data are still in evaluation. They will provide the comparison between characteristics of lifestyle and regularity or irregularity of measured FMP, motor abilities, body posture and body structure. Similar research has not yet been described in the literature.

Movement ABC

The data from the Movement ABC analysis are still in evaluation. They will provide the qualitative analysis of included motor skills and comparison between physiological and biomechanical analysis of FMP and ABC movement.

Discussion

The preliminary results of the first year of the basic research project “Analysis of fundamental motor patterns - skeletal and muscular adaptation to specific sedentary lifestyle factors in children aged 4 – 7 years” are presented in the paper. The aim of the study was to evaluate and enrich our understanding of basic motor skills – motor patterns in early infancy, and the influence of life style and its peculiarities on early child motor development. Beside the specific dimensions of the regulation and performance of the selected FMP we tried to define children’s morphological characteristics and body posture.

As with adults, excess weight and obesity are growing problems in the world for children and adolescents (Kalies et all., 2002; Petersen et all., 2002; Stomatakis et all., 2005). While in our study 17.3% of boys and 18.2% of girls were overweight, research findings shows that in 1970 this number was as low as 5 to 7% (Ogden et all., 1997). Despite the fact that an incorrect posture can be a source of many problems (e.g., lower back pain) already present in the period of the early childhood (Taimen et al., 1997) and often transferred into adulthood (Harreby et al., 1996), there are not many quantitative analyses which would have been carried out on the population of young children. In our study we detected 15% of children with knee valgus and 18% of knee varus; analyzing the regularity of feet we found 9% of children with very flat feet and 20% of children with flat feet, which amounts to a total 29% of children with flat feet. Fourty percent of measured subjects displayed irregularity (pronation or supination) of the ankle. We found that children we studied fit the expected pattern, or number of deviations, regarding irregularities in the knee joint, the axis of the hip joint, the axis of the shoulder joint, and head position. Our data are comparable with other data the data of previous studies (Lafond, 2007).

Following the aims of the study we deepened our research interest in addition into the space of FMP, starting with gait and running, and their roles and influence in early child motor development. Considering findings of previous research we can summarize that changes in kinematic, dynamic, and EMG parameters of gait in children of ages 3 to 4 correspond more to walking speed as children age (Chester et all., 2006; Ganley & Powers, 2005; Granata et all., 2005; Kram et all., 1997; Schwartz et all., 2008; Stansfield et all., 2001). As no statistically significant differences were found between sexes in the speed of walking and running in our study and considering the fact that the time parameters of muscle activation are slightly correlated with age, height, weight, BMI, speed and length of the children’s step (Chang et al., 2007) we would like to focus our future research on analyzing differences in variability of the amplitude or. dispersion of the EMG-signal (Granata et al., 2005) and any possible relationship to the coherence of performing selected FMP. In the longitudinal study we expect also to obtain some important data about periods of incidence of changes in variability of the amplitude of the EMG-signal (when diminished), about functional symmetry of variability of the amplitude of the EMG-signal and about reasons related to those differences.

Boys on average crawl faster and they have statistically more muscle mass and less fat (in our study other morphological characteristics were not statistically significant). Body dimensions influence the time when babies start to crawl and walk. Infants who were smaller and lighter (and probably with more muscle mass and less lean body mass) started to crawl and walk earlier (Adolph et all., 1998).

But the consistency of lower and upper limbs, arms and legs plays an important role in the realization and timing of crawling. Crawling is phylogenetically conditioned with a diagonal skeletal muscle activation pattern of major lower and upper limb extensors and flexor muscular chains. As we note that there are only 55.8 % of measured children that perform coordinated crawling in our study we can conclude that this motor task, for the child in an early stage of development, is very difficult. On the other hand we need to be aware of the importance of crawling, particularly from the aspect of the correct development of the lumbar part of the spine and correct placement of the pelvis, which enables its later stabilization in walking as well as in running.

The results of climbing suggest that boys in general are faster climbers than girls. While at the boys variables of climbing speed significantly correlate with body weight, height and muscle mass, there is only fat mass and free fat mass that has a correlation with climbing speed in girls.

For better insight in climbing efficiency we have strictly evaluated the different ways of climbing and we have found that motion coherence, coordination and use of the pattern of diagonal skeletal muscle activation, have an important effect on performance and speed of climbing. It is a motor pattern where children have to pick precise supporting points, use of their strength while still holding a balanced position. Although there is a frequent occurrence of injuries in climbing (Herrewegen et al., 2004) no study of the role, significance and analysis of climbing were conducted so far.

In early childhood, jumping with hands involvement is undoubtedly easier and more natural than with hands excluded from action (Miyazaki & Kuchiki, 1984; Neelly & Zebas, 2002; Šarabon et all, 2010), even if the inter-segmental jumping coordination is not optimal yet. Results of our study showed statistically significant differences in some, but not all the ground reaction force parameters when comparing cmj with and without hands involvement. it all seems that at this age neuro-muscular and inter-segmental coordination are probably of key importance, while the strength plays only a supportive role. Moreover, additional correlation analysis between static strength tests and vertical jump parameters reveals the obviously key role of the other factors such as coordination, morphology, etc. However some previous studies on preschool children (Rose et al., 2009), adolescents, and adults (Nuzzo et al., 2008; Peterson et al., 2006) reported statistically significant positive correlations between static strength and jump-related parameters, less than half of comparisons between CMJ related parameters reached the level of statistical significance in our study.

Objective analysis of the quantity and intensity of physical activity (accelerometers), motor patterns (ABC movement) and habits was an important part of the study as well as analysis of children and their parent’s life style (questionnaires, interviews). We obtained several important data which provide us the possibility of comparison between characteristics of life style and regularity or irregularity of measured FMP, motor abilities, body posture and body composition. This holistic approach in organizing such studies on children has not been described in the literature, yet. On the other side early child motor development was interpreted mainly through the framework of motor space structure studies and suggested dimensions mostly related to the factors that influence movement coordination (Pišot, R. & Planinšec, J., 2005). In the present study, after we finished with the first measurements and where analyses based on the physiological and biomechanical measurements, the results guide us to the similar conclusions. Coordination, inter-muscular, intra-muscular and inter-segmental coordination, is probably of primary importance in the performance of FMP at this age.

After our longitudinal study will be completed, we can expect to derive a much broader understanding of the processes in early child motor development. Only with holistic approach and comprehensive insight into the child's motor development and his way of living, we can expect sufficient data to suggest certain conclusions and propose intervention and adequate measures. And the better insight we have into children and their special characteristics and needs, the more positive development stimuli can be provided by assuring needed activity and friendly environment.

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INFLUENCE OF COMPETENT PE TEACHING ON PHYSICAL FITNESS OF CHILDREN – A 3-YEAR STUDY

Gregor Starc & Janko Strel

Abstract

The paper investigates whether the existing PE curriculum, delivered by specialist PE teachers with higher PE teaching competencies than generalist teacher, contributes to the improvement of children's physical fitness. For this purpose we gathered data from classes of 33 primary schools (experimental) where specialist PE teachers started teaching in second year and continued teaching in third year while in the first year PE was still delivered by generalist teachers only. We than paired each experimental class with a control class from the neighbouring school (taught all three years only by generalist teachers), to exclude as many environmental factors as possible. The sample thus consisted of 66 primary-school classes with 950 children in experimental and 994 children in control group. We used the SLOfit database to extract data of 8 motor tests (arm plate tapping, standing long jump, polygon backwards, sit-ups, forward bend touch on the bench, bent arm hang, 60 m run and 600 m run) and 3 anthropometric measurements (height, weight and triceps skinfold thickness) for every included child in the first, second and third year of schooling. Since this was a cluster-randomised quasi-experiment we used the Linear Mixed Model procedure (PASW 18 for Mac) to test the influence of specialist PE teacher teaching on the physical fitness of children by excluding gender and age and using school as a random effect. Physical fitness index (PFI) was calculated as a mean of all motor tests' mean z-scores, and body mass index (BMI) was calculated from body weight and height. The results showed that children in experimental group significantly improved their PFI in comparison with the children from control group while BMI was not affected. This proves that more competent delivery of PE curriculum positively influences children's motor development while it has a non-significant influence on their physical development. This shows that PE teachers' involvement improves the quality of PE curriculum delivery but that the curriculum itself lacks focus on the problems of obesity and this is why any change in BMI is a non-intentional coincidental byproduct.

Introduction

Obesity, poor physical fitness of children and their causal dependency are associated with many preventable diseases and present a serious contemporary and future public health problem. Regular and quality physical activity during childhood is one part of the equation (quality nutrition being the other) which can lead to improvements in numerous physiological and morphological variables in children (Owen, et al., 2010). A considerable part of children's physical activity, is today allocated to regular physical education (PE) classes in schools, which are all too frequently delivered by a generalist classroom teacher without appropriate PE teaching competences (DeCorby, Halas, Dixon, Wintrup, & Janzen, 2005; Hardman, 2007, 2008; Janzen, et al., 2003; P. Morgan & Hansen, 2007; P. J. Morgan & Hansen, 2008; Sallis, et al., 1997). This is especially problematic in the first years of school when children experience negative trends of physical fitness, which includes growth of obesity and diminishing of motor skills and functional abilities. The existing evidence suggests that activities for children have to be organised to be effective since summer holidays seem to be counterproductive (Christodoulos, Flouris, & Tokmakidis, 2006; Mitsui, Barajima, Kanachi, & Shimaoka, 2010) and since there seem to be no difference between obese and non-obese children in unorganised leisure-time activities (Graf, et al., 2004). This confirms the idea that school could be one of the most appropriate environments for the successful intervention against the health problems, related to physical inactivity and obesity. Often the authorities try to improve the negative trends by special intervention programmes in schools but such programmes usually fail to produce any considerable positive long-term effects.(Harris, Kuramoto, Schulzer, & Retallack, 2009) The interventions usually include the allocation of additional time to physical education,(Datar & Sturm, 2004; Donnelly, et al., 2009; Sollerhed & Ejlertsson, 2008) specially designed afterschool programmes,(Martinez Vizcaino, et al., 2008; Salcedo Aguilar, et al., 2010) or achanged design of PE delivery (Kain, et al., 2008). However, this brings along the demand for additional temporal, spacial, human and economic resources. We, therefore, tried to test, if there are possible alternative solutions, which can improve the situation within the educational system, without expensive external interventions or special intervention programmes and with the already existing human resources in schools.

Methods

In Slovenia specialist PE teachers are allowed to teach PE already in the first years of primary school, but this is considered as super-standard programme, demanding additional funding from parents or/and local communities, and the consent of the school board. If the school decides to have the PE specialist teacher teaching already in the first triennia, the classroom teacher has to be present in the class during these lessons. This gives us the opportunity to compare physical fitness of the minority of Slovenian children whose PE classes in the first years of school are delivered by specialist PE teachers and of the majority of children, who are taught only by generalist teachers. We were able to test whether the existing PE curriculum, delivered by specialist PE teachers with higher PE teaching competencies than generalist teacher, contributes to the improvement of children's physical fitness.

Subjects

With the use of questionnaire we gathered data from classes of 33 primary schools (experimental) where specialist PE teachers started teaching in second year and continued teaching in third year, while in the first year PE was still delivered by generalist teachers only. We than paired each experimental class with a control class from the neighbouring school (taught all three years only by generalist teachers), to exclude as many environmental factors as possible. The sample thus consisted of 66 primary-school classes with 950 children in experimental and 994 children in control group.

Instruments

We used the SLOfit database to extract data of 8 motor tests (arm plate tapping – APT, standing long jump – SLJ, polygon backwards – PB, sit-ups – SU, standing reach touch – SRT, bent arm hang – BAH, 60 m run – 60m and 600 m run – 600m) and 3 anthropometric measurements (height – BH, weight – BW and triceps skinfold thickness – TSF) for every included child in the first, second and third year of schooling.

Data analysis

Baseline comparability of physical fitness between experimental and control groups was assessed using One-way ANOVA.

Since this was a cluster-randomised quasi-experiment we used the Linear Mixed Model procedure (PASW 18 for Mac) to test the influence of specialist PE teacher teaching on the physical fitness of children by excluding gender and age and using school as a random effect. Physical fitness index (PFI) was calculated as a mean of all motor tests' mean z-scores, and body mass index (BMI) was calculated from body weight and height.

Linear Mixed Models were used to test for dependent variable PE teachers' teaching effect (PTE) with independent variables. The latter consisted of two main primary outcome variables physical fitness index (PFI) and body mass index z-score (BMI), and secondary outcome variables - z-scores of individual motor tests in third grade (PB, SLJ, HPT, 60M, 600M, BAH, FB, SU). All dependent variables were treated as primary outcome variables while PE teachers' teaching effect and age in months were treated also as random effects. Preliminary tests to identify possible effects of gender and school grade on primary and secondary variables were not performed since they were calculated from means of motor tests' z-scores according to school grade and gender. Several models and unstructured covariance matrix were tested separately for each dependent variable to find the best-fit model.

Results

Baseline comparability of physical fitness showed that there were no significant differences in PFI, F (1, 1939) = 2.79, p = .095, but there were significant differences in BMI between control and experimental group, F (1, 1939) = 4.29, p = .038 whereas intervention group had significantly higher baseline BMI.

The results of Linear Mixed Model showed that children in experimental group significantly improved their PFI in comparison with the children from control group while BMI was not affected. Significant improvement was observed also in SRT, SLJ and 60m (Table 1).

Table 1: Measurements of anthropometric and motor tests at baseline and follow-ups

	Baseline		Follow-up 1		Follow-up 2						
	Control (n = 948)	Intervention (n = 993)	Control (n = 948)	Intervention (n = 993)	Control (n = 948)	Intervention (n = 993)	Mean baseline difference	Mean difference at follow-up 1	Mean difference at follow-up 2	95% CI	P
PFI (z-score)	-0,02	0,02	-0,04	0,06	-0,04	0,05	0,05	0,10	0,09	-0.07 (-0.12, 0.02)	0.006
BMI (kg/m2)	16,05	16,24	16,90	16,94	16,83	16,92	0,19	0,03	0,09	-0.05 (-0.03, 0.13)	0.242
TSF (mm)	10,63	10,53	11,64	11,73	11,50	11,56	-0,10	0,10	0,06	0.02 (-0.06, 0.10)	0.624
BW (kg)	251	254,95	288,26	289,72	288,30	290,72	3,46	1,47	2,43	-0.03 (-0.12, 0.05)	0.451
BH (cm)	1248,53	1249,50	1301,98	1303,75	1302,72	1304,83	0,96	1,77	2,11	-0.04 (-0.13, 0.05)	0.368
APT (rep/20s)	22,46	22,61	25,92	25,94	25,78	25,83	0,14	0,02	0,05	-0.03 (-0.11, 0.04)	0.351
SU (rep/60s)	26,24	25,56	30,57	31,28	30,42	30,63	-0,68	0,71	0,21	-0.02 (-0.09, 0.05)	0.619
SRT (cm)	42,59	43,55	43,07	44,03	42,78	44,04	0,97	0,96	1,26	-0.22 (-0.29, -0.14)	<0,001
SLJ (cm)	117,97	120,69	128,60	133,34	128,18	132,13	2,72	4,74	3,95	-0,20 (-0.27, -0.13)	<0,001
BAH (s)	21,51	21,80	26,09	27,99	25,99	26,84	0,29	1,90	0,85	-0.02 (-0.09, 0.06)	0.606
PB (s)	22,04	22,51	18,02	17,82	18,83	18,83	0,47	-0,19	0,00	-0.01 (-0.07, 0.07)	0.883
600m (s)	207,69	206,56	191,47	194,08	194,26	194,19	-1,13	2,61	-0,07	-0.05 (-0.13, 0.03)	0.20
60m (s)	13,26	13,10	12,47	12,28	12,55	12,36	-0,16	-0,19	-0,19	-0.15 (-0.23, -0.08)	<0,001

The results in Table 1 show that the difference in most motor tests between children from experimental and control group increased in favour of experimental group at the first and the second follow-up. It is evident that children in experimental group significantly improved relative explosive power (measured by SLJ and 60m) and relative flexibility (SRT) in comparison to control group, while the changes (although exisiting and positive) in relative coordination, abdominal strength, shoulder-griddle strength and endurance were not significant.

Discussion and conclusion

The results prove that more competent delivery of PE curriculum by PE specialist teachers positively influences children's physical fitness while it has a non-significant influence on their physical development. Although the results of this study do not support the idea that higher quality of implementation of PE classes could effectively influence the prevention of obesity, the analysis of the Slovenian PE curriculum contents would reveal that the existing curriculum does not target the prevention of obesity but it does target the development of motor skills and physical fitness. This means that PE teachers' involvement actually improves the quality of PE curriculum delivery but that the curriculum itself lacks focus on the problems of obesity and this is why any change in BMI due to school PE is a non-intentional coincidental byproduct of targeted motor development.

Although there is skepticism about school PE classes being the appropriate environment for obesity prevention there is also evidence that school-based interventions can work if they are appropriately implemented and delivered by qualified professionals (Kriemler, et al., 2010). It is unrealistic to expect from school PE to be the key factor in the prevention of children obesity and PE should not take up the responsibility for that, however, some more curricular attention should be given to the prevention of obesity, along with a coordinated effort of different institutions and communities. The research shows the value and effectiveness of PE specialist teaching in the first years of schooling and the evidence clearly indicates that higher professional competencies are reflected in more favourable children's physical and motor development. The school authorities should, therefore, consider introducing specialist PE teacher from the first grade of primary school onwards as a standard and not only as super-standard.

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HIGH-TECH IN YOUTH SPORT: RTK GNSS MEASUREMENTS IN ALPINE SKIING

Matej Supej

Abstract

In practice of "youth sport" it is usually considered that high-tech measurements and analysis are not necessary or even not desired to be used. However, nowadays children are grown up using different types advanced devices. The purpose of this study was to use high-end GNSS measurements and analysis to help young alpine skiers to improve their racing performance. Nine skiers, members of the regional team (age: 16-18y) participated in the study. Two independent test trials were performed. In both trials a giant slalom course setup of 19 gates was set on a glacier on the same slope during autumn pre-season preparation period. In the first trial (day-1), each of the participants was recorded with a high end GNSS RTK system. For each skier velocity, energy dissipation and gate to gate times were calculated and compared. The data obtained from the GNSS was synchronized with video recordings for easier analysis and the overall time was measured using a Microgate starting gate, a set of Polyfemo photocells, and Racetime 2 chronometer with a resolution of $1.25 \cdot 10^{-4}$ s. After day-1, the skiers have received an extensive video and data feedback of their performance. In the second trial (day-2) the skiers were video recorded and measured as regards their overall time using the Microgate system. The time differences among nine skiers from the day-1 to the day-2 decreased from approximately 1.9 s (the fastest compared to the slowest) in an approximately 35 second long gate setup to approximately 1 s in the day-2.

Introduction

Alpine ski racing is one of the most complex top level sports. Many factors such as physical training, motor ability, nutrition, psychological preparation, appropriate racing equipment including its preparation and tuning, snow and terrain properties, weather conditions (temperature, visibility, humidity, wind etc.), technical skills, tactical abilities to the course set up and terrain/snow properties etc. are of great importance in winning a race. Furthermore, carving skis came along to World Cup racing (Specifications for competition equipment 2002/2003, 2002) and it is scientifically proven that carving technique is far different then the classical "side skidding" technique (Howe, 1983; Kugovnik, Nemec, & Supej, 2000; Raschner, Zallinger, Hofer, Brunner, & Müller, 2001; Supej, Kugovnik, & Nemec, 2002; Mueller, Schiefermuller, Kroll, & Schwameder, 2005 etc.). Nowadays, the racers during WC races are performing carving and pivoting (side skidding) turns (Supej & Kugovnik, 2002; Supej, Kugovnik, & Nemec, 2005). And it is already known that two different techniques single motion and double motion (Supej et al., 2002) are not equally fast when performing pivoting or carved turns (Supej, 2004). Normally it is more beneficial to use the double motion technique in pivoting turns and single motion technique in carving turns.

Therefore the technical skills and tactical abilities are getting more and more important. But if you want to be good in tactics it is not enough to be excellent only in the technique which is utmost important, but in all listed factors above. In order to analyze some of these questions and to find out the relations among techniques and tactics high tech measurements are required.

However, in practice of "youth sport" it is usually considered that high-tech measurements and analysis are not necessary or even not desired to be used. Nowadays children are grown up using different types of considerable high-tech equipment starting with smart mobile phones and personal computers enabling advanced 3D or even virtual reality video games. As alpine skiing is a complex sport in outdoor environment with high technical demands different types of mechanical measurements and analysis have been used on elite skiers in the past. The purpose of this study was to use high-end GNSS measurements and analysis to help young alpine skiers to improve their racing performance.

Methods

Nine skiers, members of the regional team (age: 16-18y) participated in the study. Procedures were explained in detail prior to participants signing a written informed consent. All procedures were approved by the Ethical Committee of the Faculty of Sport in Ljubljana, Slovenia and the study was conducted according to the Declaration of Helsinki.

Two independent test trials were performed. In both trials a giant slalom course setup of 19 gates was set on a glacier on the same slope during autumn pre-season preparation period. The slope had various slope inclinations as well as transitions from flat to steep slope and vice versa.

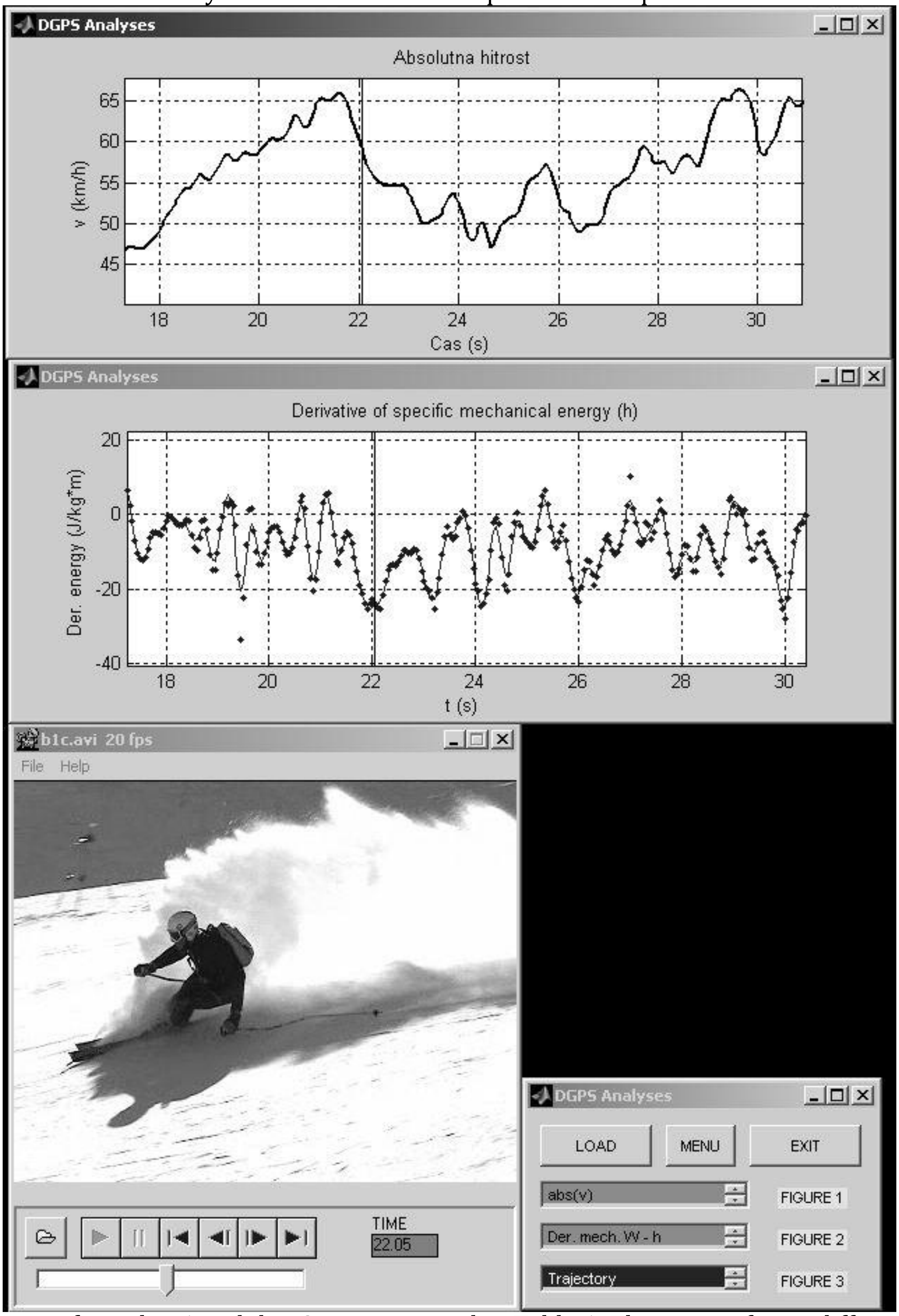
In the first trial (day-1), each of the participants was recorded with a high end GNSS RTK system. The rover and reference station for the GNSS system consisted of 1) Leica GX1230 GG, 72 channel, dual frequency L1/L2 receivers, 2) Leica AX1202 GG survey antennas and 3) Leica GFU14 Satelline 3AS radio modems (Leica Geosystems AG, Heerbrugg, Switzerland). The system simultaneously receives signals from both the United States' and Russian global navigation systems (GPS and GLONASS) and surveys positions with 1 cm + 1 ppm and 2 cm + 1 ppm horizontal and vertical accuracy respectively, at a 20 Hz sampling rate in the real time kinematics (RTK) mode (99.99% position accuracy reliability) (Takac et al. 2005). During the measurements the reference station stood on a fixed tripod < 300 m from all surveyed points to assure maximum accuracy. The rover was stacked into a specially designed small backpack carried by the skiers (total weight ~ 1.64 kg). The antenna was positioned at the height of the skier's upper back (level Th2-Th4) to ensure minimum disturbance to the skiers and good visibility of the sensor to the satellites. The receiver and modem (the heavier part of the system) were positioned in the lowest part of the backpack, slightly above the waist. Only the antenna (the lighter and smaller part of the system) was stationed on the upper back. To survey the terrain properties and all the ski gates the GNSS antenna was attached to a 2 m long carbon geodetic pole with onboard inclinometer (Leica Geosystems AG, Heerbrugg, Switzerland). To minimize errors from the GNSS measurements the giant slalom course was chosen to be in "open" terrain without adjacent forest and on a hig altitude on the glacier. All tests were carried out between 8:30 AM and 11.30 PM. This time frame had the highest satellite availability and resulted in 9-16 visible satellites above the 15° azimuth angle during all measurements. During the runs the skiers were filmed continuously with one camcorder (JVC GR-DV4000E). Before each measurement the satellite availability, GDOP (Geometric Dilution of Precision) value and position error were verified. The GNSS system and the video were time synchronized by an isolated rapid vertical squat movement prior to each measurement.

For each skier 1) absolute velocity, 2) energy dissipation, i.e. differential specific mechanical energy (Supej, 2008; Supej & Holmberg 2010), which , and gate to gate times were calculated and compared. The data obtained from the GNSS was synchronized with video recordings for easier analysis using a custom build application DGPSana. The overall time was measured using a Microgate starting gate, a set of Polyfemo photocells, and Racetime 2 chronometer with a resolution of $1.25 \cdot 10^{-4}$ s. After day-1, the skiers have received an extensive video and data feedback of their performance. In the second trial (day-2) the skiers were video recorded and measured as regards their overall time using the Microgate system.

Results

Figure 1 demonstrates DGPSana computer application, which was used to provide data analysis and feedback to skiers after day-1. The absolute velocity and energy dissipation diagrams magnified to a short section along the giant slalom course are synchronized with the video recording. The skier is in the section before the transition from a flat to the steep slope. Tactically, the skier decreased his velocity and consequently the energy dissipation was high (highly negative differential specific mechanical energy values). Comparing to other skiers, his decrease of velocity was too high and as a result his performance in the following two gates was rather poor with high time loses.

Figure 1: Absolute velocity and energy dissipation (differential specific mechanical energy) synchronized with an adequate video clip.



Overall times from day-1 and day-2 are presented in Table 1. The range of time differences among the nine skiers from Day 1 to Day 2 decreased from approximately 1.9 s (the fastest compared to the slowest) in an approximately 35-second long gate setup to approximately 1 s in Day 2. Obvious technique and tactics improvements were observed from Day 1 to Day 2 using recorded video clips.

Table 1:Overall times for nine skiers in Day 1 and Day 2

	Overall time (s)	
Skier	Day 1	Day 2
1	32.954	34.409
2	33.294	34.43
3	33.451	34.667
4	33.709	34.951
5	33.999	34.589
6	34.316	34.950
7	34.452	35.407
8	34.564	34.798
9	34.848	35.041

Discussion

During the experiment the young skiers were very well focused on their tasks and interested in the measurement as well as technology. The results demonstrated that high-tech in youth sport can significantly help to improve their performance. The reasons for the overnight improvements can be explained with detailed information on 1) exactly where the skier is losing or winning time provided by gate to gate times, 2) absolute velocity and/or energy dissipation (differential specific mechanical energy) in each point of observation along the course synchronized with the video recording for easier understanding and analysis. Furthermore, it was observed that the skiers before the experiment did not believe the coaches' advices, until they have observed the irrefutable difference shown with this high-precision technology. In conclusion, such technologies can significantly accelerate the learning process and provide more cconfidence in coaches advices.

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SHOULD ENHANCEMENT OF TRAINING CHARACTERISTICS PRECEED OR FOLLOW TRAINING ADAPTATIONS?

Anton Ušaj

Abstract

Theory of training suggests that training should enhance its characteristics at the moment when adaptations occur. Therefore, the enhancement of training characteristics should follow training adaptations. The alternative hypothesis may also be constructed: the enhancement of training characteristics should precede training adaptations to influence even greater and quick adaptations. For testing presented hypothesis, which contradict the theory, certain conditions were analyzed: a) The athlete level of his adaptations**.** Those who already reach the limit of their adaptations should try to increase training without adaptations and waiting following for possible effects. The danger of accumulation of fatigue, or overreaching is presented. Differently, athletes who still enhance their performance can follow theoretical suggestion. Additionally, also alternative hypothesis may be incorporated in the system. b) Enhancement of single training characteristics. During maximal exercise of short duration the athlete can repeat similar exercise again, after 5-7 minutes of recovery, this permit him to enhance duration of training stimulus by repetitions. Therefore, training can be enhanced before adaptations occur. Theoretical background should be respected, during maximal exercise of long duration. During sub maximal exercise, there are different variations, how to enhanced training characteristics before reaching training adaptations by using interval training. c) The increase of a series of training units during certain training periods (mezocycles) can be applied without accompanied significant adaptation. Coaches already practice such work during planning training throughout whole competition season. They make plans on the basis of calendar characteristics, without any relationship with possible adaptations. The manipulation with training characteristics in sport regularly precedes training adaptations. This is in contradiction with theoretical background, which suggests that training enhancement should follow training adaptations. This suggests that a certain part of training theory should be rearranged.

Introduction

The training theory suggests that training should enhance its characteristics in according to reached training adaptations (Bompa, 2004; Gordon, 2009; Ušaj, 2003). The theory therefore suggests that regular testing of each athlete performance should be realized (Ušaj, 2003). This makes possible that the moment of adaptation can be detected with relatively small delay during training process.

There were no significant adaptations during training of top level athletes and those who already reached saturation in development of their performance or competition results. A question arises how the presented training theory should be applied in training process of these subjects

Training of athletes, who significantly enhance their performance, influenced significant adaptations. Therefore, presented theoretical concept can be applied in the training process. In spite of that, the question arises: Whether this concept is the only successful? Especially training of youth athletes, who are specific according to their intense maturation, should be carefully planned by coaches.

Theory of training uses the relationship between training dose, representing by training characteristics and training stimulus, which is representing by changes in organism and its response. The same training dose is adequate until the adaptation occur. Following, the stimulus starts to reduce because of already reached adaptation. The training dose will not be appropriate any more. It should enhance. Because training is generally not maximal, it may be interesting to know what happens if enhancement of training dose occur before adaptation. The hypothesis we were tested was followed. If the adaptability of the athlete´s organism is preserved, then the organism will adapted earlier and/or with larger enhancement. Therefore, the training which precedes adaptation will cause earlier adaptations. If adaptability of organism is not preserved, then fatigue accumulates and continues to overtraining. The aim of this paper is therefore to representing possible reasons for using one or another strategy and explains possible mechanisms of adaptation, by using theoretical approach.

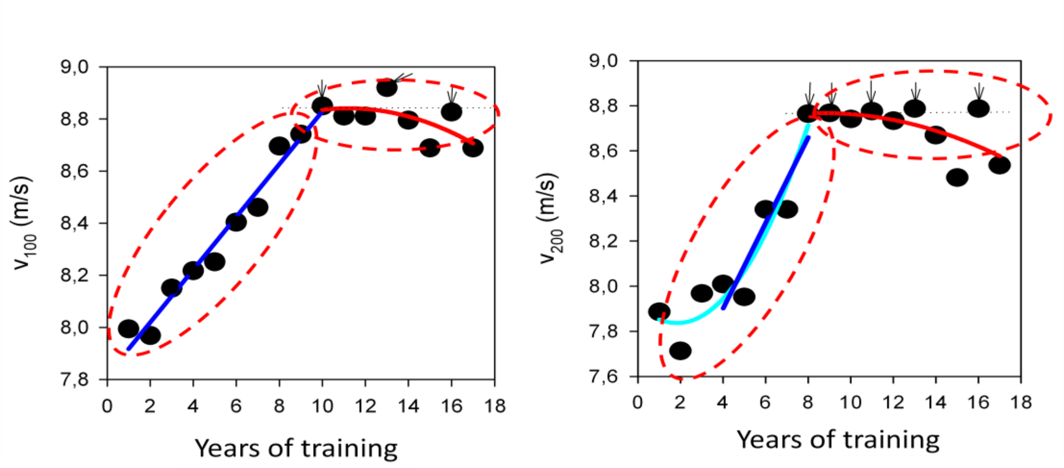
Testing the hypothesis by performance level of an athlete

Athlete who already reach the plateau in development of sport results (sports where competition results are measuring objectively by exact measurements) are accompanied by small or practically none adaptations. The top level athletes represent the highest level of such population. If presented training theory will be applied to their training, then training dose should be the same, because no adaptation is occur. If observed alternative hypothesis will be applied in such system, then training stimulus will enhances without previous adaptation. The organism will react by larger changes of homeostasis. If certain level of plasticity will still be presented, then organism will further adapts. Athletes often changes training system in such situations, or even coaches for reaching changes in their training system. However, there is also another possibility. If plasticity of adaptation is not available any more, then fatigue accumulated and overtraining occurs.

Athlete, who regularly enhances his performance and sport results, can realize both: the presented training theory and the alternate hypothesis. The adaptability of organism is still preserved. Even a certain reserve may be assessed. When the training theory is realized, then the athlete can adapt to training with a certain delay, which occur because of the difference in time interval, when the adaptation occur, when it is detected by testing, and the moment when training characteristics were enhanced. Therefore, the testing frequency should be appropriate.

Youth athlete should probably follow the training theory. This preserves its adaptation reserve, which may be used for their maturation and other activities (school, hobby,). The main goal of training should be in enhancement of performance without overtraining.

Figure 1: The specific adaptation of a female sprinter, who increase her running velocity less steep on 100m than on 200m

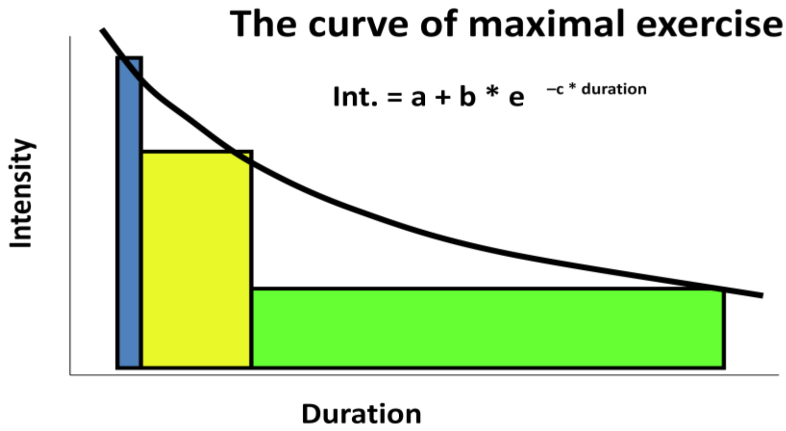


It can be assumed that the same training differently influences two similar performances. The training adaptations were adequate for 100 m competition, but not for the 200 m during first 4 years of her career. After that, training was adequate for both distances. During the last period of her career as a high level sprinter, the applied training was not longer "adequate" for each of both distances.

Testing the hypothesis by using characteristics of the single training

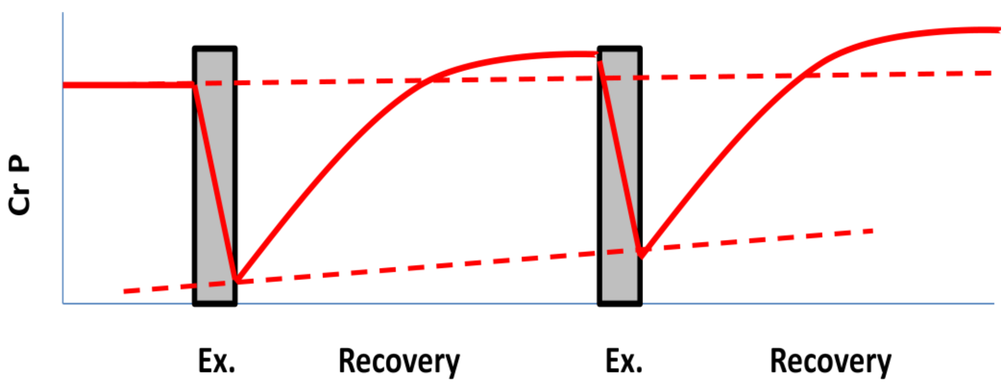
The single training consisted of training dose, which is represented by the exercise, its duration (distance, number of repetitions) and by its intensity (velocity, power, force, etc.) (Ušaj, 2003). According to these characteristics it can be maximal or sub maximal. The basic relationship between intensity and duration at maximal exercises is characteristically (Figure 2).

Figure 2: A hypothetical relationship between exercise intensity and it´s duration



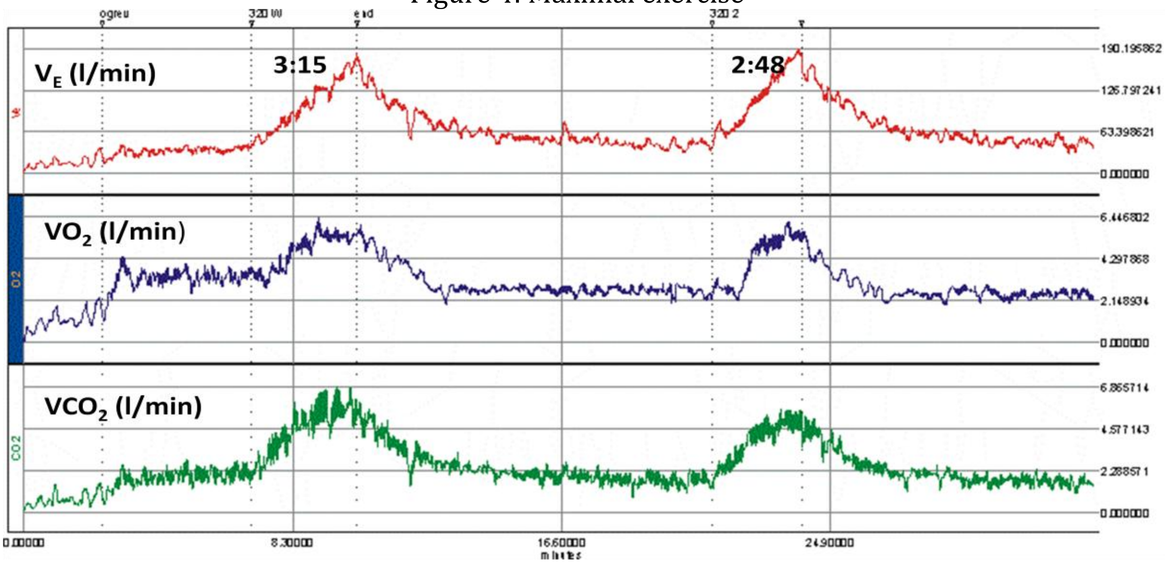
All exercises that reach the curve by their intensity and/or duration are maximal. If maximal exercise is short (< 30 s) then predominant muscle fuel is a Creatin Phosphate (CrP). It significantly reduces throughout the exercise and takes part in development of fatigue (Figure 3) (Fox et al., 1989). During recovery, the CrP enhanced even above its resting level (supercompensation (Figure 3). After 5-8 min athlete can perform similar maximal exercise. This maximal exercise can be repeated 3-5 times before fatigue will be accumulated. Additionally, the enhancement activation of the organism may occur by enhanced activation of central nervous system, reflexes and hormones (Astrand et. al, 2004). Therefore, the repetition of maximal short term exercise can be performed during particular training, without expected training adaptations.

Figure 3: A schematically presentation of the time course of CrP changes during 10-20 s of maximal exercise followed by 5-8 min recovery. CrP increases over resting values during recovery (supercompensation)



Additionally, even longer maximal exercise (3 – 5 min) can be repeated 1- 3 times, if exercise bouts are separated by recovery interval of about 6-10 min (Figure 4). In spite glycolysis (anaerobic energetic processes) dominates and hydrogen ions dramatically increases, it can be observed that such training can be enhanced by increasing of repetitions, without waiting for adaptations. Probably, the release of H^+ ions from exercising muscles and restitution of electrolyte balance during such recovery may be accompanied by significant decrease of fatigue (Astrand et al., 2004; Fox et al., 1989).

Figure 4: Maximal exercise

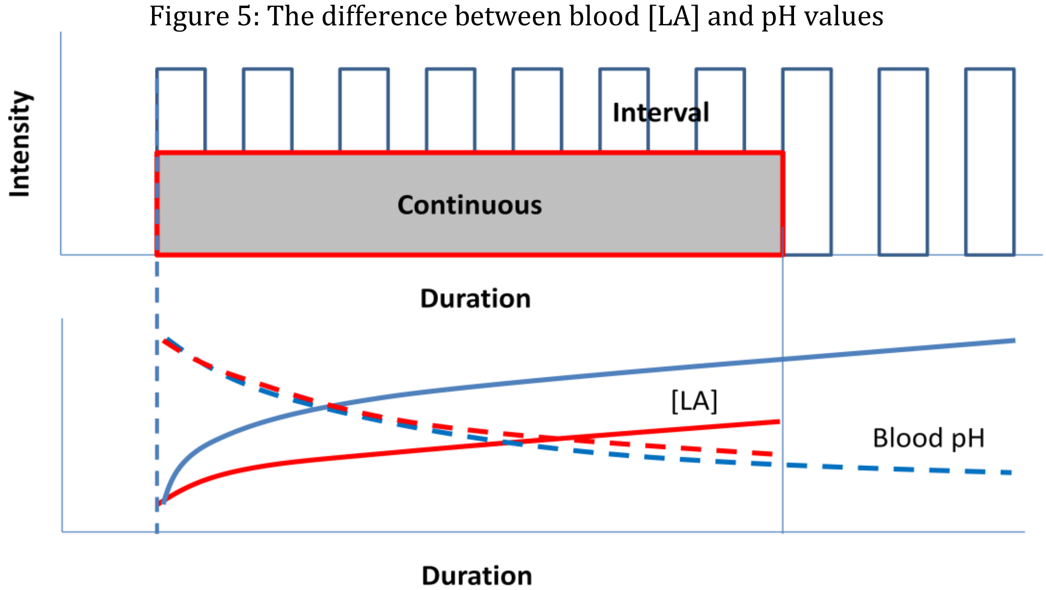


Maximal exercise of 3:15 min was repeated again with similar intensity (3.5 w/kg) and duration (2:48 min) in spite of relatively short recovery (about 9 min). Therefore, the enhancement of training duration but not its intensity may occur.

Maximal prolonged exercise cannot be immediately enhanced by its duration or average intensity. Therefore, if continuous method is using then the presented training theory is adequate.

Sub maximal exercise can be enhanced by its characteristics without training adaptation. In this case, the sub maximal characteristic of exercise changed versus maximal one, but support application of alternative hypothesis.

Figure 5: The difference between blood [LA] and pH values



Prolonged maximal and sub maximal exercise can be divided to several shorter exercises, separated by shorter recovery intervals. This is interval training method (Astrand et al., 2004). The intensity of such training can be immediately increases if compared by continuous exercise (Fig 5). Even the sum of exercise intervals exceed the duration of continuous exercise. Again, the enhancement of training intensity can occur by change the training method and without any training adaptation.

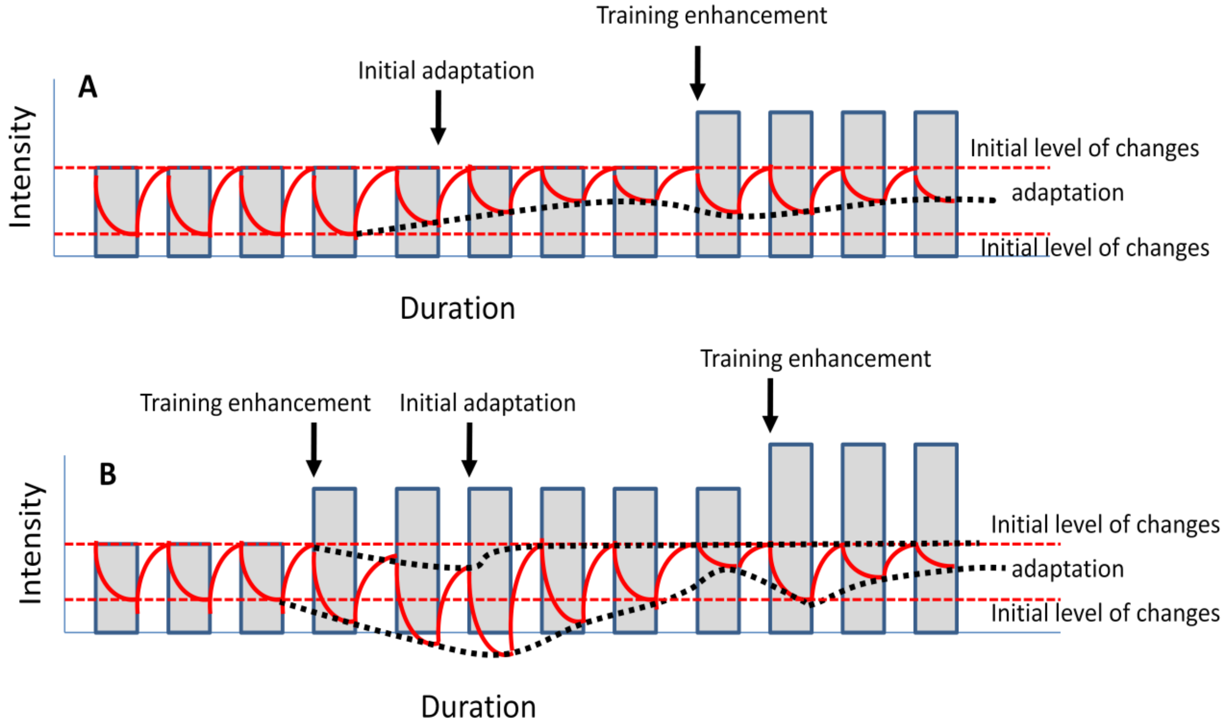
The difference between blood [LA] and pH values, when continuous and interval training is applied. Higher intensity during interval training influence larger [LA] increase than continuous exercise. In contrary, blood pH changes similarly, which suggested successful compensation of acidosis, probably during recovery intervals.

Testing the mechanism of adaptations during training, if enhancement follows or preceed adaptations.

Each training session can be described by its duration and intensity, by changes in organism homeostasis and by organism´s response. The adaptation of organism during training process is basically reduction in changes in the magnitude of that phenomenon which accompanied an increasing in the performance. This is a characteristically adaptation during sub maximal exercise. The training enhancement uses the training theory n this case (Figure 6A). This training adaptation reduces changes during exercise intervals (Figure 6 A, initial adaptation). When training intensity increases, the changes magnitude increases towards initial magnitude (Figure 6, dotted line).

The presented alternative hypothesis predicts an enhancement of training intensity before an occurring of the adaptations. Therefore the magnitude of changes enhanced more than previously (Figure 6, dotted curve). This causes an accumulation of fatigue and sometimes also incomplete recovery. If adaptability of organism is preserved, then this magnitude of changes decreases. This matched performance. In contrary, if adaptability of organism is overpasses, accumulated fatigue leads to overtraining.

Figure 6: Two principles of enhancement of training intensity



Upper graph (A) shows an example of enhancement of training intensity in the moment after adaptation is reached (initial adaptation). Lower graph (B) shows an example of enhancement of training intensity before an adaptation. If adaptability of organism is still adequate, then the second example can influence faster and larger adaptations.

Conclussions

The main finding of presented theoretical analysis is conclusion that the enhancement of training can be performed before adaptations. Therefore, in addition to theory, which suggests that training should enhance following training adaptations, also alternative hypothesis can be applied in training. Three main circumstances approved that both alternatives can be applied in training. The training enhancement should follow adaptations during the early period of athlete career. Also youth athletes should applied this strategy, in spite of possibility of using also alternative theoretical concept tested in our study. On the contrary, the part of athlete career when a limit in adaptations is reaching the only alternative theory can be applied: the enhancement of training irrespective whether adaptations were reached or not. The danger of occur of negative adaptations is presented here. Accumulated fatigue can influence overtraining. The possibility that training is enhanced without adaptation can be reached by change of training method. For example, the continuous method can be exchange by an interval, for this purpose.

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PE AND SPORTS OF CHILDREN WITH DISABILITIES

Hana Válková

Abstract

The relation between movement and personality development is proclaimed topic supported with various authors from Johan Commenius period. The similar principles related to development of child with disability are described. The aim of this paper to explain basic terminology, relevant to motor development of children with disability (early intervention, early sports socialization, motor quotient, motor competence, movement literacy) and to describe the principles of adaptations. Methods used are documents analyses, literature review, and practice based analyses. On the background of the basic terminology the recommendations for motor development of children/youth disability are described, good examples, examples of available and frequent physical activities and sports.

Historical introduction

The relation between movement and personality development is proclaimed topic supported with various authors from Johan Commenius period. Related to physical activities (and later Adapted Physical Activities) we can discover the first sources in Johann Amos Commenius (Jan Amos Komenský) teaching publications. Commenius – called teacher of nations, born in Moravian region 28.3.1592, died in Naarden 15.11.1670. As an exultant due to Thirty Years War he travelled from Moravian region through Poland (Leszno), Hungary (Sarisz Patak), Scandinavian countries and England to Netherland. He stressed the importance of the games, particularly *movement games for child* development, success in education (Scholas Ludus) and *the right of education for all*: poor – rich, clever – week. His idea – *all individuals are educable* – can be considered as the starting point in approach equal right for education persons with disabilities (Didactica Magna). Compare former recognition of children in categories "educable" or only "trainable" who had to be officially excluded from education in 90ies of the last century (Kovářiček, 1984).

The 19 century was important with founding of the first residential homes for persons with disabilities (the region of recent Switzerland was the first, after that other CE countries under umbrella of Habsburg monarchy). The pioneering period is linked with the names like Tissot (1785: medical and surgical gymnastics), Itard (1775-1839: special education approach), Seguin (1842: perceptual-motor training) and Ling (1776-1839: system of medical gymnastics). No specialists were involved in the physical activities of persons with disabilities. Leading role in applying manual motor exercises, physical exercises played enthusiasts, mainly philosophers or medical staff. (Sherrill, 2003). Among them there is necessary to remember memory of specialists from Central European (CE) region, like J. B. Riedel (1844, composer of the first official P.E. program in CE), Jan Ev. Purkyně (1787-1869, biologist, physiologist, anthropologist, discoverer of the cell). The idea of the importance of self-service and job-chance improving for persons with disabilities supported the attention to motor activities in these homes. In spite of this progressive starting point "charity approach" was leading approach in this period (Válková, 2009).

The year 1869 was very important: the imperial education law involved 2 obligatory P.E. lessons per week in all school levels. Besides public schools special institutions, special schools were founded, but system of professionals education in P.E. or special schools had not been established yet. The end of 19th century and the beginning of the 20th century first sport activities and clubs are reported (e.g. chess of blind, International Deaf Sports Federation - 1924) (Morkes, 1999).

First professional group in the USA called Association for the Advancement of Physical Education (the forerunner of AAHPERD) was established in 1905. Next approach was created with Montessori, oriented on early intervention (1912-1917) based on perceptual-motor training. Corrective physical education programs (represented with Josephine Rathbone, 1934) influenced children motor development from the aspect of prevention and re-covering motor patterns. Next important names are: N.C. Kephart and B.J. Cratty. Kephart (1911-1973) presented the idea "the movement is the bases for the intellectual development". He discussed a lot of motor features relevant to maturation of central nervous system or "brain maturation", like: motor exploration, reflex and postural adjustment, balance, laterality and directionality, body image. He began to compose perceptual motor development programs with testing and evaluating general child development and/or children with developmental delay (Sherrill, 2003).

Cratty is known with the most important publishing in 60ies and 70ies focused on mental disability, perceptual-motor games, training and research. Ocular control and proprioceptive perception were stressed in his programs in early intervention period. Cratty is the author of the first gross motor tests for children with disability. He started with systematic programs for 6-10 years old children with intellectual disability within Special Olympics (Cratty, 1972).

Even we have information from foreign countries we can be proud on having very good books in our home origin. Pioneering authors were: Koch (1959), Hoch (in Berdychová, 1969). Koch was Czech podiatrist supported exercising mothers with their newborns from birth up to three years. He developed special controlled program of early intervention for all children. Similarly Hoch developed aquatic program of body hardening and motor development of toddlers. Recent very popular "baby swimming clubs" toddlers and mothers used the same principles. Berdychová (1969) is well known pioneer, founder promoter of exclusive program based on psychological principle of affiliation: children and parents. The program was transformed to 23 languages. Program was presented several times on Czechoslovak Spartakiada Games. Probably other countries have developed program for all children up to school age. When they are in home languages (and not in English) the national home programs are not known in world-wide context.

Understanding – Child with special needs and movement

First problem of the topic there is formulation "special needs", in general, which is considered as an umbrella of a lot of particular "differences". "Something" which labels "minorities" from "majority". "Something" which can help us to recognize "all" from "others", "normal, usual " from "strange, unusual". Other terms are used: children need special education support. However – pre-school children, children in short-term life difficult period, pubescent, clumsy children, do they need special education respect? What about gifted children, gifted intellectually, gifted in motor abilities or gifted in others domains? Do they need special education respect? From the social development aspect and/or from the aspect of motor development? What about children with social disadvantages, ethnic minorities groups? We can see – the topic "child with special needs" is too broad for generalization. Related to humanistic approach those persons need special education respect are included in World Health Organization (WHO) terminology. The term "persons with the phenomenon the other, different" is used as the term emotionally neutral. But, for practical reason, we will use the term "child with special education needs". Child means the individual from birth up to the end of elementary school level (cca 10-11 years).

Importance and the role of movement, motor activities and sports of children with special needs for their beneficial development became the main task for the theory and field practice improvement. The topic "mobility", "motor activity", "movement" of different children became important since 70ies (Broadhead, & Church, 1984; Cratty, 1972; Dykens, & Cohen, 1996; Eichstaedt, & Lavay, 1992; Rarick, Widdop, & Broadhead, 1970; Roswal, Roswal, & Dunleavy, 1984; Vermeer, et al., 1990; Winnick, & Short, 1985; Wright, & Cowden, 1986).

Let us have a look at the other aspects of "movement" linked with term physical activities, motor activities, sports which evoke different levels of performance and intensity of activities (from daily life activities, leisure/recreational to top competitive sports), as well as different content (outdoor - indoor, winter – summer, individual – team). Physical activities and sports are realized in different environment related to typical activities more or less socially determined (family, peer groups, institutions, under spectators attention or non attention). Particular conditions for process of motor activities and sports of children with special needs can be provided on continuum "last restrictive – least restrictive" environment, it means on continuum from separated over parallel to inclusive environment. Last but not least phenomenon influenced on physical activities process – this is the person in the role of the leader : parents, educators, P.E. teachers, coaches, etc. Their professional education or training, knowledge and skills as well as attitudes and enthusiasm can provide the quality of the process and adherence of participants with special needs since childhood to adolescents.

In summary we can see the topic "child with special needs in motion" is not only too broad but very complicated, multi- and inter-disciplinary, related to periods of child development since birth up to 6-9 years.

Understanding - Child with special needs in the domains of motion

Child with special needs in motion can be described from different aspects.

Evolution aspect

Four movement phases are described by (McCall, & Craft, 2000, 152): 1. reflexive movement phase (primary reflexes, postural reflexes); 2. rudimentary movement phase (stability, locomotor horizontal and upright gait, manipulative abilities); 3. fundamentals movement phase (locomotor, object control, stability skills); 4. specialized movement phase (including sport specific skills).

First and 2nd phase is described by Auxter, Pyfer and Huettig (2005).

Early diagnoses, early intervention: relevant to parents information and knowledge, medical care and special education centers care. Basic information comes from reflex presentation. Early intervention has to follow as prevention, physiotherapy and/or other type of therapy. The period lasts since the birth to walking skills. Elementary movement includes:

- locomotion (walking, running, leaping, jumping, hooping, etc),
- manipulation (rolling, throwing, kicking, bouncing, etc),
- stability (balance, stretching, turning, twisting, swinging, etc) (Gallahue, & Donnelly, 2003).

Movement standards aspect

Motor quotient: motor quotient is understood as the standard relevant to usual motor development, motor skills of age children majority. Those standards should be known to parents and has to be known to pediatricians, e.g.: range of locomotion patterns. (Auxter, Pyfer, & Huettig, 2005, 322). Motor competence (different than movement competence) includes social behavior relevant to PA environment, it means to select appropriate movement act relevant to determine situation (to be motor active or quiet, to walk slowly or fast, to play or stop play, etc.) (Válková, 1995).

Movement competence is a combination of applicable multi-functional knowledge and understanding, motor skills, motor abilities and human attitudes, values and norms, which are necessary for movement growth, optimum physical, psychological and motor development, motor performance, personal fulfilment, overall healthy well-being and employment satisfaction. Basic indicators of movement competence are: mobility of everyday life, manual skills, active life-style and its quality, prevention of civilization diseases, postural health, specific PE or sport activities, professional and inter-personal skills. Movement literacy is used as the synonym very often but the idea of mutual influence in context of learning is presented in idea "moving to learn, learning to move" (Talbot, 2005.) It involves a whole range of learning outcomes which go beyond learning how to engage in selected physical activities – social skills; managing competition and cooperation, including of use strategies and tactics; problem solving; applying moral and aesthetic judgments; and knowing when and why different actions and behaviors are appropriate and effective; including the relationship of exercise to health and well-being.

Aspect of social development

Children need to move, children need relax. The early sports socialization is developed in early childhood in family: various indoor – outdoor activity should be applied, as so as winter and aquatics activity. Not only basic skills and latent learning is developed but attitudes to difficulties, winning-loosing values, competition-cooperation is learned through physical institutions and other settings (educational, social and cultural, public, private, commercial and voluntary systems and sub-systems). (Válková, 2000). Essentially, there are three stages in education: 1. informal education (in family, in life situations); 2. non–formal education (in specific educational and social organizations and institutions); 3. formal education (every schools level). It can be learned, taught and developed (both indirectly and directly) in a range of forms. (McCall, & Craft, 2000).

Games: children need games which act as motivation, emotion, joy. Through games self-awareness, braveness can be developed, safety behaviour can be learned. Children need to play and communicate. Social context of games is realized in family, with siblings, peers, in the first children clubs, even alone.

Dance: is important domain for every individuals as creative rhythmic movement and imaginative thinking, self-discovery and self-expression. Dance can be realized in different setting: walking, wheelchair, sitting position. "Dance programming is particularly important for people with emotional disturbances, behavioural disorders, and learning disabilities" (Sherrill, 2003, 411). Adapted dance and dance therapy are to pedagogical approaches with some similarities and some differences related to purpose, content and realization.

Aspect of physical activity or sports program application

The WHO recommendation related to health prevention there is 30 min. of vigorous or 40 min. moderate intensity of physical activity daily for all children. Specially the children games can saturate the range: *heart – lungs – joy* for *healthy oriented physical activity*. Games can include either cooperative or competitive skills; social attitudes; different difficultness; complex motor acts with language, mathematic or other cognitive skills development; variants of sports games focused on basic sport skills (decision making, latent skills learning, regulation respecting) (Cheffers, 2010).

Some countries composed the governmental policy focused on support to early intervention or movement literacy. E.g.: Canadian system "Active start" (www.ltad.ca) oriented on children healthy life style through physical education (Higgs, 2008). Other available model is British model (www.talentmatters.uk). Even the motivation is focused on new generation of potential participants in 2012 London Olympics or Paralympic Games great attention is paid to wide bases of children of all levels. Parents as so as PE teachers are involved in this system. Education is oriented on issue how to motivate children to be active, how to adhere mass of children in joy education and healthy life style. Scottish program similar like Australian are targeted on physical activity in inclusive setting (www.scottishdisabilitysport.com). There is quite a lot of books describing different programs, the games, plays, either in gym/indoor environment (Bielenberg, 2008; Huetting, Pyfer, & Auxter, 2005; McCall, & Craft, 2000, 2004; Van Coppenolle, Djobova, & Van Lent, et al., 2006; Werner, 1992), or in water environment (Lepore, Gayle, & Stevens, 2007). Surely the games, plays and programs development books and manuals are published in home national languages with original examples: national games, dance, etc.

Aspect of adaptations

Aspects described above are important for all children both able-bodies and with special needs children. But – according to limits or differences in motor competence of children with disabilities some determinants has to be adapt so that due to adaptation individual motor competence can be in function. STEPS model is accepted with Scottish association of disabled sport Scottish model (www.scottishdisabilitysport.com):

S Space (where)
T Task (what)

E Equipment (what being used)
P People (who is involved)
S Speed (the pace of activity)

Model "Three on Tree" is Australian model focus on adaptation in tree basic components presented in Y scheme (like tree). Three components are: 1. teacher (his/her methods, teaching approaches, decisions); 2. pupil/student with various special needs; 3. environment (conditions of accessibility, equipment, task, space, movement intensity). (Válkova, & Morisbak, 2006). Complex approach issued from categorical approach followed with individual´s attention is presented in table 1.

Table 1: Principles of adaptations. (Modified related to Válkova, & Morisbak, 2006.)

Item/domain	MD	HD	VD	PhD W	PhD AMP	PhD CP
Communication (manner, style)	X	X	X			o
Methods, teaching approaches	o	o	X	o	o	o
Content, task of activity			X	X	o	o
Sports regulations		o	X	X	X	o
Conditions: accessibility			X	X	X	o
venue, facility			o	o	o	o
adapted tools, instruments	o		X	X	X	o
socio-ecological	o	o	o	o	o	o
Sports classification system		o	X	X	X	X

Legend: **MD -** mental (intellectual) disability, **PhD W -** physical disability, wheelchair users, **HD -** hearing disability, **PhD AMP -** physical disability, amputees, **VD -** visual disability, **PhD CP -** physical disability, Cerebral Palsy, **X -** basic principle adaptation; individual, **o -** partial adaptation; slight, not frequent adaptation.

From this aspect above Gallahue and Donnelly (2003, 148) recommend to realize program in three approaches:

1. the adapted program: a modified program of movement activities that maximizes the potential of children with disabilities through an individualized intervention or education program;
2. the remedial program: a program of specific exercises and activities for correcting errors in body mechanics and perceptual motor functioning;
3. the developmental program: an individualized program of movement activities based on personal needs and designed to enhance movement, fitness, physical activity, and social/emotional skills.

Socio-ecological and psychosocial conditions underline either separate (special) setting or parallel or inclusive ones. Team programs as so as individual or face to face (e.g. Halliwick aquatics program, motor activities training program in Special Olympics, etc.) are applied according to actual situation.

Huge amount of research is oriented on evaluation the effect of intervention relevant to adaptations, both from physiology view (health variables, fitness, skills progress) or psycho-social view (attitudes, self-awareness, program management, etc.). There is several special journals focused on research results in children APA domain and the articles and authors are concentrated there: APAQ - Adapted Physical Activity Quarterly, (www.apaq.com), EUJAPA (European Journal of APA), (www.eufapa.eu) and others.

Conclusion

The period since child birth to approximately 6 years is important, so called sensitive period in motor and personal development for future. Early motor intervention influences next motor competence of all children: able-bodied and disabled. On the background of the basic terminology, understanding to child with special needs, understanding of motor quotient and motor competence issues and principles of adaptation there is possible to moderate and control appropriate intervention programs in different socio-ecological setting. Games, plays, dance aquatic and outdoor activities seem to be very important aid for adequate child development even within individual limits. In spite of the frequent publications in English focused on description and explanation of various activities usable in practice books, handbooks or manuals with national-cultural design activities/plays in home languages are necessary.

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SHOLAR SPORT: A PROBLEM BETWEEN EDUCATION, CULTURE AND SOCIAL PRACTICES

Manuel Vizuete Carrizosa

Introduction

The different processes of reform of education systems in Europe often touch only tangentially the issue of sport at school age. The lack of tradition in the educational system with respect to physical education as a subject fully integrated into education systems and the lack of appreciation of their curricula and educational content as well as the fact that sport in school has been located , from its origins in a kind of nebula or *no man's land* in which the education and culture concepts are confused usually, which has given more importance to the forms than to the bottom, along with the not inconsiderable political and media pressure on educational concepts relating to sport in school, have led both the sport and the sport-school curriculum, an *educational immunodeficiency situation*, which places the faculty and the education system with almost no ability to react, to pressing issues with nature of pandemics, are affecting not only the educational treatment of sports, intra-and extra-curricular, but also the social body, which alarms relating to health in terms of morbid obesity of children, violence in sport, doping of athletes schoolchildren and other types of abuse in sport as a framework, urging a full investigation and urgent action.

True, and in this case contrasted, than necessary educational reforms often lack influence in the life of the classroom, especially if no special attention to training and professional development of teachers, since this is the key factor that determines the success or failure of the implementation of any reform or curriculum innovation. In this case, and despite being a group particularly young and anxious about his training, both the inertia and the huge deficits as a theoretical foundation within their initial training, unable to change the preconceptions they bring and justify the choice of profession, Fullan (1991) validates the theory when he argues that: “Changes in education depend on what the teachers think and do something so simple and yet so complex...”.

Despite having made a huge effort, probably one of the biggest and best in the neighboring countries, in curriculum design in the planning approach and teaching in physical education at all levels, is no less true that these efforts and the consequent structural and curricular changes proposed from the government are not sufficient to cause a significant change in the teaching approaches of teachers, leading to real clarification of objectives and content and, consequently, to improve education, simply because teachers are not just limited to technical reforms or implement curricular innovations. The teachers have knowledge, ideas, values, attitudes and ways of understanding their discipline that are motivating its decision-making, which must be added, his own life experience, the personal and social and professional contexts in working, which are especially critical to the implementation of any proposed curriculum implementation.

We are facing a new position and social requirement responds to recent demand, emergent and urgent, seeking in physical education and the practice of sport and physical activity an effective defense against threats to health and quality of life, resulting from the new social dynamics and changes in lifestyles. Those circumstances having been raised in a geometric progression in the last quarter of the twentieth century, pandemics threaten to become, if not social cancers, economically costly, difficult to treat and great alarm. The disappearance of the cold war and the new social dynamics imposed by this circumstance to sports policies, severely marked traditional perspectives and approaches existing physical education and school sport until then oriented towards a sports physical concept to be restated, in the light of these new demands and social perspectives, towards a new concept emerging in Europe, related to the health and quality of life, defined as culture of the movement. In this regard have been key studies and investigations made by Bart Crum (2004), Brettschneider and Kleine (2003), Hardman and Marshall (2000), Vizuete (2002) Carreiro da Costa (2005) subject to rigorous debate within the scientific community and backed by European investigations and meetings.

This is of the necessary conceptual clarification, whether the sport in school or sports activities offered to our school curriculum both in the physical education course as the social practices of sport in school, promoted by the administrations, qualify and educational teaching, both quantitative and qualitative, targeted and justified, to this new social orientation of physical activity, defined as health practice is a hallmark of growing, the same way, which have established to be institutional and educational measures to ensure the educational dimension.

The problem lies in not having been able, so far, to understand from education budgets, the striking changes in mentality and social dynamics, related to sport and culture of the movement, which have taken place in recent years, and should have been assumed by the school concept of discipline, redefining the curricular and extracurricular sports, physical education guidance to this new form of culture.

From a strictly scientific and educational, in the light of scientific contributions in the area of knowledge and contemporary science education, we must ask:

- We now hold that the mere practice of a sport, without there being any process of teaching and curriculum planning in itself is educational?
- From a scientific point of view and educational, you can continue to accept and maintain that a child or a child in school, do a sport with the same rules, same disciplinary rigor and the same intent as an adult?
- You can accept that an activity with great educational potential, such as sport, can be manipulated, more to miseducate which to form democratic citizens and socially integrated, due to which interest is not known and that it may also be made from pure voluntarism and teaching without training?

In contemporary education, physical education for the XXI century, to which we refer, aims to *educate in sports* rather than *education through sport*. The reasons are simple and coincide with the above. Education through sport requires, in principle, in practice ignore the value and impact of the uncertainty factor on the outcome of the alleged action sports and education, which is what makes an attractive activity. Scientifically speaking, you cannot raise educational activity assuming, *a priori*, a high degree of uncertainty about the results, while, *to educate in sport*, education involves the acceptance of uncertainty factors and recognizing its educational value as a driver of practice of physical activities and sports throughout life.

In the usual practice of physical activities, the company is ahead of policy approaches and educational inertia showing every day, every time we go out into the street, in sports news or on television, what are the contemporary requirements of knowledge physical activity, and which is therefore the treatment of sport education required by the twenty-first century society.

This is how the sport at school age has to be rethought and oriented towards the participation and integration of future citizens in the culture of the movement. This approach requires less curricular school sport sportsman and closer to the humanistic, individual reality of each school, their physical capabilities and their integration into this new way of understanding physical activity.

It must be possible to sport at school age to suit each and every need, which would lead, in practice, the application of the concept individualized instruction in physical education and sport, without this may be antithetical to the values of solidarity, cooperation and teamwork, traditionally attributed to the sport, as part of their own educational rhetoric. This concept leads us to the school sports curriculum with formal and informal means of quality requirement, qualified technicians, open and non-traumatic, which is really important social integration and maintenance of health through the practice of physical activities.

These are the motivations that lead us to rethink the concept of sport at school age, research and the first prospective study and then the sport in the school they founded, technically and socially, the educational practices of children's sports content and young twenty-first century. Some backgrounds of these concerns are part of the line of work developed in recent years in many European countries. As reference works, worth mentioning the following:

European trends in Youth Sport: A report from 11 European Countries, is a cross-European comparative study and directed by Paul De Knop (1996) significant countries in different areas and geographic and socio-economics of the European Union, which were studied sports promotion policies directed at young people which showed the characteristics of youth sporting activities in Europe. As the most common problems identified in most countries studied, in relation to youth and sport, De Knop highlights:

a) Neglect and loss of interest in the young for organized sports.
b) Excessive adult influence of sport on sport for children and young people, both as regards the values to the rules and regulations, in such a way that forces a child of eight years to play with the same rules and standards as an adult. In many sports, says the report, children are treated as adults or tiny homunculi.
c) The sport has become too organized, too serious and less fun, the seriousness of this is directly proportional to the decrease in age of the athlete.
d) The sport tends to increase the social differences between young people, so that both practical and accessibility are, at heart, conditioned by the social position of the family. This segregation is not intentional but is caused due to different causes and issues familiar to the availability of logistics and transport, equipment, etc.
e) The influence of the economy is another factor influencing the youth sport, the cost of the facilities and coaches, etc...
f) Ethical issues are another problem that appears to be significant, some of them, as will be related to the identity of sport in education.
g) Ensuring qualified faculty and staff is another outstanding problem because, in too many cases, the sport of children and young people is in the hands of volunteers.

Sport, Health and Physical Education: Reconsideration. Another relevant research and background we use was developed in the UK and put on the table the following conclusions:

a) It is not possible to generalize or encapsulate the complex relationships between physical education, health and sports.
b) It is absolutely necessary to establish a clear distinction between sport and exercise, as they involve different types of values and social relations are the result of different personal reasons that each access to physical activity and also have different impacts on health.
c) There must be differences between different types and levels of sport with the distinctions of contact sport and non-contact and between mass sports and elite sport and define, in each case the differential impact that these types of exercise have on health.
d) Encourage the practice of rhythmic activities uncompetitive due to their higher health benefits and fewer lesions, compared to competitive activities and contact.

Summarizing these two studies, we can determine the existence of a crossroads situation in Europe regarding youth sport in the sense that exhausted traditional sports promotion based on talent identification or increased competitive practice from early ages, as ideal formula to increase the number of elite athletes, there is a situation of social reaction in the youth and intellectual world, against the social and institutional structures in the last quarter century, have been giving shelter to sport Youth from the quarry on this understanding of elite sport, or as a way to justify social policies relating to culture and the welfare society. In our view, the leaders of these crisis situations would be:

a) The sports policy of the last thirty years in which bet heavily on a fall in the age of initiation into competitive sport.
b) The identification of talents and expanding technology, compared to the monitoring of the educational theories and pedagogical qualification for professional practice of physical education and school sport and youth.

In the first case the drop of sport are caused by exhaustion of the capacity for satisfaction of personal needs from the sport by establishing a common denominator for all, with the consequent consideration *like things* of athletes, and an assessment of individuals base its competitiveness and its sporting success and, second, by the existence of a dehumanizing practice of selective physical activities, so that detected the talent, the almost-no-talent or talents, to add to the ranks of absolute anonymity without the sports system, again have the slightest interest in them. In both cases, the dropout are more than justified and demonstrates the inability of the sport to have a complete picture of the social landscape from an educational perspective.

Studies on the state of affairs in Spain.

The survey Extremadura.

From these concerns expressed and experience in different European studies, was offered to the Junta de Extremadura the possibility of a thorough study on the reality of sport at school age in Extremadura. The aim was to establish the status of the issue to from there, establish a starting point for proposals and solutions that promote physical activity among schoolchildren. Project approved by the Board of Extremadura - Department of Sports-The survey was conducted among 1046 people, in a totally random, ranging from school sports practitioners in general schoolchildren, parents, tutors, class teachers, teachers, education specialists physical and public, with a reliability index greater than 98% provided the following information:

a) *Interest in sports and physical activities in general:* Depending on the genre seems to be slightly higher in men than in women, showing a very slight downward trend of interest in physical activity as a function of age. It shows a greater interest in locations with populations between 10,000 and 24,000.
b) *The persons surveyed answered the common pattern of European sportsman society* as it is expected a considerable increase in demand for sports facilities and greater quality requirement in providing them. Similarly, the emergence of private provision as a result of increased quality requirement, which ultimately calls for a paradigm shift in the supply of services.
c) *Degree of participation in physical activities and sports:* 20% of the surveyed population did not practice any physical activity and sport, 32% engage in physical activity at least one sport while 22% carried two and 26% more than two sports and physical activities. The answers we would stand in clear agreement with the Knopp's report, in the sense of the need to increase advocacy efforts on the female population, with more programs tailored to their needs and, in particular, in ways of understanding physical activity more focused on the utilitarian and aesthetic in entertainment or sports.

Relationship between interest in physical activity level and the practice thereof. 47% of the population say they would very interested in physical activity and also the practice, so the same 30% of the population say they would very interested but it does not practice it as much as they wanted. It is noteworthy that only 2% of the population reported that physical activity did not practice and also is not interested.

In the analysis of sporting interest and gender are some differences between men and women, and that 58% of men say that physical activity is very interested and also practice it, while only 35% of women is very interested and engaged.

The answers to this question support the perceptions highlighted in the previous two, signifying the perception of the need of time available for physical activity. This output is typical of society's sportsman and responds to cultural and convincing answer, but in our case, we would indicate the need for better and tighter public offering marketing focused on physical activity and social perceptions the need for a more diverse offer in which each citizen found his personal model. In short, what we are suggesting is the need for a sport to the letter, second is the European model of physical activity that currently prevails.

a) *Sport in school. Considers that school sport is:* 82% of the surveyed population considers that school sport is an activity that is part of Physical Education, thus giving it an educational value to school sport.

No significant differences by gender, 80% of men and 81% of women believe that school sport is part of Physical Education. Noteworthy is the low percentage of the option is to become a champion or champion showing little interest, both adult and school performance in sport, which reinforces the idea of an educational purpose.

Policy efforts aimed at satisfying sporting interests or to the predominance of competitive sport, now we verify, have failed to change the social perception about the location and purpose of school sports. The population, almost unanimously, which makes it physical education content, therefore, no doubt, their full integration into the school is one of the ideas firmly rooted in the population.

b) *The personal experience in school sport.* 74% of the population surveyed considered positive experience or memory of school sport and show that they would repeat this experience.

The analysis revealed that gender does not influence the opinion of respondents, 75% of men and 72% of women positively value their experience in school sports and repeat the same. The analysis of this question in terms of age shows that both adults and students considered at a high rate, over 70%, which was a positive experience and would repeat the same.

Highlights the high esteem and the positive assessment that all make their way through school sport which no doubt would be endorsing quality standards, probably more in the surrounding of educational and relational school sport to sport. An improvement in standards of quality would certainly be welcome.

c) *Orientation of the physical activity and sport at school age:* 60% of the surveyed population believes that the philosophy of sport at school age should be an educational activity and therefore part of the curriculum. 16% believe there should be external to the school curriculum but steeped in educational values, while 10% believe that school sport should be outside the school curriculum and with values close to the Land and professional sports. 14% of respondents felt that school sports should be directed to the development of personal relationships and health care.

Even when 60% of respondents, prefers the school as part of school sports location, the presence of 40%, as a whole, which does not participate in this view, would indicate or levels of dissatisfaction, or the desire for new alternatives in a range that would go from a greater use of technology and competitiveness which, until just the opposite.

d) *The values of sport and physical activities at school age:* On the value placed on physical activity, 80% of respondents stated that encourages tolerance, discipline and comradeship and 8% considered not a activity is so important to subtract time to the other, 9% which is an activity that encourages and promotes the performance of other materials and 1% which is a harmful activity because it promotes aggression and competitiveness.

Respondents participate in traditional perceptions about the sport-related values, which certainly supports some of the previous answers, but in light of current research, it is clear the presence of these supposed values in sport depending on that assessment (Breschtneider) of agents who manage school activity or school sports, some of which not only are not interested in the development of these values but, at times and deliberately promote anti values. The consequences would be exquisitely care planning activities in order that these values are made explicit and are revealed as one of the hallmarks of school sport.

e) *Knowledge about the organization of sport at school age:* 43% of respondents felt sufficiently familiar organization of school sport in their environment and 22% considered to have a broad knowledge of the organization of school sport. By contrast, 18% of respondents felt that their knowledge of sport in schools is insufficient and 12% say they do not know.

The data obtained would advise marketing closer to the public about school sports, its organization and objectives and products it offers. This recommendation would be consistent with the proposal of the Council of Europe adopted by Parliament in the sense of involvement, through appropriate information and abundant, families and local authorities in physical activity of children and youth.

f) *Assessment of the range of activities for sport at school age:* 27% of the population believes that knowledge of the offer of sport activities for school age they have is limited. Given the percentages, it appears as school sport for children is one thing on which adults do not have a definite idea and certainly very little information, or educational efforts, or institutional efforts for the development of social and cultural education. In the evaluation of a change of models this should be particularly taken into account both for their participation in the design to its management at different levels.
g) *Knowledge of the administrative structure of school sports:* 48% of the surveyed population knows where to make an entry or claim for or on school sports, 41% claim not to know where they go. 52% of misunderstanding about the organizational structure of school sports, but ratify the previous answer is certainly worrying and abound in the need for social and public dissemination of school sport and its functions and objectives.
h) *Adequacy of training schedules.* 52% of respondents stated that training schedules are adequate, 16% which is well suited and another 16% are all appropriate. In general the view of respondents in terms of number of population where they live is that training schedules are appropriate. It is noteworthy that in populations of 2000-4000 people and more than 50,000 inhabitants 23% of respondents believe that times are less than adequate.
i) *Preference competition schedules.* On the preference schedule for the competition, 29% of respondents prefer that this takes place in the afternoons from Monday to Thursday, 26% on Saturday morning, 23% on Friday afternoon and 14% prefer Saturday afternoon.

In general the view of respondents in terms of number of inhabitants of the village where they live is that they prefer that the times of competition will develop in the afternoon from Monday to Thursday and/or Friday afternoons. The answer is consistent with the dynamics of contemporary society that prefers free of occupation and easements, and participate in a sporting competition is, as long as possible this weekend, so that future planning should be taken this factor into account, especially in places where competition that requires the family member or volunteer to develop the competition.

j) *The location of sports facilities.* Proximity or distance to sports facilities can be a handicap for the schoolchildren and their parents to enroll in the school sports program in your area. The responses regarding facilities indicate that there is a good level of equipment for the practice of physical activities, even if unaware of the ownership and activities carried out therein.

k) *Preference ownership of sports facilities:* Overwhelmingly, the surveyed population prefers publicly owned facilities, 36% prefer to municipal facilities, 27% those run by the autonomous region and 16% of the schools facilities. Only 8% of respondents prefer private facilities, of which 5% preferred to be of restricted use.

l) Of the adults surveyed, 46% say they prefer plants with municipal management. The students expressed their preferences for publicly owned sports facilities, both of the Autonomous Community as those run by the municipality.

m) *Valuation on the training of technical sports.* A very important part of the process of training and management in school sports are sports technicians, and in this case, the opinion they have of schoolchildren and their parents about their training is crucial for the success or failure. In general the view of respondents is satisfactory and that 52% believe it is appropriate and 26% which is very appropriate. Only 10% of respondents consider that training is inadequate and 2% which is nothing suitable.

n) Suitability of transport used in school sport: Another important factor when participating in school sport is the quality perceived by users of transport for school sports. 45% of respondents felt that transport to school sport is adequate and 17% which is quite adequate. 16% say it is inappropriate and 5% which is nothing suitable.

o) *Nature of Sports School at age:* Extracurricular physical activity appears rather fragmented and divided. Emphasizes the high participation in school physical activity institutionalized and, above all, the high percentage of people who adopt physical activity unregulated. Discounting school sports activity the majority of citizens are directed to a spontaneous practice of physical activity, to a culture of *sportivizated* society movement towards that target would require a new model of school sport.

p) *What kind of sport you do?* The answer to this question underscores the fact, very important to us, that 42% of women have practiced or only special school sports. This is particularly interesting, when it states that school sports should be or at least has proved to be an excellent vehicle for promoting women in sport, for sport and education for their participation in the culture of movement.

q) *Reasons for the practice or neglect of sport in school.* The main argument in sport and physical activities expressed by respondents is the fun, 72%, followed by the improvement and maintenance of health, 33%, the improvement of the physical form with 28% and be with friends 26%. Only 11% expressed their interest to become an elite athlete. It is noteworthy that adults value significantly the practice of sports physical activity in leisure time and fun for school pupils, 56%, and as a means to improve health, 52% and improve the physical one 49%.

r) *Reasons for not practicing sports:* 37% of respondents do not engage in physical activity - sport in their leisure time that they are bored. 17% of respondents felt that physical activity will not play sports are not out with friends. 17% say they do not want to be an elite athlete and that is a reason for not playing sports, a fact which indicates a perception by these persons of school sports is to get to elite sports.

40% 3rd and 4th grade students in the primary who say they do not play sports do not believe that this will get bored. About 19% do not play sports because there are fights, 18% because it encourages individualism and 17% because they can be with friends. In compulsory secondary education remain the same opinions than in primary. In 3rd and 4th High takes an important significance on the grounds that do not practice because they want to reach the elite "24%. 18% of those who do not practice in the second cycle of secondary do not because they believe that no good for this, have a low assessment of their chances and probably a perception that the sport is important to perform well level.

Conceptualization and meaning of "sport at school age"

After two days' work in a multidisciplinary group and an excellent work for discussion and reflection by the experts participating in a previous consultation who attended the meeting sponsored by the Higher Sports Council, the Generalitat de Catalunya and the Barcelona Olympic Foundation, it was a series of concussions; the listed the most important and significant.

Means for sport at school age that develops with children at these ages and therefore may have different levels of organization and guidance, but always respecting their rights and developmental characteristics that are established as lower and as an athlete in school. Differentiating the school sports curriculum integrated into the physical education curriculum own educational goals, school-age sport, as a projection of the practice-oriented learning stable physical activity.

From the clarity of this approach is necessary to establish a route of administration and powers that will allow both processes are possible and complementary.

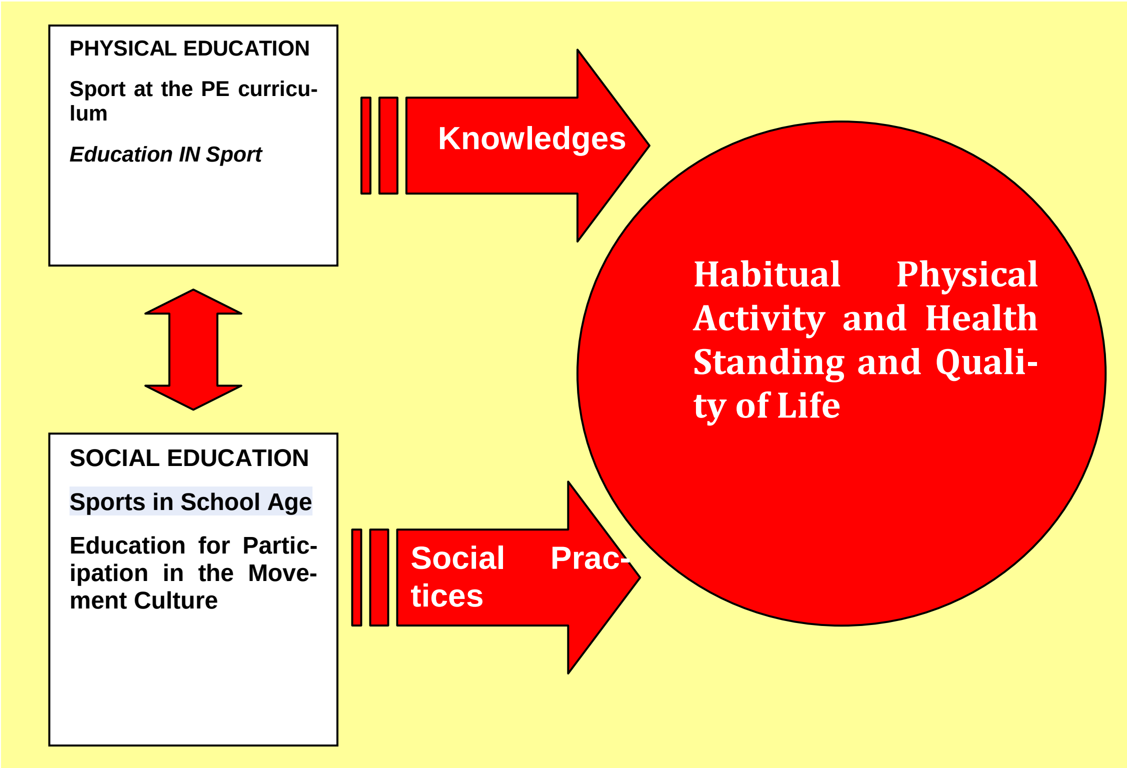
This discussion should generate the necessary and fundamental arguments that define the areas of institutional competence on sport at school age, from the considerations mentioned in the above headings.

We understand that the concept of sport in school should be placed in the context closest to the student's life, and that its two fundamental references should be the school and the family home, so that the powers should be, both in educational administration and in the next sports administration.

There is unanimity in considering the educational dimension of sport in school age and the need for its close relationship with the school based management in this sense should distinguish between:

a) *Curricular school sport.* As an essential part of the curriculum of physical education course, aimed at acquiring knowledge, skills and abilities related to different sports and ultimate purpose of which corresponds to the health and social dimension of the practice of physical activities as usual activity the rest of life.
b) *Sport at school age.* Understood as a practical application of knowledge acquired in the subject of physical education, aimed at social and civic participation in the culture of movement from outside the school, involving all social partners and governments, maintaining the educational dimension and taught by experts with the required quality controls in a democratic society and technologically advanced.
c) High competition sport with school ages athletes. Understood as practiced by the school or school-age persons belonging to the elite sports. He was out of the debate by having their own identity and not be applicable to the objective of the discussion group, however, raised the need to work in a Child Protection Policy which give equal protection Athlete both these athletes as any other aimed at both the punishment and prevention of any circumstances, criminal conduct, or abuse that may occur to the school both in sport immediately, and to the physical or psychological consequences as a result of sports could occurring.

Figure 1: Location curriculum, extracurricular sports. Study for the White Paper on Sport in the 2006 School-Age



The sportivization of the physical education is presented as the result of external pressures that have participated equally in the schools, teachers, school athletes and parents, having been in too many cases, undermined the purpose of sport in the curriculum and external practice.

National guidelines on sport at school age. They appear as absolutely necessary and urgent, and must be addressed in a legal document to establish and clarify the powers of the state both as models of participation and competence of the Autonomous Communities related to/or:

- Equality of opportunity for all children to sport at school age, regardless of the territory in which they are.
- From the understanding of the educational value of sport in school and their membership unequivocally the concept of integral education of the person, must be treated like any other field of education, guaranteeing a minimum educational content for all Citizens, especially geared to the health and quality of life.
- Development of the freedom of movement, choice and participation in sport at school age, regardless of the territory in which they are.
- Enjoy the rights established for the practice and / or competitive sport, regardless of the territory in which they are or where they reside.

It therefore poses the need for a pact of state for sport at school age that should be translated into a National Plan of sport at school age.

Although popular culture is one of the benchmarks of educational action, however, in practice, it should be noted certain positive and negative factors that could undermine or qualify the educational outcomes of sport at school age:

- Excessive media influence or introducing negative factors in the ways of understanding the sport.
- The early specialization and the pursuit of early results.

- The value and impact of social integration that the practices of sport at school age have as a positive.
- Development of democratic values and participation in social development of the sport.

Participation in sport federations at school age, is complex and not without debate, it seems clear that the vast majority of actors involved, do not bet on the sports federations involved in the sport at age school, and in any case, if necessary, it seems clear that their participation should be subject to a number of controls and constraints of powers to ensure the educational function that is pursued and that, by its nature, departs from the purposes of competition, selection and elitism of the world federation for themselves what is involved:

- Establish general guidelines that clearly define the functions and objectives of the sports federations in sport at school age, and the powers of the institutions involved.
- Establish clear separation between the sport in school and sports Land, ensuring the identity of both approaches to sports, without possibility of errors or confusion.

In terms of sports policies in the last 30 years. Persistent errors are recognized, of which are the following:

a) Existence of standard low-current and without connection to reality and the interests of children and young people today.
b) Persistence of models competitiveness which anchored in the period of the Cold War and in school sports schemes as grassroots sport.
c) No attention to diversity and customization of training and education in sport.
d) Sports selective versus inclusive sport and neglect poorly equipped.
e) Lack of training and specific technical update for the sport at school age with rigor and scientific approaches.
f) Institutional policies silos with little or no permeability, without optimization of resources or support for school athletes.
g) Lack of an educational approach rigorous scientific approach.
h) Permanent divorce between the curricular school sport and sport at school age.
i) The need to develop a curricular approach for school age sports on scientific and rationally built on real budgets.
j) Increase investment in research and technical training in sport at school age.

Conclusions and proposals for the development of school sport at school age.

From the results, the scientific bibliographic and consulted, and in light of our own study we believe that following the methodology marked by the Council of Europe, the sport at school age in Europe, should ensure its efficiency and quality in accordance the following criteria and actions:

a) Understand that the schedules of sport in school must assess the materiality both physical and psycho-evolutionary of children and adolescents, avoiding the overlapping patterns of adult sport.
b) Develop models of democracy programs in which young people themselves can have a voice and participate in making decisions. In this sense, it recommends the development of protocols and manuals of good practice to guide the various actors of sport at school age.
c) Establishment of minimum requirements that give a common structure for sport in school, and that contains these features:
    - Participatory.
    - Adapted. Creation of different types of rules.

- Co-educational and inclusive. Enhancement of association.
- Additional physical education.
- Coordinated (government agents).
- Education in the competition.
- Safe and healthy, and health enhancer and values.

Policies to develop both the State and the Communities should be framed according to these premises, with the current social structure and taking into account all the actors involved:

Necessity of an International Body for the prevention of risks, and abuses, on sport and the athletes of school age

The reality of the contemporary world and uniformly accelerated social changes that characterize the society of communication and new technology of the twenty-first century requires an ongoing effort to upgrade and enhancement of the reality of sport in school and sport for young, so it is seen as absolutely essential to the creation of an international conference of sport at school age permanently to guide the development of sport for children and youth in two ways:

a) As the guarantor of cultural identity and education, taking the lead and responsibility in each case may be.
b) As a vigilant and responsible for establishing early warning signals to react in time on the aggressions from the world of entertainment, fashion or jeopardize the health of children and youth.

The public authorities shall maintain and ensure the operation of this conference regulations establishing its endowment, its functions, composition and functioning, should be represented all those involved in sport at school age.

Rules for the Protection of the highly competitive athlete in school ages

Access to high competition and professionalism of the athletes is produced in ever younger ages and within the school, so that specific legislation, it is necessary to ensure:

- The constitutional rights of compulsory education and quality assurance.
- The ban on training sessions that exceed the limit on average working hours or the time corresponding to the age of the athlete.
- The availability of leisure time and guarantees of social relationship with people his age concentration outside the sport.
- The maintenance of family ties as much as possible avoiding the uprooting.
- Establishment of measures to overcome the post-competitive phase, avoiding the psychological damage or feelings of frustration when leaving the competition.
- Creation of guarantee funds to ensure financial and professional future after leaving the competition or the end of the sporting life, avoiding the economic vacuum and the social uprooting.

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PAPERS

EFFECTS OF ADAPTED SWIMMING PROGRAM ONTO ORIENTATION IN WATER OF CHILDREN WITH NEUROMUSCULAR IMPAIRMENTS

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Abstract

The purpose of this research is to show the effects of adapted swimming program on children with neuromuscular impairments. The research sample consisted of 7 children with neuromuscular impairments (cerebral palsy, paresis, spina bifida) age 5 to 13 that are participants regardless of their swimming knowledge. Sample of variables consisted of one multi-item test WOTA2, swimming knowledge test for persons with disabilities. For determining the level of orientation in the water in children with neuromuscular impairment basic statistical parameters were applied at initial and final measuring and differences between initial and final measuring were determined by applying t-test for small, dependent samples. It is noticeable that there are statistically relevant differences between the measuring in favor of the final one.

Introduction

Persons with disabilities with different diagnosis such as cerebral palsy, muscle dystrophy, paraparesis and paraplegia…) should be integrated in all social mainstreams in young age including social activities (Association of Swimming Therapy, 1992). Swimming is one of the activities that persons with this type of diagnosis can perform. In children with cerebral palsy, paraparesis, muscle dystrophy, multiple sclerosis, paraplegia performing this type of physical activity (through several types of adapted programs of swimming, hydro therapy, aqua therapy, balneal-therapy) depending on a degree and kind of diagnosis, intensity and duration, one can significantly improve or maintain: good pulmonary function, cardio-vascular system, muscle and joint function, good balance walking, self-concept, self-esteem, integration in the environment, everyday skills…(Getz, Hutzler, & Vermeer, 2006; Daly & Lambeck, 2007). Also, these activities decrease the number of stereotypic movements, hyperactive behavior, anxiety, bad back posture… Sport activities are beneficial for healthy body and healthy spirit, and when the spirit is healthy it is easier to progress in others areas of life (education, culture…).

The history of adapted programs in the water for persons with developmental disorders advances from hydro-therapy toward adapted water sports including swimming program and exercising in the water. Persons with developmental disorders today have the possibility to participate in a series of water-based activities including swimming competitions, swimming in the open, diving, synchronous swimming, water polo, triathlon (competition that includes 3 different disciplines: regular swimming, riding a bicycle and running), diving with an oxygen bottle , rowing and boat riding activities. On the other hand hydro-therapy relates to the water exercises that have therapeutic purpose. The aims of this program are circulation, muscle strength, endurance, range of movement, balance and coordination. Programs are run by therapists or specialists certified by the organizations such as: Hydro-therapy and rehabilitation institute. Hydro-therapy was systematized in 1930's by Charlie Loman, orthopedist that is considered to be the father of hydrotherapy. Although they are primarily used for persons with developmental disorders, water exercises are recommended to everyone. Water exercises can be used as an addition or alternative to the land exercises (Prins, 2009). The purpose of this research is to show the effects of adapted swimming program on children with neuromuscular impairments.

Methods

The research sample consisted of 7 children with neuromuscular impairments (cerebral palsy, paresis, spina bifida) age 5 to 13 that are participants regardless of their swimming knowledge[6]. Sample of variables consisted of one multi-item test WOTA2, swimming knowledge test for persons with disabilities (Tirosh, Katz-Leurer, & Getz, 2008). WOTA2 has 27 particles i.e. questions that are being answered via evaluation grading from 0 to 3:

1 General adjustment to the water	15 Jumping and ducking in & out
2 Blowing bubbles through the mouth	16 Change position from standing to back floating
3 Blowing bubbles through the nose	17 Static back float for 5s
4 Blowing bubbles with head immersed	18 Change position from back floating to standing
5 Rhythmically exhaling while moving	19 Prone gliding from wall to therapist
6 Exhalation alternately, nose & mouth	20 Change position from prone floating to standing
7 Entering the water	21 Right Longitudinal Rotation
8 Getting out of the water	22 Left Longitudinal Rotation
9 Sitting in the water	23 Combined rotation
10 Moving along the pool side rail using hands	24 Diving
11 Walking across the pool	25 Simple progression on the back
12 Jumping forward	26 Freestyle
13 General adjustment to the water	27 Backstroke
14 Blowing bubbles through the mouth	

For determining the level of orientation in the water in children with neuromuscular impairment basic statistical parameters were applied at initial and final measuring: arithmetic mean (X), standard deviation (SD), minimum (Min) and maximum (Max) value, range (Range), standard arithmetic mean error (SX), scewness (Scew) and kurtosis (Kurt). Differences between initial and final measuring were determined by applying t-test for small, dependent samples.

Experimental treatment lasted for 8 weeks, two classes of 45 minutes per week. The work was mainly individual –one (instructor) on one (participant). Additional requisites were adapted to age and type of disability.

Principles of Halliwick method, hydro-therapy and non-swimmers training for healthy population were used. The goal of this adaptive swimming program is to teach the participants to move through the water safely and independently, that is, teach them to swim.

Results and discussion

Table 1 shows the results of descriptive analysis of WOTA2 test at initial measuring. It is noticeable that before taking this course the participants had low average score of mental

[6] Inclusion criteria for taking part in the project are: the participants do not suffer from epilepsy, they have their parents' /guardians'consent and their level of GMFCS is not low.

adjustment to the water (tests 1 to 13), while they were almost unfamiliar with the ability to control balance and movements (tests 14 to 27).

There is obvious heterogeneity in scores related to orientation in the water, most of all in the particles representing mental adjustment.

Table 1: Results of descriptive analysis of WOTA2 test at initial measuring.

	N	Mean	Min	Max	Range	SD	Error	Skew	Kurt
1	7	2	1	3	2	0.577	0.218	0	3
2	7	1.71	1	3	2	0.756	0.286	0.5953	-0.35
3	7	1.29	0	3	3	1.113	0.421	0.2489	-0.9444
4	7	1	0	3	3	1.155	0.436	0.9093	-0.15
5	7	0.71	0	2	2	0.756	0.286	0.5953	-0.35
6	7	1	0	3	3	1.291	0.488	0.6507	-1.704
7	7	2	1	3	2	0.816	0.309	0	-1.2
8	7	1.29	0	3	3	1.254	0.474	0.6817	-1.0992
9	7	0.71	0	2	2	0.756	0.286	0.5953	-0.35
10	7	2.57	2	3	1	0.535	0.202	-0.3742	-2.8
11	7	2.43	0	3	3	1.134	0.429	-2.1558	4.5802
12	7	2	0	3	3	1.155	0.436	-0.9093	-0.15
13	7	1.14	0	3	3	1.215	0.459	0.4142	-1.5253
14	7	0.14	0	1	1	0.378	0.143	2.6458	7
15	7	0.29	0	1	1	0.488	0.184	1.2296	-0.84
16	7	0.14	0	1	1	0.378	0.143	2.6458	7
17	7	0.14	0	1	1	0.378	0.143	2.6458	7
18	7	0	0	0	0	0	0	0	0
19	7	0	0	0	0	0	0	0	0
20	7	0	0	0	0	0	0	0	0
21	7	0	0	0	0	0	0	0	0
22	7	0	0	0	0	0	0	0	0
23	7	0	0	0	0	0	0	0	0
24	7	0	0	0	0	0	0	0	0
25	7	0	0	0	0	0	0	0	0
26	7	0	0	0	0	0	0	0	0
27	7	0	0	0	0	0	0	0	0

Table 2 shows the results of descriptive analysis of WOTA2 test at final measuring. It is noticeable that after taking this course the participants had higher average scores of mental adjustment to the water comparing to their previous state and none of the tasks were unknown to them (tests 1 to 13).

The ability to control balance and movements (tests 14 to 27) that was almost unknown to them was now "accomplishable" by some participants. Also there is an obvious improvement in swimming shorter distances (tests 23 to 27). There is also noticeable heterogeneity at final measuring in scores of orientation in water, primarily in the particles representing mental adjustment.

Table 3 shows results of Student's t-test for small dependent samples. It is noticeable that there are relevant differences between the measuring, in favour of the final one. Namely, in all mental adjustment tasks (tasks 1 to 14) there was a statistically relevant improvement in the final measuring.

We are assuming that the adaptive swimming program influenced this phenomenon. The participants were almost unable to control their balance and movements at the beginning of the program and now they have a significant increase in four of the tasks (tasks 15 to 18). Although there is no statistical relevance between initial and final measuring in other balance and movement control tasks, there is an obvious improvement thanks to the program (tasks 19 to 27).

Table 2: Results of descriptive analysis of WOTA2 test at final measuring.

	N	Mean	Min	Max	Range	SD	Error	Skew	Kurt
1	7	2.00	1.00	3.00	2.00	0	0	0	0
2	7	1.71	1.00	3.00	2.00	0.378	0.143	-2.6458	7
3	7	1.29	0.00	3.00	3.00	0.787	0.297	-1.7598	2.3609
4	7	1.00	0.00	3.00	3.00	0.787	0.297	-1.7598	2.3609
5	7	0.71	0.00	2.00	2.00	0.787	0.297	-1.1145	0.2734
6	7	1.00	0.00	3.00	3.00	0.951	0.36	-0.7636	-1.687
7	7	2.00	1.00	3.00	2.00	0.378	0.143	-2.6458	7
8	7	1.29	0.00	3.00	3.00	0.816	0.309	0	-1.2
9	7	0.71	0.00	2.00	2.00	0.488	0.184	-1.2296	-0.84
10	7	2.57	2.00	3.00	1.00	0.00	0.00	0.00	0.00
11	7	2.43	0.00	3.00	3.00	0.756	0.286	-2.6458	7
12	7	2.00	0.00	3.00	3.00	0.787	0.297	-1.7598	2.3609
13	7	1.14	0.00	3.00	3.00	0.00	0.00	0.00	0.00
14	7	0.14	0.00	1.00	1.00	1.345	0.508	-0.7982	-1.2798
15	7	0.29	0.00	1.00	1.00	1.254	0.474	-0.6817	-1.0992
16	7	0.14	0.00	1.00	1.00	1.272	0.481	-0.2219	-1.7149
17	7	0.14	0.00	1.00	1.00	1.414	0.535	-0.9899	-1.2
18	7	0.00	0.00	0.00	0.00	1.254	0.474	-0.6817	-1.0992
19	7	0.00	0.00	0.00	0.00	1.155	0.436	0.9093	-0.15
20	7	0.00	0.00	0.00	0.00	1.155	0.436	0.9093	-0.15
21	7	0.00	0.00	0.00	0.00	1.215	0.459	1.147	-0.0568
22	7	0.00	0.00	0.00	0.00	1.215	0.459	1.147	-0.0568
23	7	0.00	0.00	0.00	0.00	0.787	0.297	1.7598	2.3609
24	7	0.00	0.00	0.00	0.00	1.254	0.474	-0.6817	-1.0992
25	7	0.00	0.00	0.00	0.00	1.069	0.404	1.52	2.7125
26	7	0.00	0.00	0.00	0.00	1.069	0.404	0.7717	0.2625
26	7	0.00	0.00	0.00	0.00	1.069	0.404	0.7717	0.2625
27	7	0.71	0.00	3.00	3.00	1.113	0.421	1.7836	3.2308

Table 3: results of Student's t-test for small dependent samples.

Variable	Measuring	Mean	Min	Max	SD	p
1	Initial	2.00	1.00	3.00	0.577	0.0038
	Final	3.00	3.00	3.00	0.000	
2	Initial	1.71	1.00	3.00	0.756	0.0047
	Final	2.86	2.00	3.00	0.378	
3	Initial	1.29	0.00	3.00	1.113	0.0117
	Final	2.57	1.00	3.00	0.787	
4	Initial	1.00	0.00	3.00	1.155	0.0105
	Final	2.57	1.00	3.00	0.787	
5	Initial	0.71	0.00	2.00	0.756	0.001
	Final	2.43	1.00	3.00	0.787	
6	Initial	1.00	0.00	3.00	1.291	0.0117
	Final	2.29	1.00	3.00	0.951	
7	Initial	2.00	1.00	3.00	0.816	0.0453
	Final	2.86	2.00	3.00	0.378	
8	Initial	1.29	0.00	3.00	1.254	0.0082
	Final	2.00	1.00	3.00	0.816	
9	Initial	0.71	0.00	2.00	0.756	0.0001
	Final	2.71	2.00	3.00	0.488	
10	Initial	2.57	2.00	3.00	0.535	0.0781
	Final	3.00	3.00	3.00	0.000	
11	Initial	2.43	0.00	3.00	1.134	0.1723
	Final	2.71	1.00	3.00	0.756	
12	Initial	2.00	0.00	3.00	1.155	0.03
	Final	2.57	1.00	3.00	0.787	
13	Initial	1.14	0.00	3.00	1.215	0.0068
	Final	3.00	3.00	3.00	0.000	
14	Initial	0.14	0.00	1.00	0.378	0.0111

	Final	1.86	0.00	3.00	1.345	
15	Initial	0.29	0.00	1.00	0.488	0.0082
	Final	1.71	0.00	3.00	1.254	
16	Initial	0.14	0.00	1.00	0.378	0.0157
	Final	1.57	0.00	3.00	1.272	
17	Initial	0.14	0.00	1.00	0.378	0.0107
	Final	2.00	0.00	3.00	1.414	
18	Initial	0.00	0.00	0.00	0.000	0.0111
	Final	1.71	0.00	3.00	1.254	
19	Initial	0.00	0.00	0.00	0.000	0.0618
	Final	1.00	0.00	3.00	1.155	
20	Initial	0.00	0.00	0.00	0.000	0.0618
	Final	1.00	0.00	3.00	1.155	
21	Initial	0.00	0.00	0.00	0.000	0.1112
	Final	0.86	0.00	3.00	1.215	
22	Initial	0.00	0.00	0.00	0.000	0.1112
	Final	0.86	0.00	3.00	1.215	
23	Initial	0.00	0.00	0.00	0.000	0.1112
	Final	1.43	1.00	3.00	0.787	
24	Initial	0.00	0.00	0.00	0.000	0.1112
	Final	1.71	0.00	3.00	1.254	
25	Initial	0.00	0.00	0.00	0.000	0.1112
	Final	0.86	0.00	3.00	1.069	
26	Initial	0.00	0.00	0.00	0.000	0.1112
	Final	1.14	0.00	3.00	1.069	
27	Initial	0.00	0.00	0.00	0.000	0.1112
	Final	0.71	0.00	3.00	1.113	

Conclusion

The purpose of this research is to show the effects of adapted swimming program on children with neuromuscular impairments. The research sample consisted of 7 children with neuromuscular impairments (cerebral palsy, paresis, spina bifida) age from 5 to 13 that are participants regardless of their swimming knowledge.

Sample of variables consisted of one multi-item test WOTA2, swimming knowledge test for persons with disabilities. For determining the level of orientation in the water in children with neuromuscular impairment basic statistical parameters were applied at initial and final measuring and differences between initial and final measuring were determined by applying t-test for small, dependent samples.

It is noticeable that there are statistically relevant differences between the measuring in favor of the final one. Namely, in all mental adjustment tasks there was a statistically relevant improvement in the final measuring so it can be concluded that the adaptive swimming program influenced this phenomenon. The participants were almost unable to control their balance and movements at the beginning of the program and now they have a significant increase in four of the tasks. Although there is no statistical relevance between initial and final measuring in other balance and movement control tasks, there is an obvious improvement thanks to the program.

Shortcomings of this research lie in the fact of a small number of respondents (7) and heterogeneity on age (age from 5 to 13). To do further research with more subjects are similar ages. This would get more complete data on the effects of adapted swimming program on children with neuromuscular impairments.

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THE DEVELOPMENT AND USE OF MODEL OF SUCCESSFULNESS FOR YOUNG CATEGORIES IN ALPINE SKIING

Miha Bandalo, Milan Žvan and Blaž Lešnik

Abstract

In Slovenia expert modelling is an important part of planning and analysing the effects of training of different categories of competitors in alpine skiing. With the help of the SMMS program package, marks were computed at all levels of a potential model of successfulness. Marks computed for an individual competitor as well as for the whole group serve the coaches as a useful orientation when planning and conducting the training process.In the second part of the survey, we tried to establish the connection between the marks calculated by means of the expert system method (heuristic approach) and the criterion variable. We computed Pearson's correlation coefficient for the sample of young competitors in Alpine skiing and thus confirmed the statistically significant connection between the calculated marks (expert system method) and the actual successfulness (points won in the Argeta Cup competitions). The result (r=0.47) obtained is a relevant indicator of the validity and appropriate configuration of a reduced model of potential successfulness which forms a basis for the planning of the training process and the selection of young competitors.

Introduction

In different age periods a biopsychosocial development of a subject is marked by various phases of the skeletal and muscular development as well as the psychological and social development. It is therefore important to consider the developmental principles and characteristics of a subject in a particular age period when planning and conducting the training process. In this respect, careful attention should be paid to younger categories of competitors aged 10 to 15 or more who are affected by considerable developmental changes, such as accelerated growth of the skeletal system, sexual maturation, etc. This can result in greater fluctuations in an individual's motor abilities and physical and psychic characteristics (Thompson, Humbert, & Mirwald, 2003). One of the basic tasks of a coach is therefore to adapt the contents, quantity and intensity of the training process to the state of the competitors. At the same time, the coach has to take into account the objectives of training which must be oriented towards efficiency and finally also towards achieving the best results in competitions. Consequently, feedback obtained on the basis of measurements that have been carried out contributes to quality training; these measurements are aimed at checking the state of the dimensions that play an important role in the successfulness in Alpine skiing. Regular monitoring and checking of positive and negative changes in the dimensions of a psychosomatic status of competitors are therefore of great importance in the competitive, transition and preparatory periods of the training because of the possibility of deviations from the coach's and competitors' expectations. Nowadays, it can be said that the training process, besides various manifestations of the power of the whole body, is oriented primarily towards acquiring a broad spectrum of motor information with the emphasis on different kinds of coordination. Many studies (Klika & Malina, 1996; Lešnik, 1996; Dolenec 1996; Žvan & Lešnik, 2000; Von Duvillard, 2004; Spitzenpfeil, Niessen, Rienacker, & Hartmann, 2004) confirm that successfulness in a particular sport depends primarily on the development of motor abilities and many other dimensions of a psychosomatic status of competitors. This also holds true of Alpine skiing. That is why the state of basic and special motor abilities is of the greatest importance when studying the successfulness of young competitors. Other sets of dimensions that may have a significant influence on achieving good results in competitions should by no means be neglected.

The mutual connection of the results of the potential and competitive models of successfulness is an indicator of the suitability and quality of both models that have been developed (Rajkovič, Bohanec, Leskošek, & Šturm, 1990; Jošt & Pustovrh, 1998; Černohorski & Pustovrh, 2008).

Figure 1: Reduced model of potential successfulness for younger categories of competitors in Alpine skiing

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POTENTIAL SUCCESSFULNESS (successfulness in a certain sport)
├─ MORPHOLOGICAL CHARACTERISTICS
│     ├─ internal geometric dimensions
│     └─ external geometric dimensions
└─ MOTOR ABILITIES
      ├─ basic motor abilities
└─ special motor abilities
```

In the last twenty years, numerous researchers have used different samples to determine the connection between particular potential dimensions and the successfulness in competitions (Ulaga, 2001). It has been scientifically proved that among potential dimensions the subsystems of the chosen motor and morphological variables are connected to the greatest extent with the successfulness of young competitors in competitions. The successfulness of a sportsman is determined on the basis of the results achieved in competitions.

The model of competitive successfulness helps us to correctly place an individual competitor within his competitive category; this placing is based on a particular scoring system (Ski Assoociation of Slovenia, 2009). In Alpine skiing as well as in other sports, results achieved in competitions are the best criterion of the quality of the training process in the transition, preparatory and competitive periods. This means that the developed model of successfulness will only be reliable if it consists of suitably weighted potential dimensions of the successfulness of a particular sample of subjects; on the other hand, competitive successfulness will be assessed on the basis of the most important competitions, in which the same sample of subjects took part (Figure 2).

Figure 2: System of competitive successfulness for younger categories of competitors in Alpine skiing

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COMPETITIVE SUCCESSFULNESS
├─ INTERNATIONAL COMPETITIONS
└─ DOMESTIC COMPETITIONS
   └─ 6 COMPETITIONS FOR THE ARGETA CUP
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Taking the basic goal of our study into consideration, we intended to check the validity of the set model of successfulness. For this reason, we first had to determine the criterion which is (based on the calculation of points scored) represented by the actual successfulness of the subjects in the Argeta Cup competitions.

Then two methods were used in accordance with the set goals. The first method is the method of expert modelling with the help of which the marks at all levels of the tree of successfulness were calculated. The second method (the calculation of Spearman's correlation coefficient) was used to determine the connection between the marks obtained at the highest level of the tree of successfulness and the points scored in the Argeta Cup competitions.

Methods of work

In the past few years, the measurements of morphological and motor dimensions of younger categories of competitors in Alpine skiing have been carried out twice a year at the Faculty of Sport. Testing carried out in spring shows the state of motor abilities and morphological dimensions after the end of the skiing season (the beginning of the transition period), whereas testing performed in autumn represents the starting point for fitness before the beginning of the competitive period. The data are processed by means of the SMMS (Sport Measurement Management System) program; (Leskošek, Bohanec, & Rajkovič, 2002, Lešnik, 1996; Ulaga, 2001, Černohorsky & Pustovrh, 2008) in the form of profiles and in other forms, they may help the coaches to analyse the training realized in the past as well as to plan the training programme in the future.

Participants

The research included 31 competitors in the category of older boys who took part in the Argeta Cup competitions in the 2007/08 season. In measurements performed in autumn, they had to fulfil the following requirements: they were born between 1993 and 1994, they had at least three placings in the giant slalom, two placings in the slalom and at least one placing in the super giant slalom in the Argeta Cup in the 2007/08 season, they are registered as competitors of Slovene skiing clubs, they took an active part in the regular training process in the previous year and they were without any physical injuries or other complaints. All competitors were included into experiment according the rules and on the base of official ethical consideration (Etics committee, Faculty of sport, Ljubljana) and agreement of their parents.

Variables

The sample of variables comprises the dimensions used in practice for checking the motor and morphological status of competitors. In the past few years, the battery of variables which were used in a particular period to measure the most important dimensions of the successfulness of young competitors has been adapted to the changes in the technique of performing competitive turns. Already in the past, we strove to include the sets of dimensions which have an important influence on the achievement of good results from the energy as well as information aspect when studying different categories of subjects. Alpine skiing requires basic muscular power, aerobic and anaerobic abilities as well as a wide movement programme of specific motor abilities (Lešnik, 1996; Dolenec, 1996; Maffiuleti, Jordan, Spring, Impellizzeri, & Bizzini, 2007).
In the past few years, the battery of tests for the younger categories of competitors has consisted of 17 motor and 8 morphological tests which are classified and explained in Table 1. According to the results of different studies (Lešnik, 1996; Reid, Johnson, Kipp, Albert, & White, 1996) they can be good predictors of successfulness in Alpine skiing. The linearity of predictor variables are also shown in Table 1.

Table 1: Hierarchically arranged expert model of morphological and motor dimensions with set absolute decision rules and normalizers and the linearity of predictor variables for older boys (aged 13–14)

Code	Names of nodes and variables*	Unit	Weight (%)	Normalisers and linearity of variables
mark	final mark		100	
Code	MORPHOLOGY: Names of nodes and variables*	Unit	Weight (%)	MORPHOLOGY: Normalisers of variables
├─morf	MORPHOLOGY	----	35	
│ ├─intgd	internal geometric dimensions	----	10	
│ │ └─***BW***	**Variable: body weight**	**kg**	**10**	25:0. 30:0, 40:1, 45:2, 50:3, 54:4,

				60:5, 76:4, 84:3, 90:2, 100:1, 110:0
│ ├─exgd	external geometric dimensions	----	22	
│ │ ├─longdim	longitudinal body dimensions	----	13	
│ │ │ ├─***BH***	**Variable: body height**	**cm**	**8,5**	140:0, 145:1, 148:2, 154:3, 160:4, 164:5, 174:4, 178:3, 180:2, 182:1, 188:0
│ │ │ └─***LENLEG***	**Variable: length of leg**	**cm**	**4.5**	82:0, 86:1, 88,5:2, 90:3, 92:4, 96:5, 100:4, 102:3, 104:2, 106:1, 110:0
│ │ ├─transdim	transverse body dimensions	----	6	
│ │ │ ├─***DIALKN***	**Variable: diameter of the left knee**	**cm**	**3**	6,8:0, 7:0, 7,8:1, 8,6:2, 9,4:3, 10,2:4, 11:5, 11,2:5
│ │ │ └─***DIALAN***	**Variable: diameter of the left ankle joint**	**cm**	**3**	4:0, 5,2:1, 6:2, 7:3, 8:4, 9,1:5, 9,3:5
│ │ └─vol	circumference of the legs	----	3	
│ │ └─***CIRLTH***	**Variable: circumference of the left thigh**	**cm**	**3**	42:0, 44:0, 46:1, 48:2, 50:3, 52:4, 55:5, 58:4, 61:3, 64:2, 66:1, 68:0
│ └─intgd	internal geometric dimensions	----	3	
│ ├─***SFSTOM***	**Variable: stomach skin fold**	**mm**	**1.5**	3,6:5, 7:4, 11:3, 15:2, 20:1, 36:0, 40:0
│ └─***SFTHI***	**Variable: skin fold of the left thigh**	**mm**	**1.5**	4:5, 8:4, 12:3, 15:2, 20:1, 28:0, 30:0
Code	MOTOR SKILLS: Names of nodes and variables*	Unit	Weight (%)	MOTOR SKILLS: Normalisers of variables
└─mot	MOTOR SKILLS	----	65	
├─basmot	basic motor skills	----	35.5	
│ ├─encom	energy component of movement	----	29	
│ │ ├─power	basic power	----	17	
│ │ │ ├─powsingl	takeoff power – single leg	----	4	
│ │ │ │ └─***MST3JSL***	**Variable: standing triple jump**	**cm**	**4**	450:0, 500:1, 600:2, 640:3, 700:4, 750:5, 800:5
│ │ │ ├─powdoubl	takeoff power – double leg	----	9.5	
│ │ │ │ ├─***MSTLJDL***	**Variable: standing long jump**	**cm**	**5**	150:0, 175:1, 190:2, 210:3, 235:4, 245:5, 250:5
│ │ │ │ └─***MSTLJ10DL***	**Variable: ten consecutive double leg jumps**	**m**	**4.5**	15:0, 17:1, 19:2, 21:3, 23:4, 26:5, 27:5
│ │ │ └─powrep	repetitive power	----	3.5	

│ │ │ └─***MBAHUGR***	**Variable: bent arm hangs with an undergrip**	**rep**	**3.5**	0:0, 0:0, 5:2,5, 8:3, 0:0, 1:1, 3:2, 14:4, 19:5, 20:5
│ │ └─speed	Speed	----	12	
│ │ ├─spmaxmexc	speed of the maximum muscle excitation	----	4,5	
│ │ │ └─***MS20***	**Variable: 20-metre sprint – crouch start**	**sec**	**4.5**	2,8:5, 3,2:4, 3,7:3, 4,1:2, 4,4:1, 4,6:0
│ │ ├─spmax	maximum speed	----	4	
│ │ │ └─***MS20L***	**Variable: 20-m sprint – running already before the start**	**sec**	**4**	2,4:5, 2,6:4, 2,85:3, 3,1:2, 3,3:0
│ │ └─spend	speed endurance	----	3.5	
│ │ └─***MR300***	**Variable: 300-metre run**	**sec**	**3.5**	40:5, 45:4, 49:3, 53:2, 60:1, 70:0
│ └─infcom	Information component of movement	----	6.5	
│ └─regsynant	regulation of synergists and antagonists	----	6.5	
│ ├─balance	Balance	----	4	
│ │ ├─***MBTR***	**Variable: balance transversely on a T-bench**	**sec**	**2**	0,5:0, 1:1, 1,5:2, 3:3, 4,5:4, 8:5, 11:5
│ │ └─***MBLO***	**Variable: balance longitudinally on a T-bench**	**sec**	**2**	0,6:0, 1:1, 2:2, 3:3, 5:4, 8,5:5, 9:5
│ └─flex	Flexibility	----	2.5	
│ └─***MFLEXFW***	**Variable: forward bend on the bench**	**cm**	**2.5**	0:0, 40:1, 45:2, 50:3, 60:4, 70:5, 0:0, 0:0
└─specmot	special motor skills	----	29.5	
├─encom	energy component of movement	----	16.5	
│ ├─power	special power	----	9.5	
│ │ ├─powelast	elastic power	----	5	
│ │ │ └─***MJOB30S***	**Variable: jumps over the bench for 30 seconds**	**rep**	**5**	0:0, 25:0, 30:0, 35,8:1, 41,6:2, 51:3, 54:4, 58:5, 62:5
│ │ └─powstat	static power	----	4.5	
│ │ └─***MDHPOS***	**Variable: Egg (downhill) position**	**sec**	**4.5**	0:0, 0:0, 30:1, 80:2, 130:3, 170:4, 210:5, 240:5
│ └─speed	Speed	----	7	
│ └─spaltmovleg	speed of performing alternating movements with legs	----	7	
│ ├─***MTAPRL***	**Variable: right leg tapping**	**rep**	**3.5**	14:0, 16:0, 18,2:1, 20,4:2, 22,6:3, 25:4, 27:5, 28:5
│ └─***MTAPLL***	**Variable: left leg tapping**	**rep**	**3.5**	16:0, 18:0, 19,6:1, 21,2:2, 22,8:3, 24,4:4, 26:5, 27:5
└─infcom	Information component of movement	----	13	
└─coord	special coordination	----	13	
├─complmot	speed of performing complex motor tasks	----	4	
│ └─***MASCDESC***	**Variable: ascending and descending**	**sec**	**4**	10:5, 12:5, 13,5:4, 16:3, 17:2, 18:1, 20:0

├─agil	Agility	----	5	
│ └─***MSKI9***	**Variable: figures 8 around 9 clubs**	**sec**	**5**	28:5, 29,5:5, 30,5:4, 33:3, 35:2, 37:1, 38:0
└─reorg	ability of reorganization of motor stereotypes	----	4	
└─***MSTJBW***	**Variable: standing long jump backwards**	**cm**	**4**	50:0, 75:1, 90:2, 120:3, 150:4, 165:5, 180:5

Legend: Code – the codes of individual nodes and variables (*detailed description of variables; Lešnik & Žvan,1998; Žvan & Lešnik, 2000).
Names of nodes and variables*- names of nodes and variables (morphology and motor skills space)
Unit: - the units of measurement of variables
kg - kilograms
rep - number of repetitions
sec - seconds
m - metres
cm - centimetres
mm - millimetres
Weight (%)- % of value from the final mark (100 %)
Normalisers and linearity of variables - values of numerical limits for determination of descriptive marks of morphology and motor skills variables
normal text - hierarchically arranged nodes of expert model
bold text - hierarchically arranged individual (measured) variables of expert model (description of individual tests in Lešnik, 1996)

Procedure and data analysis of the study Criterion variable (competitive successfulness)

The criterion variable is represented by a sum of points scored in competitions within the Argeta Cup in the 2007/08 season (Table 2). We tried to increase the objectivity of the results by determining the criterion variable (actual competitive successfulness) on the basis of the system of points of the Ski Association of Slovenia for the 2007/08 season (Ski Assoociation of Slovenia, 2009). The total number of points scored in three best placings in the giant slalom, two best placings in the slalom and the points scored by the best placing in the super giant slalom was calculated for each competitor. On the basis of the obtained values, the competitors were ranked from the best to the worst.

Expert system method

When seeking answers to the research questions, two methods were used. The first one is the expert system method which belongs to the methods of artificial intelligence. The expert model is composed of hierarchically arranged dimensions of the specification equation which have the characters of multi-dimensionality. This means that at individual levels and at the end also at the highest level the characteristics of all the other (hierarchically lower) variables as well as the lowest possible share of mistake are encompassed. Individual variables were joined in a hierarchical tree, where the potential successfulness of an individual within the group of test subjects was calculated on the basis of a criterion function (normalizers) and weights (Table 1).

The calculation of descriptive marks at various levels of successfulness are important for two reasons: a) besides the mark at the highest level, we can also get the marks at all lower levels (the assessments of the node of a model and the assessments of individual variables) for an individual and b) regarding the distribution of the calculated marks at the highest level, it is possible to establish the quality of the entire group of test subjects. Taking the obtained results of the entire group into account, the coach can establish whether the group he/she leads consists of competitors with better or worse marks.

Relationship of the connection between the results of the expert model and criterion variable

The second part of research dealt with the calculation of the basic statistical parameters and the calculation of Pearson's correlation coefficient between the calculated marks (obtained by means of the expert system method) and competitive successfulness (results obtained by the final calculation of all the Argeta Cup competitions). By calculating the correlation, we tried to answer the dilemma whether those competitors who had better motor abilities or who were morphologically more suitable achieved better or worse results in the Argeta Cup in the 2007/08 season.

Results

Table 2: The classification of the measured sample on the basis of the calculation of the points scored in the Argeta Cup competitions (criterion variable) and the calculation of the marks of the measured sample at the highest level according to the expert system method:

Rank	Competitor	Competitive successfulness	expert system mark	descriptive mark
1.	E	855	3.84	very good
2.	C	806	4.15	excellent
3.	AD	771	3.77	very good
4.	AA	726	3.33	good
5.	O	674	3.15	good
6.	V	599	3.43	good
7.	S	500	3.35	good
8.	Z	495	3.54	very good
9.	F	454	4.02	excellent
10.	N	431	3.76	very good
11.	AB	392	2.61	suitable
12.	M	366	3.45	good
13.	L	308	3.8	very good
14.	I	286	3.22	good
15.	AC	282	3.88	very good
16.	K	236	3.23	good
17.	D	231	3.7	very good
18.	B	182	2.93	suitable
19.	J	181	3.46	good
20.	H	173	3.23	good
21.	AE	143	3.65	very good
22.	AG	143	2.62	suitable
23.	AH	138	3.35	good
24.	A	127	3.47	good
25.	AF	83	3.41	good
26.	R	81	3.09	good
27.	P	42	2.34	satisfactory
28.	G	41	3.78	very good
29.	U	17	1.64	satisfactory
30.	AI	16	2.8	suitable
31.	T	3	3.26	good

The values of final marks based on the expert system method (Table 2) are in accordance with the quality of the selected sample. This sample consists of competitors who differ to a great extent in marks at the highest level as well as in marks at hierarchically lower levels. This is also proved by the range of the calculated marks from the lowest 1.64 (satisfactory) to the highest 4.15 (excellent). The normal distribution of the results obtained is confirmed by the calculated value of the coefficient of the normality of distribution according to the K–S test ($r = 0.884$).

The presented final order of the potential successfulness of the sample of test subjects (Table 2) shows that the competitors with the mark ‘good’ are most numerous (14 test subjects). At the highest level of the tree of successfulness, the ‘very good’ mark was achieved by 9 test subjects, 4 test subjects were marked ‘suitable’, 2 competitors obtained the ‘excellent’ mark and 2 ‘satisfactory’ mark.

An example of the interpretation of the results of expert system method for individual competitor

Table 3: Presentation of the results and calculated marks of an individual competitor according to the expert system method

Official code	Competitor E Result	f(x)	Mark
mark		3.84	very good
├─morf		4.28	excellent
│ ├─intgd		4.44	excellent
│ │ └─***BW***	***68.9 kg***	***4.44***	***excellent***
│ ├─exgd		4.37	excellent
│ │ ├─longdim		4.64	excellent
│ │ │ ├─***BH***	***168.9 cm***	***4.51***	***excellent***
│ │ │ └─***LENLEG***	***96.5 cm***	***4.88***	***excellent***
│ │ ├─transdim		3.55	very good
│ │ │ ├─***DIALKN***	***9.8 cm***	***3.50***	***very good***
│ │ │ └─***DIALAN***	***7.6 cm***	***3.60***	***very good***
│ │ └─vol		4.83	excellent
│ │ └─***CIRLTH***	***54.5 cm***	***4.83***	***excellent***
│ └─intgd		3.05	good
│ ├─***SFSTOM***	***13.6 mm***	***2.35***	***satisfactory***
│ └─***SFTHI***	***9 mm***	***3.75***	***very good***
└─mot		3.61	very good
├─basmot		3.56	very good
│ ├─encom		3.61	very good
│ │ ├─power		3.38	good
│ │ │ ├─powsingl		2.70	suitable
│ │ │ │ └─***MST3JSL***	***628 cm***	***2.70***	***suitable***
│ │ │ ├─powdoubl		3.44	good
│ │ │ │ ├─***MSTLJDL***	***219 cm***	***3.36***	***good***
│ │ │ │ └─***MSTLJ10DL***	***22.04 m***	***3.52***	***very good***
│ │ │ └─powrep		4.00	excellent
│ │ │ └─***MBAHUGR***	***14 rep***	***4.00***	***excellent***
│ │ └─speed		3.93	very good
│ │ ├─spmaxmexc		3.56	very good
│ │ │ └─***MS20***	***3.42 sec***	***3.56***	***very good***
│ │ ├─spmax		4.45	excellent
│ │ │ └─***MS20L***	***2.51 sec***	***4.45***	***excellent***
│ │ └─spend		3.80	very good
│ │ └─***MR300***	***45.8***	***3.80***	***very good***
│ └─infcom		3.34	good
│ └─regsynant		3.34	good
│ ├─balance		3.24	good
│ │ ├─***MBTR***	***5.71 sec***	***4.35***	***excellent***

│ │ └─***MBLO***	***2.13 sec***	***2.13***	***satisfactory***
│ └─flex		3.50	very good
│ └─***MFLEXFW***	***55 cm***	***3.50***	***very good***
└─specmot		3.67	very good
├─encom		4.36	excellent
│ ├─power		4.87	excellent
│ │ ├─powelast		4.75	excellent
│ │ │ └─***MJOB30S***	***57***	***4.75***	***excellent***
│ │ └─powstat		5.00	excellent
│ │ └─***MDHPOS***	***210 sec***	***5.00***	***excellent***
│ └─speed		3.67	very good
│ └─spaltmovleg		3.67	very good
│ ├─***MTAPRL***	***24 rep***	***3.67***	***very good***
│ └─***MTAPLL***	***24 rep***	***3.67***	***very good***
└─infcom		3.75	very good
└─coord		2.80	suitable
├─complmot		2.10	suitable
│ └─***MASCDESC***	***16.9 sec***	***2.10***	***satisfactory***
├─agil		2.30	satisfactory
│ └─***MSKI9***	***34.4 sec***	***2.30***	***satisfactory***
└─reorg		4.13	satisfactory
└─***MSTJBW***	***152 cm***	***4.13***	***excellent***

Legend: Italic bold text/large caps – variables of model; small caps – individual nodes of expert model
kg - kilograms
rep - number of repetitions
sec - seconds
m - metres
cm - centimetres
mm - millimetres

According to the calculation of points, competitor E gathered the maximum number of points (total 855) in the previous season. At the highest level of the model of potential successfulness (Table 3), he was marked ‘very good’ (mark = 3.84) according to the expert system method, which places him at the fourth place within the tested sample. He obtained the ‘excellent’ or ‘very good’ mark in both main subsystems of the dimensions measured (morf = 4.28, mot = 3.61). According to the marks of the anthropometric and morphological measures, this competitor could suit the desired type of skier. The excellent assessment of body weight most certainly contributes to this fact (BW = 4.44) because the possibility to master the weight of one’s own body in time and space is conditioned to a great extent by body weight. The longitudinal dimensions of this competitor are also marked ‘excellent’ (BH = 4.51; LENLEG = 4.88), the same holds true of the thigh circumference (CIRLTH = 4.83). This exerts an important influence on the ‘excellent’ mark of the space of external geometric dimensions (exgd = 4.37). Within the “exgd” code, his marks for the transverse dimensions of the lower extremities were very good (DIALKN = 3.50; DIALAN = 3.60); they are linked with the ability of the skeleton to endure great forces formed during skiing. The space of internal geometric characteristics is marked ‘good’ (intgd = 3.05). A slightly lower mark is due to a slightly lower mark of the quantity of the subcutaneous stomach fat (SFSTOM = 2.35), whereas the measurement of the skin fold of the thigh was marked with ‘very good’ (SFTHI = 3.75). The mark of the skin fold of the thigh can be encouraging with regards to the assessments of the ratio of the muscle fibres to the thickness of the fatty tissue on the thigh.

Within the framework of the space of motor dimensions, basic as well as special motor functions of competitor E were marked 'very good' (basmot = 3.56; specmot = 3.67). The analysis of the marks of the space of basic motor functions shows that within the space of the energy component of movement which is marked 'very good', certain forms of repetitive and takeoff power (MBAHUGR = 4.00; MSTLJ10DL = 3.52), speed (MS20L = 4.45; MS20 = 3.56) and speed endurance (MR300 = 3.80) of the test subject are excellent or very good. Within the category of the takeoff power, the test subject achieved the mark 'very good' in the test double leg takeoff power (MSTLJDL = 3.36) and a worse mark ('suitable') in the test single leg takeoff power (MST3JSL = 2.70).

The information component of movement within the space of basic motor dimensions represents a secondary motor ability and is indicative of the regulation of the functioning of synergists and antagonists. It is in a close connection with the functioning of the centres in the central nervous system, whose functions are the formation, performance and control of motor actions (Enoka, R. M.,1994).

In competitor E, the information component of movement within the space of basic motor dimensions was marked 'good' (infcom = 3.34). Interesting results in tests testing the ability of keeping the balance position indicate primarily great differences regarding the balance position in the sagittal and frontal planes of the test subjects. The marks of the tests show that the test subject is capable of an excellent control of the oscillation of the centre of gravity in the left and right directions (MBTR = 4.35), whereas in the second balance test, the test subject achieved only a satisfactory result (MBLO = 2.13). In Alpine skiing, the flexibility enables the competitor the quality stretching of the muscles prior to and after a particular load. During skiing, the quality flexibility reduces the possibility of injuries when it comes to different (unexpected) reactions. On the basis of the linear flexibility test, the competitor's mark is 'very good' (MFLEXFW = 3.50).

In the space of special motor variables which arise from the structure of movement in skiing, competitor E obtained the 'very good' mark (specmot = 3.67). The excellent mark for energy component of movement (encom = 4.36) and the mark for the dimensions of the information component of movement (infcom = 3.75) contributed to this mark.

The energy component of movement within the special motor dimensions is composed of the dimensions of takeoff and static strengths, in which the test subject was marked 'excellent' (power = 4.87), and dimensions of the speed of alternating movements, in which the test subject was marked 'very good' (spaltmovleg = 3.67). Excellent marks for the repetitive strength of the legs (MJOB30S = 4.75) and static strength of the legs (MDHPOS = 5.0) show a good development of abilities which play an important part in the successfulness model. If the structure of movement in the slalom and to a certain level also in the giant slalom course settings is based primarily on successive cycles of eccentric and concentric muscular contractions of the legs, the ability of enduring in a low (static) skiing position is of great importance in fast disciplines.

The speed of coordinated execution of alternating movements with the leg (spaltmovleg = 3.67) is defined with variables of plate tapping with the right leg (MTAPRL = 3.67) and plate tapping with the left leg (MTAPLL = 3.67). The tests can be treated as an imitation of a series of fast movements with legs in the left and right directions in very frequent and arhythmic slalom course settings.

Under mechanism for the regulation of movement (infcom), we classified the area of coordination (coord) within the framework of special motor abilities. The ability of carrying out elements in Alpine skiing that are demanding from the point of view of coordination is not important only because of an easier teaching of skiing elements. The ability of executing complex motor tasks is an essential dimension that provides the competitors with a feeling that enables an effective skiing technique along the set course.

Within the independent node of coordination (coord), we have focussed on factors that play an important role in Alpine skiing. The first node represents the speed of performing complex motor tasks (complmot = 2.10). The setting of the gates on the course as well as the variable ascending and descending represents an obstacle that has been determined in advance and that the test subjects must overcome with precisely prescribed movements as quickly as possible. At the same time, the test shows the ability of a quick solution to motor problems; this ability represents an upgrade of motor stereotypes in competitive Alpine skiing. Competitor E has achieved a worse mark in this ability (MASCDESC = 2.10).

The second node of coordination is represented by a variable which helps us to establish a fast change in the direction of movement. The correct performance of the test is based on how the test subject moves and on the length of the path but it is, however, not important which path leading to the finish the test subject chooses. Since this is a markedly skiing test, the time of the performance of the test depends on the distance of the line of movement around and past the set clubs. Precision and punctuality are of great importance and are determined by means of various course settings in the training process. The ability of competitor E is at a lower level also in this task (MSKI9 = 2.30).

The third node of coordination within the framework of special motor abilities is represented by the ability of reorganization of motor stereotypes (reorg). The test standing long jump backwards is an indicator of the ability to use automated motor information and an indicator of its yield when learning and carrying out new motor tasks (motor transfer). The test subject was marked 'excellent' in the variable standing long jump backwards (MSTJBW = 4.13).

In Alpine skiing, the quality of this ability is useful in testing and in the selection of the skis for the competitive skiing season as well as when adapting topical knowledge and techniques to new trends which are a key to achieving better or even the best results in competitions (Žvan & Lešnik, 2000).

On the basis of information obtained by the coach about each individual competitor in the training process, the coach can numerically and descriptively assess the competitor's state of motor abilities and morphological characteristics with the help of expert modelling. The data processing with the SMMS program also makes various presentations of results (profiles, graphs, histograms, etc.) possible; these presentations enable the coach to quickly understand the state of each individual. Taking the individual's advantages and disadvantages into account, the coach can make more detailed plans concerning the quantity as well as the contents of training in future.

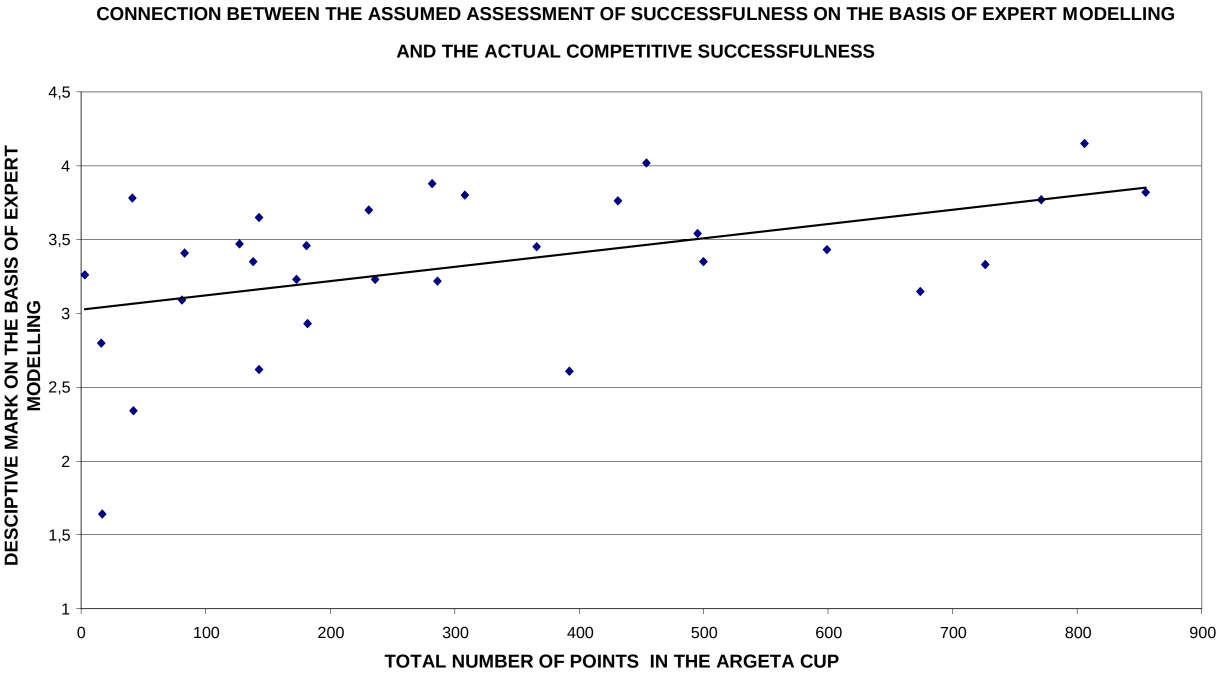
Relationship between the assumed assessments of potential successfulness (expert system) and the actual competitive successfulness

On the basis of the calculation of Pearson's correlation coefficient between the marks obtained by the expert system method and the actual successfulness (points scored in the Argeta Cup competitions), we established a statistically significant level of correlation (r=0.47). The calculation of the level of connection between the assumed assessment of the competitive successfulness (expert system) and the actual successfulness (points) is a relevant indicator of the validity and quality of the reduced model of potential successfulness.

The value of Spearman,s correlation coefficient of the connections between the assumed assessments of successfulness based on the expert system method and competitive successfulness of older boys in Alpine skiing is statistically significant and amounts to (r=0.47). The value of the obtained coefficient is statistically significant at the level of 1 % risk, which proves not only the quality of the chosen sample of variables of morphology and motor functions but also the suitability of the configuration of the developed potential model of successfulness for the treated sample of test subjects.

Disscusion

Chart 1: Presentation of the dispersion of results gained by the expert system method and the results of the criterion variable (points scored in the Argeta Cup competitions):



The presentation of the dispersion of results gained (Graph 1) shows that the quality of the sample measured differs greatly. The straight line which represents the direction of the connection between the marks obtained and the points scored in the competitions is directed upwards. A slightly greater concentration of test subjects is noticeable in the area of relatively high assessments of the state of motor and morphological dimensions (calculation based on the expert system method), but it does not exceed 500 points calculated with the help of the criterion value (competitive successfulness). This information reveals that the competitors comprising the sample measured have a good potential basis for achieving top results; at the same time, it is necessary for them to make progress in other dimensions which are, besides morphology and motor functions, essential for achieving good results in competitions. In the past, expert modelling was used to establish not only the motor and morphological but also the psychological status of young competitors. In younger categories of competitors, the psychological model did not show statistically significant influence on the competitive successfulness. The reasons for that can be due to the fact that the 13 and 14 year old children are immature personalities, therefore they are unable to appropriately answer the questionnaires concerning the personality characteristics and motivation (Lešnik, 1996). Besides psychological and other aspects of treating young competitors (social, medical status, etc.), the quality and quantity of work on snow is another important factor in the training process itself.

Conclusion

In modern times, the possibilities of achieving top results can be increased only by expert and scientifically supported work of coaches and others who take part in the training process. In planning and conducting the training process, it is important to take account of the greatest possible number of those dimensions which exert a decisive influence on the competitive success (Le Master, 2007; Neumayr, Hoertnagl,, Pfister, Koller, Eibl, & Raas, 2003; Ulaga, 2001).

The component part of the planning and conducting the training process is the use of methods and means for the monitoring of factors that exert the greatest influence on success. Therefore the choice of a suitable and effective battery of variables with the help of which we establish the progress of competitors is of great importance. On the one hand, it represents an important basic starting point for the planning and conducting of the training process and on the other hand, it represents the basic monitoring and control of the psychophysical fitness of sportsmen. In top sport, the results achieved in competitions are a reflection of how well the competitors are prepared and at the same time, the competitions represent a criterion of quality of the entire training process.

In Slovenia, there is an increasing number of coaches who make use of the SMMS program in planning and conducting training. On the basis of the results of studies that have been obtained in the period of more than twenty years, the coach can (with greater certainty) include those contents in the training process with the help of which an individual will make progress in worse assessed dimensions and will consequently have a greater chance to achieve better results in competitions.

The evaluation of the psychomotor status is one of the most important components of the training process (Reid, Johnson, Kipp, Albert, & White, 1996). On the basis of the results and the obtained marks, the coach exerts an effective influence with the help of training on the development of those abilities in which the competitor is still able to make progress.

With the help of expert modelling we have confirmed that the coaches' work concerning the motor preparation of competitors is well planned. The calculation of the correlation between the potential and competitive successfulness has confirmed the quality of the choice of predictors which form the current model of potential successfulness. Despite that the obtained curve of the connection between the calculated marks of the expert model and criterion variable leads to the conclusion that besides the morphological and motor status, competitors possess quite a few potentials that are not exploited sufficiently (psychology, technique, tactics, etc.).

The results achieved in the most important international competitions for children (Troffeo Toppolinno, Loka Cup, etc.) already confirm the correct orientation of the coaches' work. We will try to make use of this in the future. Our task is to help the greatest possible number of young potentials in order to direct them to become champions in senior competitions.

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ANAEROBIC POWER IN MALE SUBJECTS OF DIFFERENT CHRONOLOGICAL AND BIOLOGICAL AGE

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Abstract

The aim of the present study was to determine and compare the anaerobic power parameters (mean and peak power) in the subjects of different chronological and biological age. The first group of subjects (boys, n=30) was composed of preadolescent boys at the chronological age of 11.2±0.4 years, Tanner's pre-pubertal stage 1. The second group of subjects (men, n=30) was composed of male adults at the chronological age of 20.1±0.5 years. The investigation protocol included anthropometric measurements and two series of Wingate anaerobic test. The mean and peak power output values developed during the Wingate anaerobic test is lower in boys than in men even when it is expressed by total (absolute), body mass or fat free mass unit. The results of our and similar investigations undoubtedly point out that in comparison to adult males, preadolescent boys appear to be limited in their ability to perform short-term anaerobic exercise. Research is still needed on the specific developmental stage at which an individual acquires the adult characteristics for anaerobic exercise.

Introduction

Anaerobic energy sources provide a large amount of energy in a short period of time, allow short-term intensive physical activity and are basis of muscular strength and speed. Muscle mass is evenly increased in parallel with the increasing body weight from the birth to the adolescence. Considering the boys, the most muscle growth is achieved at puberty along with rapidly increasing production of testosterone. The girls, during puberty lack the pronounced increase in muscle mass. Increasing of the muscle mass in boys and girls is primarily the result of hypertrophy of muscle fibres. In females, the maximum muscle mass is reached between 16 and 20 years and males between 18 and 25 years, provided that it is possible to further develop the appropriate training and adequate nutrition (Rowland, 1996). According to the results of some previous studies in preadolescent children have the same or a lower ability to increase the relative power (expressed in percent improvement), but still lower absolute possibility of increasing force (pronounced improvement of the measuring unit) compared to adolescents and young adults.

One of the reasons for a relative small number of investigations of anaerobic capacity and muscle strength and power in children is the non-existence of the optimal test. Many tests have been devised to assess anaerobic power and endurance for the evaluation of anaerobic fitness levels and to examine anaerobic training effects. Tests have measured both physiological and performance variables. Physiological parameters examined have included oxygen debt, and post exercise blood and muscle lactate levels. However, the tests are invasive and require sophisticated equipment so they are expensive and mainly inconvenient for use in children. On the other hand, performance tests are non-invasive, simple and inexpensive, but of lower validity i.e. they cannot display the maximum anaerobic ability of the subject. Earlier studies of muscle strength with measurements of strength in hand grip, knee flexion and back extension demonstrated low correlation coefficient of strength in other muscle group. For example, hand grip strength is correlated to the strength in the other muscle groups with a low correlation coefficient of 0.25-0.51 (Armstrong, Welsman, Williams, & Kirby, 2000). After that, investigators have used short term cycle tests with various protocols, and insufficiently investigated sensibility and validity for anaerobic capacity (Williams, 1997). Over the last two decades, most laboratories for functional diagnostics have used the Wingate anaerobic sprint test in the investigation of anaerobic capacity. This standardized test presupposes the 30-s all-out maximal effort on a cycle ergometer (Bar-Or, 1994). The way of loading the subjects is in a direct dependence of the manufacturer i.e. the type of cycle ergometer used, but there are standardized and precise testing protocols for all types. During the Wingate anaerobic test, the recording of the two parameters is compulsory (mean and peak power) whereas the other values can be derived from the basic (fatigue index, speed of achieving peak power values, etc.). Mean power output is the average power output for the entire 30-s test. Peak power output is the highest power output during any 5-s interval during the test. The sensibility and validity of the test have been confirmed by several direct studies (Beneke, Pollmann, Bleifi, Leithauser, & Hustler, 2002), and the Wingate test is currently considered the best performance test for determining anaerobic capacity and it is widely used for investigating athletes, children and even children with certain neuromuscular diseases.

The aim of the present study was to determine and compare the anaerobic capacity parameters (mean and peak power) in the subjects of different chronological and biological age.

Methods

Sample

The first group of subjects (boys, n=30) was composed of preadolescent boys at the chronological age of 11.2±0.4 years. All subjects were pupils attending the city elementary schools who were not engaged in any kind of organized physical activity at least six months prior to the investigation. All children volunteered to participate in the study. Before the beginning of the study, the informed consent of both the children and their parents were obtained. The same trained research team made all measures and assessments throughout the duration of the study. The age was computed from date of birth and date of examination. Sexual maturation was classified according to Tanner's indexes of pubic hair (Tanner, 1962). All subjects in this group were at Tanner's pre-pubertal stage 1. A total of 30 subjects in this group underwent a protocol of investigation.

The second group (men, n=30) of subjects was composed of male adults at the chronological age of 20.1±0.5 years. None of the subjects in this group was engaged in organized physical activity at least six months prior to the investigation. A total of 30 subjects in this group underwent a protocol of investigation. The subjects were introduced to the protocol of investigation, and before the beginning of the investigation, they gave written informed consent, confirming voluntary participation.

The examinees were admitted for laboratory examination at 11 a.m. after at least 8 hours of an overnight rest, and a light breakfast at least 2 hours before the laboratory examination. The examination was performed in a well-ventilated laboratory, under thermo-neutral conditions at 22-23 degrees C, and 55-60% relative air humidity. During the examination, the subjects were using the sports equipment.

Variables

The investigation protocol included anthropometric measurements and Wingate anaerobic test. Anthropometric equipment was calibrated according to the manufacturer's instructions. Stature was measured by using a stadiometer (GPM, Swiss) to the nearest 0,1 cm. Body weight was determined using electronic balance scale (Tefal, M6010, France) to nearest 0,1 kg. Fat mass (FM) and fat free mass (FFM) were determined by bioelectrical impedance analysis-BIA (US National Institute of Health Technology, 1996) using an Omron (Japan) device according to standardized procedure for the type of device used (Chumlea et al., 2002). The Wingate test was conducted on a cycle ergometer interfaced with computer. Data registration was performed using the computer program specially designed according to standards of the author's test (Inbar, Bar-Or, & Skinner, 1996) and announced technical description of the system for computer data registration (Inesta, Izquierdo, & Angeles Sarti, 1995). The rest of the Wingate standardization elements were applied following the author's recommendation. The results obtained during the test were automatically recorded and computed. The investigated parameters of anaerobic capacity were expressed both in absolute (W), and in two relative values: in relation to body weight ($W \cdot kg^{-1}$) and fat free mass ($W \cdot kg^{-1}FFM$). The examinees performed Wingate anaerobic test in two series, which were separated by a 45 min break. The protocol of investigation was the same for all participants, and the same ergometer was used for all tests throughout the study. All investigated subjects underwent the Wingate test for the first time. Results included the series that revealed parameters with better values of peak power (PP) and mean power (MP).

Data analysis

Statistical processing of anthropometric values was evaluated by Student's t-test. The evaluation of differences in estimating fat mass percentage, fat free mass and the values of the peak and mean power between groups was performed by Mann-Whitney U – Wilcoxon Rank Sum W test.

Results

All results are presented in Table 1 and Table 2. The data are expressed as means±SD.

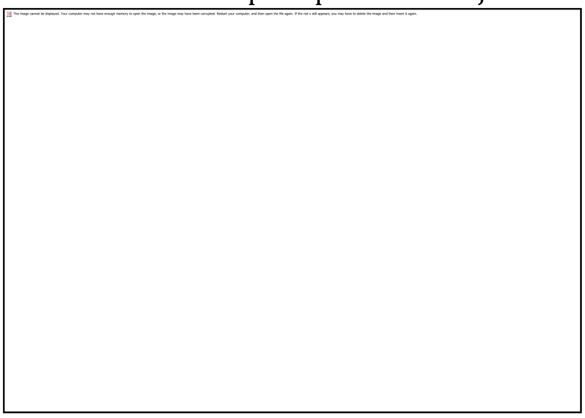
Table 1: Anthropological variables in subjects under investigation

	Boys (n=30)	Men (n=30)	P value
Age (years)	11.2±0.4	20.1±0.5	<0.01
Body height (cm)	148.46±5.24	178.22±7.04	<0.01
Body weight (kg)	41.83±6.12	74.06±7.98	<0.01
Fat mass (%)	19.06±5.89	14.8±4.56	<0.05
Fat free mass (kg)	33.86±5.11	63.1±7.37	<0.01

Table 2: Absolute and relative values of peak and mean power in subjects under investigation

	Boys (n=30)	Men (n=30)	P value
Peak power (W)	339.26±89.25	753.74±111.26	<0.01
Mean power (W)	293.12±76.13	641.88±94.72	<0.01
Peak power ($W \cdot kg^{-1}$)	8.11±1.22	10.18±2.84	<0.05
Mean power ($W \cdot kg^{-1}$)	7.01±1.08	8.66±1.53	<0.05
Peak power ($W \cdot kg^{-1}$FFM)	10.02±1.14	11.95±1.98	<0.05
Mean power ($W \cdot kg^{-1}$FFM)	8.66±1.43	10.17±1.61	<0.05

Figure 1: Absolute values of peak power in subjects under investigation

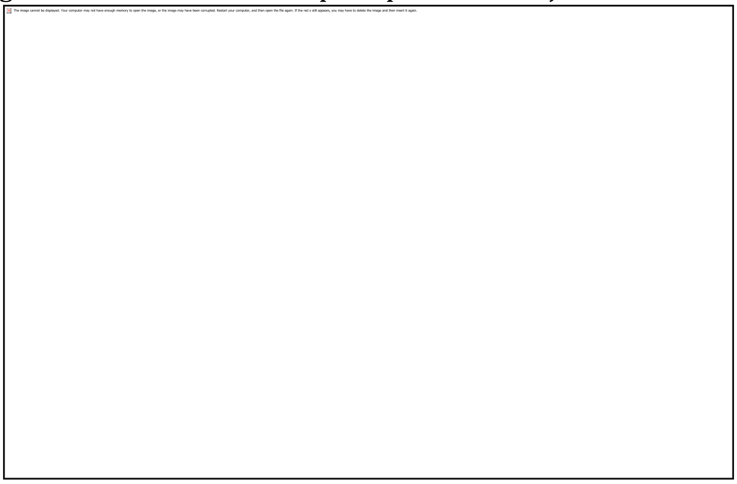


Values are means; * significant difference (p < 0.01).

The results obtained show that anaerobic mean and peak power outputs are lower in first group subjects (boys) than in second (men) in all investigated variables. The differences exist in absolute values (PP boys vs. men: 339.26±89.25 vs. 753.74±111.26, p<0.01), as it showed in Figure 1.

When the obtained values are expressed in relative units, i.e. in relation to body weight, the differences remain statistically significant (PP boys vs. men: 10.02±1.14 vs. 10.17±1.61; p<0.05), as it showed in Figure 2.

Figure 2: Relative values of peak power in subjects under investigation



Values are means; * significant difference (p < 0.01).

Discussion

The results obtained show that anaerobic mean and peak power outputs are lower in first group subjects (boys) than in second (men). Certainly, the greatest differences exist in absolute values (MP boys vs. men: 293.12±76.13 vs. 641.88±94.72, p<0.01). However, even when the obtained values are expressed in relative units, i.e. in relation to body weight, the differences remain statistically significant (MP boys vs. men: 7.01±1.08 vs. 8.66±1.53; p<0.05). In order to determine the differences in investigated values of anaerobic power even more accurately, the obtained values were expressed in relation to fat free mass, which is not a common case in similar investigations. Fat free mass represents the body mass devoid of all extractable fat. The differences in mean and peak power outputs between the groups, although lower than in the comparison of absolute and relative values, showed a statistical significance as well (MP boys vs. men: 8.66±1.43 vs. 10.17±1.61; p<0.05). The investigation pursuing a similar concept showed no differences in anthropometric characteristics and values of short term muscle power in the subjects of the same sex aged 8-12 years. A longitudinal investigation of De Ste Croix, Armstrong, Chia, Welsman, Parsons, & Sharpe (2001), carried out on the same subjects who underwent two tests within an interval of almost complete two years confirmed that there were no differences in the values of short term muscle power between sexes in the preadolescent period, and the increase in the values of final in relation to initial measurement was the consequence of the increase in body mass, i.e. muscle tissue mass during the period of growth. The results of our previous (Ranković, Radovanović, & Ranković, 2007; Bratić, Radovanović, & Nurkić, 2008) and similar investigations undoubtedly point out that in comparison to adult males, preadolescent boys appear to be limited in their ability to perform short-term anaerobic exercise (Inbar, 1996).

In comparison of obtained results with results of similar investigations of this problem worldwide, an interesting finding was that regardless of the type of equipment and protocols used, the subjects included in our study were taller, heavier, and with a higher percentage of fat tissue in relation to both preadolescent and adult male subjects included in those investigations.

The results of investigations in which other tests such as force-velocity and isokinetic cycle ergometers were used also show that children's and adolescent's anaerobic power scores are lower than those in adults (Dore, et al., 2005). Qualitative muscular differences are cited more frequently for this disparity than differences in the quantity of muscle, but conclusive research is lacking in this area. It has been considered that children have a limited ability to perform anaerobic type activities. The results of some investigations showed a lower concentration of phosphofructokinase, the key rate-limiting enzyme of anaerobic glycolysis which indicated that children cannot achieve adults concentrations of lactate in either muscle or blood for maximal and supramaximal rates of exercise (Froberg & Lammert, 1996). However, lactate threshold, when expressed as a percentage of VO_{2max}, does not appear to be a limiting factor in children because children's lactate thresholds are similar if not higher than those in similarly trained adults (Williams, 1997). Some data on children's muscles suggest that their biochemical characteristics are different from young adults muscle. The concentration of ATP in resting muscle and its utilization during intense exercise seem to be similar in preadolescent boys and older males. By contrast, phosphocreatine concentration is somewhat lower at rest in preadolescent boys and has the same or slightly lower rate of utilization than that found in older males. The main age of maturation related difference is in the concentration and utilization of muscle glycogen. Both factors are distinctly lower in preadolescent boys (Armstrong, Welsman, & Chia, 2001). Based on these data, it seems that the biochemical difference in anaerobic power between children and adults is associated with anaerobic glycolysis and less with phosphagen system. There are no data to explain why prepubescent children have a lower glycolytic capacity. There are indications that the development of neural activation of motor units and muscle metabolism during exercise play a significant role. To generate maximum power, muscle must be fully activated, and whether young people can, or do, fully activate their muscles during exercise is difficult to establish with certainty. No longitudinal data are available that examine the issue through adolescence, but it has been reported that 16-year-olds have a greater degree of motor unit activation of the knee extensors than 10-year-olds. Furthermore, Sargeant (2000) has pointed out that maturation of the corticospinal tract continues into the second decade with, for example, cortico spinal conduction velocity continuing to increase up to about 15 years.

The science and profession of sport do not yet have a definitive opinion on the effectiveness of force and strength training in the preadolescent period. With proper technical instruction, the exercise of the adequate exercise and supervision during training, force and strength training is a particularly risky activity for preadolescents and adolescents.

Conclusion

The mean and peak power output values developed during the Wingate anaerobic test is lower in preadolescent boys than in adults even when it is expressed by total (absolute), body mass or fat free mass unit. Research is still needed on the specific developmental stage at which an individual acquires the adult characteristics for anaerobic exercise. Although the biochemical data mentioned above are in line with lower ability of children to perform anaerobic exercise, they do not explain the mechanism of such a deficiency. Studies at the cellular level are needed to tell whether there are any age or maturation related differences in muscle fiber types that are recruited during supramaximal exercise. With regards to training exercise planning and dosing in our conditions, from the practical point of view, there is a need to conduct several longitudinal studies on a bigger sample of children of both genders in order to get a broader picture of anaerobic capacity depending on the chronological and biological age. These data would present significant practical directions for the beginning and intensification of strength and endurance training program during the preadolescent and adolescent period.

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THE CHANGE OF SPECIFIC MOTOR INDEX INDICATORS IN YOUNG WATER POLO PLAYERS AFTER THE PREPARATORY PERIOD

Zoran Bratuša and Milivoj Dopsaj

Abstract

Training work with junior age groups requires constant control in order to control the work effect. Permanent testing, as a manner of monitoring, i.e., training control can indicate to intensity and direction of changes that occur after the completion of training period. General and specific dry land and tests in water are usually used for monitoring the development of young water polo players (up to the age of 12). The comparison of the test indicate to a possible change in the level of motor abilities influenced by training, but based on such methodology procedures it is very hard to define the structure of the occurred changes. The aim of this paper is to obtain, based on the index indicators of motor abilities at the initial and final measurement, the structure changes occurred after training. The obtained information should primarily be used for improvement of training work. For the purposes of this paper, 20 water polo players were monitored for 12 weeks. During this period players had 72 training days. The change of motor abilities structure was monitored through five variables – index indicators, calculated as relations of 8 motor tests. All index variables were subjected to descriptive statistical analysis and MANOVA analysis. The results displayed that, on general level, between the initial and final measurement there is a difference (Wilk's Lambda = 0,626 for p = 0,045). The only statistically significant difference was established in the index (ThB-J10×) – relation between throwing the ball at distance in water and jumping 10× from the basic water polo position to touch the crossbar with hands. The results show that there were statistically significant differences in both basic variables, and since both techniques base the performance on leg stroke, we can conclude that the training work contributed to the improvement in the performance of motor actions very significant in certain game segments, dominantly realized in vertical position. Such consideration of the obtained results should enable better understanding of the training process effects and the structures of changes resulted after training, and thus affect the methods and metrology procedures of training process control.

Introduction

Training work with junior age groups requires constant control so that the work effect could be followed. As the children at the age of 12 are at the beginning of a period of turbulent growth and development, it is necessary to constantly control both training and development. Permanent testing indicates to changes that occur after the completion of training period. General and specific dry land and tests in water are usually used for monitoring the development of young water polo players (up to the age of 12) (Gatta, 1992; Bratusa, Dopsaj, Štirn, Peranovič, 2008). The players were tested at the beginning of the preparatory period (initial test) and after the preparatory period - twelve weeks later (final testing). Test results indicate that there was an improvement of the monitored motor abilities. Tests have shown that there has been an improvement of motor abilities after the completion of training, but the structure of the changes cannot be seen. The aim of this paper is to obtain, based on the index indicators of motor abilities at the initial and final measurement, the structure changes occurred after training. The obtained information should primarily enable better analysis of the obtained results and the structure of changes occurred due to training as well as to control the training process and therefore for improvement of training work.

Methods

The sample of subjects consisted of the selection on junior water polo players, of average age of 11.5 years. For the purpose of this paper, the results were taken of twenty boys who regularly attended trainings, and had less tha 10% of absence from trainings. The average training experience was 2.7 years. In the said period, there were 72 ttaining days, out of 84 calendar days, which indicates that the training index was 0.8571 (ratio of calendar and training days). The training work was realized in 152 hours, i.e., 2,1 hour per a training session. Out of 152 training hours, 21.05% was held in a hall (dry land), 31,58% trainings were held in a small pool (swimming sections) and 47.37% in a big pool. In this period the players swam (period of play included) 182.4 km, which on average is 2.52 km per training. The average value of the general index of training work intensity, defined as the ratio of the work volume expressed in hours and swimming volume expressed in meters [m] amounts to 1200 m/h. Of 182.4 km, 15.79% was warm-up swimming, 47.38% were different swimming sections and in the specific part of training (swimming at the training game with or without the ball and through specific exerxises) 28.94% was swum while 7.90% was cooldown. After the training completion, the difference between initial and final measurement indicates to changes occurred after the preparatory period.

The basic research method was experimental method with application of experiment model with one group. All the necessary measurements were performed by testing in standard conditions and according to standard procedure on the same place (Bratuša, 2000). All monitored data were recorded in the previously prepared database.

The following index indicators, i.e., variables were constructed for the needs of this paper:

- INDEX 10m crawl/crawl with ball (S10mc-cB) – the relation between crawl technique swimming 10m, start form water, without the ball and with the ball expressed in numerical index values.
- INDEX 3×5m crawl, crawl with ball (S3×5mc-cB) – the relation between crawl technique swimming 3×5m without the ball and with the ball, start form water, expressed in numerical index values
- INDEX dry land and in water ball throwing (ThBdr-w) – relation between dry land and in water ball throwing at distance expressed in numeric index values
- INDEX throwing the ball in water and jumping 10× at goal (ThB-J10×) – relation between throwing the ball at distance in water and jumping 10× from the basic water polo position to touch the crossbar with hands expressed in numerical index values
- INDEX long jump, throwing the ball in water (LJ-ThBw). The relation between standing long jump, dry land and throwing the ball in water expressed in numerical index values

The variables were subject to the following statistical analysis – descriptive (MEAN-mean values, SD-standard deviation and cV%-coeficient of variation) and MANOVA (Hair, Anderson, Tatham, Black, 1995).

Results

Table 1 indicates the values of basic descriptive statistics at initial and final measurements of the constructed variables. The results indicate to an extraordinary uniformity of the monitored variables in both measurements.

Table 2 shows the values of basic descriptive statistics at both the initial and final measurements of the tests performed prior to and after the preparatory period (ML-LJ – long jump; ML-ThBdr – throwing ball on the lend; S-10m – swimming 10m; S-10mB - swimming 10m with ball; S-3x5m – swimming 3x5m; S-3x5mB - swimming 3x5m with ball; S-ThBw – throwing a ball in the water and S-Jw-10x jumping 10× from the basic water polo position to touch the crossbar with hands. Even here, the results point out an exceptional uniformity.

After MANOVA, Table 3, it can be concluded that on general level there is a difference (Wilki's Lambda = 0.626 for p = 0.045) between the initial and final measurement.

The only statistically significant difference was established at the INDEX of throwing ball in water with jump 10× at goal (ThB-J10×) - relation between throwing the ball at distance in water and jumping 10× from the basic water polo position to touch the crossbar with hands. In both tests, ball throwing at distance and jumps at goal, the result is directly related to the efficiency of leg performance. There were improvements in both tests, in jumps at goal 10× the players would perform the task of high jump in shorter time ($mean_{ini}$=14.03 sek; $mean_{final}$=12.49 sek), and after a 3-month period there were improvements even in throwing ball at distance ($mean_{ini}$=13.20 m; $mean_{final}$=14.07 m) Table 2.

Table 1: Descriptive Statistics

Descriptive Statistics				
	Test	Mean	Std. Deviation	N
S10mc-cB	Initial	.9142	.0621	20
	Final	.9041	.0351	20
S3×5mc-cB	Initial	.9046	.0621	20
	Final	.9269	.0430	20
ThBdr-w	Initial	1.4373	.1976	20
	Final	1.4551	.1550	20
ThB-J10×	Initial	.9625	.2002	20
	Final	1.1550	.2536	20
LJ-ThBw	Initial	12.5753	2.0279	20
	Final	12.0960	1.8088	20

Table 2: Descriptive statistic of initial and final testing

Results of tests									
		ML-LJ	ML-ThBdr	S-10m	S-10m-B	S-3x5m	S-3x5m-B	S-ThBw	S-Jw-10x
I	MEAN	163.50	18.74	7.79	8.55	15.91	17.62	13.20	14.03
n	SD	17.18	1.91	0.55	0.61	1.37	1.51	1.66	1.91
i	cV%	10.50	10.22	7.11	7.17	8.64	8.57	12.58	13.64
F	MEAN	167.75	20.29	7.39	8.18	14.96	16.17	14.07	12.49
i	SD	15.17	1.89	0.49	0.50	1.01	1.23	1.83	2.12
n	cV%	9.04	9.31	6.69	6.13	6.67	7.63	12.99	12.09

Table 3: Multivariate analysis of variance

Effect		Value	F	Hypothesis df	Error df	Sig.
Test	Wilki's Lambda	.626	2.318[a]	8.000	31.000	.045

Table 4: Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Test	S10mk-kB	.001	1	.001	.405	.528
	S3×5mk-kB	.005	1	.005	1.734	.196
	ThBdr-w	.003	1	.003	.100	.753
	ThB-J10×	.371	1	.371	7.101	.011
	LJ-ThBw	2.297	1	2.297	.622	.435

Discussion

The obtained results indicated that after the preparatory period, there were statistically significant differences in the testing results (Table 2). The values of the obtained results display an improvement in all tests. Therefore, the testing results indicate that the applied training positively affected and that the progress resulted form the training process. However, in order to comprehend the structure of changes we have constructed variables which represent relations of the tests, i.e., index indicators. The descriptive indicators of index results (Table 1) also display a positive difference between the first and the second testing. After MANOVA, on general level, between the initial and final measurement there is a difference and thus the results can be considered valid for analysis. Individual test analysis indicate that, although there is a statistically significant difference, on the general level, the only test where statistically significant difference was achieved (Table 4) is the INDEX of throwing ball in water with jump

10× at goal (ThB-J10×) - relation between throwing the ball at distance in water and jumping 10× from the basic water polo position to touch the crossbar with hands (p=0.011).

In all tests, as previously remarked, showed the improvement of results, as follows: in the test of standing long jump (ML-LJ) the results were improved for 2.60%; in the test of dry land throwing ball at distance (ML-ThBdr) there was an improvement of results for 8.27%; in the test of craw swimming 10m crawl (S-10m) the results were improved for 5.13%; in the swimming test 10m crawl with the ball (S-10mB) the results were improved for 4.33%; in the swimming test 3×5m crawl (S-3×5m) the improvement of 5.97% was achieved; in the swimming test 3×5m crawl with the ball (S-3×5mB) there was an improvement of results for 8.23%; in the test of throwing the ball at distance in water (S-ThBw) the results were improved for 6.59% and in the test of jumps at goal 10× (S-Jw-10x) there was an improvement of results for 10.97%, which shows that only in the test of jumps at goal 10× (S-Jw-10x) the result increase was over 10%. INDEX of throwing the ball in water and jump 10× at goal (ThB-J10×) indicates that there was a significant improvement in performance of the observed techniques. By analyzing the technique of throwing the ball at distance (S-ThBw) and jumps at goal technique 10× (S-Jw-10x) we can conclude that both techniques are based on leg strokes in water. From the obtained result, it can be concluded that among other, the training process affected significantly the leg performance, or better say, the moment of creation of support point which is very important for jumping from water of releasing of the ball, i.e., for quality pass or shooting.

The remaining observed tests for which INDEX indicators were obtained, did not provide statistically significant results although the individual results after the final measurement were better for 2.30 up to 8.27%.

The observation of the relations between certain tests and providing of INDEX indicators should enable better understanding of the effects of training process and the structures of changes occurred after training and thus influence methods and metrology procedures of training process control.

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DYNAMICS OF THE FACTORS MOTIVATING YOUNG PEOPLE TOWARDS PHYSICAL ACTIVITY

Alena Buková, Milena Pullmanová-Švedová & Ivan Uher

Abstract

The lifestyle of today's young population is affected by a number of technical achievements in most areas of human activity, leading to restriction of natural and purposeful movement, and thus increasing the proportion of passive leasure. A particular problem is hypokinesia of the young generation, resulting in a growing number of so called lifestyle-related diseases already at an earlier age. Therefore, it seems inevitable to know the actual causes of musculoskeletal inactivity of today's young generation and their motive for sports, respectively their interests and attitudes as a possible basis for appropriate interventions in the field of motor program modes. The paper describes and examines the fundamental factors affecting the attitudes and motives of young people towards sports activity. The authors' work focused on the problem of the definition of lifestyle of today's young population; they identify the popularity of physical activity, the frequency of its implementation, respectively the causes of musculoskeletal inactivity and barriers that prevent young people from implementation of motor activity. The present study is part of an ongoing research on physical education and active lifestyle of today's young generation. To obtain empirical data on attitudes and motives of today's younger generation towards sports activity, ways of spending leisure time and the reasons for inactivity, the method of questionnaire survey was used. For data processing, the method of logical analysis, frequency analysis, data evaluation and percentage aggregation were applied.

The problem

Our ancestors, in the battle for their daily existence in the course of evolution, developed a large amount of physical activity and such lifestyle has become our hereditary feature. The modern way of existence, however, leads to gradual reduction in the number of stimuli that force us into sporting activities. Restriction or even exclusion of physical activity will be reflected negatively on the activities of the organism: it results in various diseases and activates and accelerates the aging process. All the above symptoms can further intensify in case a hypodynamic motor regime is associated with systematic mental and emotional stress.

Following past scientific investigations, there remains almost no doubt that regular exercise causes changes in cardiovascular and metabolic function and neuro-hormone activity (Bergamaschi et al., 1997; Blair, Powell, 1994; Haskell, 1994; Harris et al., 1986). Physical Exercise has a positive effect on losing excess weight and fat (Grund et al., 2000, Hamm, 1996, Harris et al., 1986). It plays an important role in the life of contemporary humans while maintaining health and physical performance, slowing down regressive processes, as well as it creates conditions for a long active life and the phenomenon of active health (Blair, Powell, 1994; Blair, Connely, 1996; Brtková, 1999; Cepková, 2009, Cooper 1990, Evans, 1999; Chovanová, 2006a, 2006b). Motor activity is becoming inevitable in the battle against muscle atrophy and physical degeneration (Baldwin, 1996; Hrčka, 1990, etc.). It is an important factor for the treatment of bone density and prevention of osteoporosis (Alekel et al., 1995, Kerr et al., 1996, Walker et al., 2001). Like food and sleep, also physical activity is a primary need at maintaining human health. The need for it is life-long, and while such is unfulfilled, it leads to disorders (Blair, Connely, 1996, Evans, 1999).

A steadily increasing standard of living allows space for a more varied way of spending free time, although being largely influenced by the current times. As a result, it seems we have little or no opportunity to freely create or modulate it to a large extent. Particular attention has to be paid to the definition of location and analysis of the content of free time. Every human chooses goals for life as an expression of boundaries to be crossed. His progress is affected by a whole range of factors, either positive or negative. The role of leisure motor activity in the life of a young man willing to remain a healthy and capable professional in his area, is irreplaceable. Therefore, it seems crucial to know the actual interests of today's young generation, their views and attitudes toward leisure and to look for the causes of their indifference to sports activity.

Methods

Knowledge of physical activity in a man's daily regime, popularity of motor activities and motives that lead young people to sports activity, respectively the reasons for their disinterest, are part of the research conducted in years 2009 and 2010 among young people of the East-Slovakia region aged 18-30 years. Out of a total of 1472 respondents, 837 were female and 635 male. The average age at the beginning of the study was 25.7 years. Of this number, 31.6% reported a university degree, 16.1% were currently studying at one of the universities. The remaining respondents had secondary (49%), or primary education (3.3%). More information on the educational attainment of respondents is shown in Table 1. Of the total number of respondents, 18.7% of men and women considered their job mostly physically strenuous, 63% of them mostly mentally demanding, and according 12.6% of them work is not tiring. Of the sample at the time of research, 5.7% were either unemployed or on maternity leave. To obtain empirical data on sports activity and the hierarchy of motives, we applied the method of questionnaire survey, whereas at processing the methods of logical analysis, frequency analysis, data evaluation and percentage aggregation were used.

Results

Subjects to the question on the implementation of physical activities, and at identifying the interest in particular motor activities, had the opportunity to choose three of their most preferred activities out of a number of sports offered, but not all participants did so. Furthermore, of the total number, 1472 men and women admitted that 16.4% of them do not perform any physical activity, and 11.1% of them are not even interested in any of the activities (Table 1).

Table 1: Types of sports carried out in relation to gender

Possible responses	Men % (n = 635)		Women % (n = 837)	
	Motor activity implementation	Interest in motor activity	Motor activity implementation	Interest in motor activity
Team sports	**75,1**	**39,5**	**2,6**	**3,3**
football	45,4	8,7	0,3	1,4
floorball	15,4	19,8	0,5	0
basketball	7,7	3	0,7	0
others (less than 5%)	6,6	8,1	0,9	1,9
Individual sports	**63,9**	**38,7**	**113,6**	**56,7**
aerobics- diff. forms	0	0	54,1	11,5
run	14,5	4,1	10,6	4,5
swimming	12,4	15,4	15,1	20,2
cycling	13,2	10,2	19,5	14
gym workout	19,8	6,8	3,7	1,9
relaxation exercises	0	0	6,2	2,5
others (less than 5%)	3,9	2,2	4,4	2,1
Extreme sports	**9,6**	**15,1**	**0**	**2**
Other sports *	**2,7**	**38,4**	**9,4**	**19,5**
Martial arts	**3,6**	**15,6**	**0,7**	**3,8**
I do not do sports/ No interest	**10,1**	**9,6**	**20,1**	**12,3**

* Unconventional, i.e. less traditional sports (pétanque, frisbee, table tennis, badminton ...)

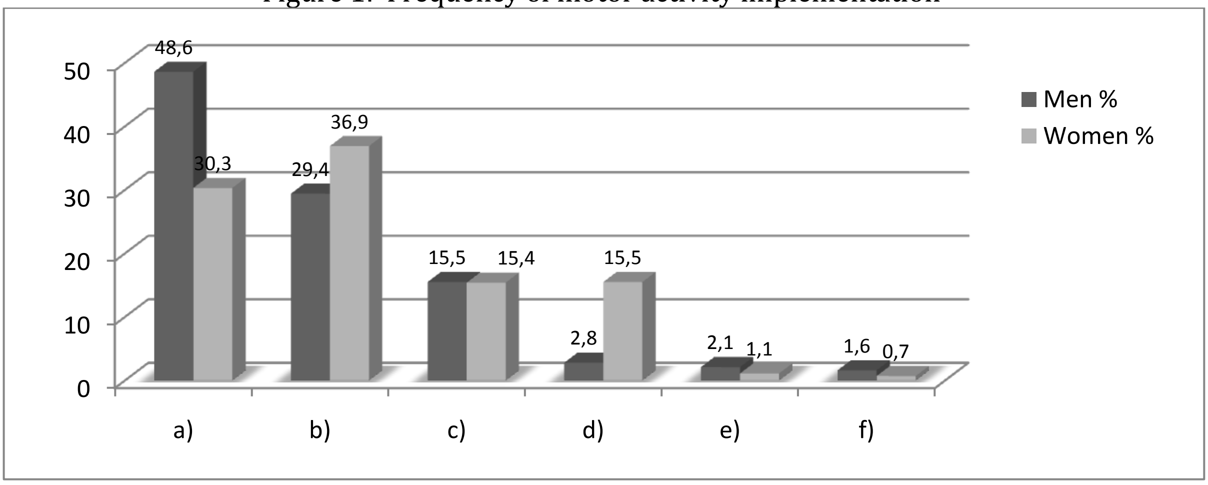
As it is obvious from the table, men prefer collective sports, while women go for individual sports. Clearly the most preferred activity among men, as expected, is football, for women it is aerobics. Other activities are lagging rather behind compared with the above. When surveying interest in the forms of sporting activities, probands were to choose an activity other than their most favourite one performed at the time. In the hierarchy of interests, the first two places, in both males and females, belong to swimming. Since swimming is subject to the opportunities provided by the city, the mere exercise of it does not reflect the actual implementation of the sport. Similarly, floorball, enjoying greatest interest in men, depends on the physical equipment of the gym. Implementation of both sports depends on the location of one's residence and the opportunities provided for the sports. Small towns and villages often do not even provide with basic facilities for sporting, with the exception of suitable nature paths for walks or run, used by only a small number of young people.

At women, interest in particular sports goes hand in hand with their actual participation despite the fact that they had to choose from activities other than the ones carried out by them at the time. Ranking among top three, with regard to both realization and interest, there are aerobics, swimming and cycling. The only difference lies in the order of their preference.

Table 1 reflects regularity of physical activity implementation by the probands. Out of 1231 respondents, who admitted doing some of the sports, up to 78% of men and slightly fewer women (67.2%) carried out the selected activity only sporadically, i.e. less than once per week. The most common reason given for non-performing is the lack of free time (almost 47%), in particular cases, they justified themselves by excessive academic or work responsibilities (33%). Frequent response was also where they confessed their own laziness (15%) and excessive fatigue after work (12%).

It is alarming that only a minimum number of men and women performed the selected activity, or activities, at a rate of more than 3 times a week.

Figure 1: Frequency of motor activity implementation



Legend: a) Irregularly, b) Less than once a week, c) Once a week, d) Twice a week, e) 3–times a week, f) More than 3-times a week

An important indicator of the interest in individual sports is the motives and incentives to do sports (Table 2). The respondents could choose and identify maximum 3 of 15 motivational factors, while number 1 was to identify the most important motive. Due to the vastness of data, here we only present the six most frequent motives.

Table 2: Motivation factors for sports

	women %			men %		
	1	2	3	1	2	3
health	42,1	13,4	8,9	37,8	13,2	5,6
mental well-being	11,6	12,9	8,6	8,8	15,4	10,1
relax, calmness	5,6	14,5	9,9	10,1	9,5	8,9
attractive figure	24,9	20,7	13,4	8,4	11,5	15,8
physical fitness	4,1	11,2	15,8	12,1	16,5	16,2
attempt to lose weight	3,9	5,8	6,6	0,7	3,8	1,8

Far the most preferred factor motivating both male and female population to physical activity was health (42% women, almost 38% men). Other motives are more or less scattered. While men got motivated by the vision of a good figure ranking fifth on the list, greater aesthetic awareness among women confirmed the positioning of this motif ranking second following physical health. By contrast, men considered physical fitness a more important motive.

Very important factors influencing the fact that people do sports are the opportunities offered by the immediate surroundings (within a distance of 10 km). With the exception of respondents who have no interest in sport and are not interested in the opportunities offered by the surroundings either, men and women residing in cities presented greater satisfaction with sports facilities (Fig. 2 to 5).

Figures 2 – 5: Sporting opportunities provided by the nearest environment

Figure 2: Men – City

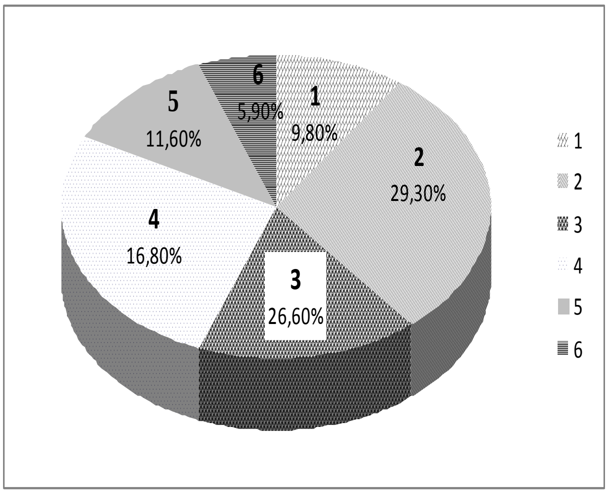


Figure 3: Men – Countryside

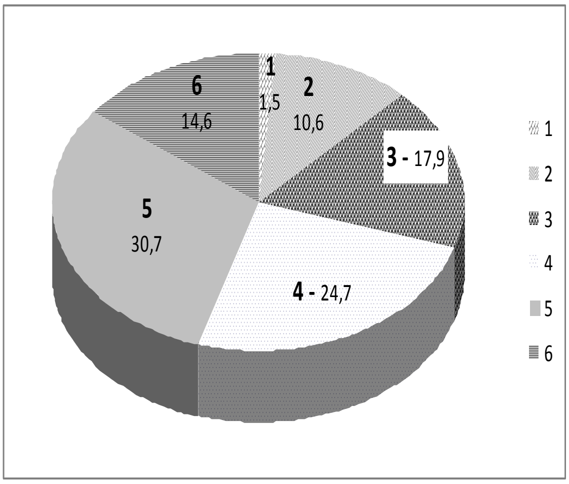


Figure 4: Women – City

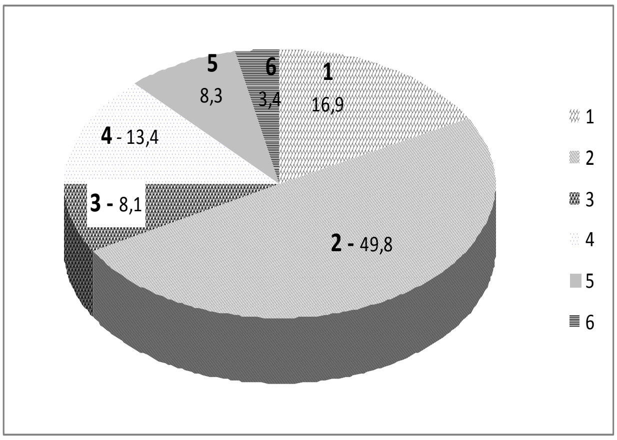
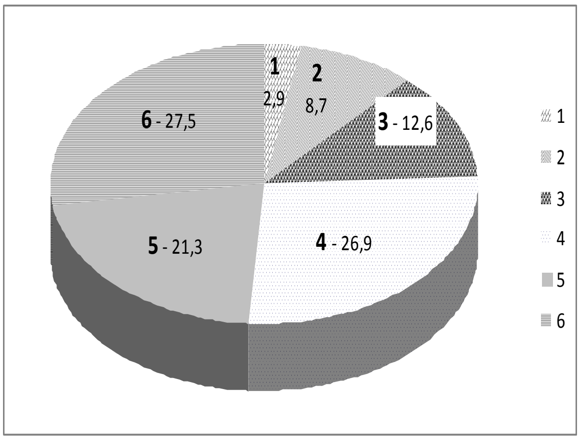


Figure 5: Women – Countryside



Legend:1 – Definitely yes, 2 – More yes, 3 – Unable to judge, 4 – More no, 5 – Definitely no, 6 – I lack interest

As shown in the figures, when comparing men and women living in the city, women are more satisfied with the opportunities they are offered; surprisingly, men are either unable to assess the situation, or they find opportunities for sporting rather insufficient. Rural women show the biggest lack of interest in the issue overall.

There are significant differences in leisure activities for men living in urban and rural areas (Table 3). While men in the city include physical activity among one of the three most preferred leisure activities, men living in the village include physical activity among the less preferred ones. Anyhow, the most preferred activities of most men in town are those rather passive ones – watching TV and passive recreation. At men from villages, in most cases active work around the house dominates (gardening, works around the house), but the three most preferred leisure activities also include passive leisure – watching TV, meeting friends etc.

Table 3: Free time activities (top 3 most preferred activities)

	Men % (n = 635)						Women % (n = 837)					
	City (n=368)			Countryside (n= 267)			City (n= 528)			Countryside (n=309)		
Order of importance	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
Motor activity	11,7	15,5	17,4	6	3,4	4,1	22	14,4	11	0	0	5,8
Gardening	3,5	1,1	3,3	22,1	10,8	9,7	0	1,3	0,6	30,1	22,3	36,2
Household chores	1,4	0	5,4	4,1	3	7,1	53,2	25,8	18,4	66,3	38,5	25,6
Works around the house	1,9	2,4	1,4	56,2	18,4	12,7	0	0	0	2,3	23,3	1,9
Reading	7,1	7,9	3,8	0,4	5,6	3,4	18,7	12,3	19,5	1,3	4,2	18,1
Studying	5,4	5,1	10,3	1,5	4,1	6,4	1,3	8,9	3,9	0	11,6	18,1
Watching TV	38,6	23,9	29,1	6,4	28,5	14,2	4	15	26,7	0	0	4,8
Passive relaxing	28,5	41,2	17,1	3,4	9	28,5	0,8	6,4	11,2	0	0	3,9
Others	1,9	2,9	12,2	0	17,2	13,9	0	15,9	8,7	0	0	0

Note: others: meeting friends, clubbing, surfing the internet, working on PC, disco. Handicrafts at women

Although neither women from towns nor villages, did rank physical activity among the most preferred activities (except for urban women), we can admit that women generally spend a predominantly active leisure as clearly their most preferred activity is housework, or even gardening and works around the house (rural women).

To summarize, men and women from towns spend a physically active leisure, while people in rural areas admit to do so only incidentally or not at all. The main excuse given is excessive workload, fatigue after work, the amount of works around the house, or even by the arguments of some, impractical and ineffective use of leisure time, respectively the lack of need for such a way of abreaction. Men in the city and the countryside prefer passive relaxation, while women predominantly spend their leisure by doing housework.

Conclusion

The questionnaire, conducted on a sample of 1.472 respondents, revealed some interesting facts. As expected, men prefer more collective and women individual sports. Obviously, the most preferred activity is soccer in men and aerobics for women. Other activities are lagging behind compared to the latter. It is sad that the interest in some types of activities is not reflected in the actual implementation of the same. The expression of interest in a particular physical activity can be justified by appreciation of the need for active and deliberate motion. On the other hand, the regime of the day and duties outside working hours put increased demand on the quantity and utilisation of leisure. For these and other reasons, even the young people often rank physical activity last in their hierarchy of interests. This fact is reflected primarily in the frequency of carrying out the selected physical activity.

The selected sample of respondents is at the age when health problems are not strictly noticeable or sensible compared with the elderly age group. Nevertheless, the majority of respondents are aware of the need to implement physical activity primarily for health reasons. Other motives in men and women differ fundamentally. Despite the significant percentage of people who have a subjective feeling of good health, improved figure or improving physical fitness due to exercise, passive way of life is still a major phenomenon.

Leisure activities are various depending on sex as well as the place of residence. While at city men passive leisure dominated despite the fact that physical activity is ranking third in the hierarchy of their leisure activities, countryside men do not consider physical activity of great importance. Either they spend their free time working around the house, or prefer passive recreation similar to city men. Most preferred activity in women in the city as well as in rural areas is housework. Based on the results obtained, we suggest paying more attention to the barriers preventing sporting activity and to other causes of people's disinterest, but above all, to finding the means to overcome them all. Despite considerable awareness of the beneficial effect of sports activities, it is necessary to resolutely address the issue on a governmental level and establish priorities by the state. At the time when obesity is seen as one of the fast-spreading lifestyle-related diseases, and cardiovascular disease is affecting young people increasingly it is necessary to create sufficient opportunities for sports. The society should not offer health insurance bonuses for the amount of drugs and medication consumed to remove the causes, but rather prevent those and address the issue comprehensively, and to achieve that prevention through proper selection of physical activity was an essential part of the lifestyle of people in each age group. It is also a challenge for physical education professionals and anyone who knows, and is fully aware of the healing effect of adequate physical activity, to contribute to inevitable promotion of irreplaceable importance of physical activity and thus stop the trend of general physical decline and resulting lifelong problems emerging the further the more often amongst the young generation.

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ETERNAL QUESTION OF COACHING: DOES COACH'S PERCEPTION OF YOUNG ATHLETE'S PERSONALITY STRUCTURE INFLUENCE HIS/HER MOTIVATIONAL BEHAVIOR?

Saša Cecić Erpič

Abstract

Leadership in sport is an interactive process between coach and his/her athletes. It means that coach's behavior affects and is affected by athletes, making leadership not unidirectional event, but an interactive process. Since athlete's personality structure is one of the dispositional factors that define which behavior of the coach would be perceived as preferred, we can assume that coach modifies his/her behavior in according to own perception of athlete's personality. Therefore the aim of the study was to research whether coach differs in his/her behavior (motivational behavior in particular) toward the athlete in relation to his/her perception of young athlete's personality. The sample consists of 42 young perspective athletes (30 boys, 12 girls) and their 9 coaches. On average athletes were committed to sport for 5.74 years, of which last 2.69 years they trained with this particular coach. Coaches (2 female, 7 male) were asked to complete The Inventory of Child Individual Differences (ICID; Halverson et al, 2003) and answer the questions of The Young Athlete in Comparison to Others (YACO; Cecić Erpič, 2006) semi-structured interview. YACO was designed to elicit coach's perceptions of individual characteristics of an athlete and his/her particular behavior toward the athlete. Answers to the YACO interview questions were content analyzed. Hierarchical cluster analysis was performed to calculate characteristics of coaching types. Each athlete was than ascribed to the prevailing coaching type, characteristic for interaction between individual athlete and his/her coach. Differences between athlete's personality characteristics in regard to different coaches' type were calculated using one-way ANOVA and post-hoc multiple comparisons. Results of hierarchical cluster analysis of YACO showed three distinctive coaching styles: A) adaptable democratic coaching style in a positive motivational climate, B) coach as educator in a negative motivational setting, C) coach as friend/confidant in a laisser-faire setting. Coaches didn't use same coaching types to all of his/her athletes and adapted their behavior regarding their perception of athlete's personality traits. Type A and type B of coaches significantly differ in perceiving athletes' conscientiousness. When ascribing other personality domains, there were no significant differences between three types of coaches. This confirms hypothesis that coaches adapt their coaching behavior according to their perception of athlete's individual characteristics (personality). Results are in line with mutual influence leadership theories.

Introduction

The coach is one of the most important factors which influences athletes' development and progress as well as athletes' career. Coach has to create an environment that facilitate and foster athlete's optimal development. While research and theories from non-sports settings provided useful frameworks for understanding leadership, unique demands of sports settings required a sport specific model. Chelladurai (1993) developed the multidimensional model of leadership that provides a conceptual framework for studying leadership effectiveness in sports domain. According to Chelladurai (1993) effective leadership is dynamic and based on a complex series of interactions between leader, group members and situational constraints. The model suggests that positive outcomes (performance and satisfaction) will occur when there is congruence between the leader's actual behavior (i.e. either organizing practices or providing positive feedback), the group members' preferred leadership behavior (i.e. preference for a highly organized, supportive leader) and the behavior that is required in relation to the situation. In addition, behavior does not occur in a vacuum, and antecedent factors such as leader and member characteristics will influence both the actual behavior of the leader and group preferences for leadership behaviors.

Coach’s leadership style affects emotional and motivational atmosphere of training sessions, influences communication processes, and interactions between all agents in the particular sport group or team (Barić, 2007). Leadership in sport should be studied from an interactionistic perspective, considering it as an interactive process between coach and his/her athletes. It means that coach’s behavior affects and is affected by athletes, making leadership not unidirectional event, but an interactive process (Loughead & Hardy, 2005). In sport context leadership behavior means decision making processes, instructiveness, motivational techniques, communication, establishing specific and general, short-and long-term goals, feedback giving, creating relatedness between athletes and encouraging team’s cohesion. Coach therefore has to make strategy to lead athletes toward desired goals, has to plan activities and procedures needed for goals' accomplishments. It is presumed that antecedent variables (coaches’ and athletes’ individual characteristics, situational factors) influence coach’s behavior, athletes’ evaluations of this behavior and coach’s behavior that athlete perceives as desired (for review see Barić, 2007).

The athlete’s personality structure is one of the dispositional factors that define which behavior of the coach would be perceived as preferred. We can assume that coach modifies his/her behavior in according to own perception of athlete’s personality. Therefore the aim of the study was to research whether coach differs in his/her behavior (motivational behavior in particular) toward the athlete in relation to his/her perception of young athlete’s personality.

Methods

Sample

The sample consists of 42 young perspective athletes, 30 of them were boys and 12 girls. Talented athletes were from 11 to 19 years old (M = 14.07 years; SD = 2.41 years). Athletes were competing in tennis, table tennis, judo, swimming, sport climbing, Nordic combination and handball. On average athletes were committed to sport for 5.74 years, of which last 2.69 years they trained with current coach. Athletes’ personality structure and other characteristics were assessed by their 9 coaches (2 female, 7 male). Each coach evaluated his/her 5 athletes and later 3 athletes were excluded from the sample due to the incomplete data. All coaches had several years of coaching experiences but were relatively novice in the profession. During the study, all coaches were studying sport training sciences on Faculty of Sport.

Instruments

Two instruments were used in the study. The coaches were asked to complete The Inventory of Child Individual Differences (ICID; Halverson et al, 2003) and answer the questions of The Young Athlete in Comparison to Others (YACO; Cecić Erpič, 2006) semi-structured interview. ICID was employed as a measure of child personality. It is composed of 108 items, which are rated along a 7-point scale (1 – *the characteristic is present in my child much less than in the average child or not at all*; 4 – *...to the same extent as in the average child*; 7 – *...much more than in the average child*). Slovenian version of the instrument (Zupančič & Kavčič, 2004) assesses five robust personality domains: conscientiousness, extraversion, disagreeableness, openness/intellect and neuroticism. All scales are highly reliable, αs ranging from .62 to.79. The first component (conscientiousness) represents orderliness, tidiness, carefulness, perfectionism, well-organized behavior, persistence, focusing on goal attainment, self-discipline, good concentration, high sustained directed attention and cooperative bahaviour in response to interpersonal authority, i.e. dependability, trustworthiness, obedience, good manners. Extraversion entails active seeking of company, having a lot of friends, enjoying company, high levels of energy output, being constantly on the move, getting along well with others, cheerfulness, happiness and concerns about others, i.e. helpfulness, empathy, sensitivity, care. Disagreeablenes denotes assertiveness, readiness to take charge, manipulative and bossy tendencies, confrontational behaviour, aggressiveness, discourtesy, rudeness and experience of negative emotions in interpersonal situations, irritability, moodiness, quick temper.

Openness/intellect is easily described by quick understanding, learning orientation and curiosity, imagination, tendency to explore and interest in new things. Finally, neuroticism comprises the individuals' tendencies to get upset easily, distressed, quick to panic, being afraid of lots of things, lacking confidence and social reticence, i.e. being withdrawn, quiet, slow to warm up to new people or situations.

The Young Athlete in Comparison to Others (YACO; Cecić Erpič, 2006) is a semi-structured interview. YACO was designed to elicit coach's perceptions of individual characteristics of an athlete and his/her particular behavior (i.e., methods and means of motivating) toward the athlete. It is composed of 9 open-ended questions, referring to coach's behavior toward individual athlete, manners of motivating and disciplining the athlete, characteristics of coach-athlete relationship and characteristics that influence their relationship.

Procedure

Each of nine coaches was asked to complete both instruments for five athletes that he/she works with for more than six months. Coaches individually completed the questionnaires, ICID and YACO for each of their five athletes. Coaches were instructed to concentrate on individual athlete's personality characteristics and their interpersonal relationship. Coaches were also instructed to answer the YACO questions as extensive as possible.

ICID results were coded according to the scoring manual and five personality domains were than calculated. Answers to the YACO interview questions were content analyzed. Thorough readings showed that answers describe 22 different content categories. Later hierarchical cluster analysis was performed to calculate characteristics of coaching types. Each athlete was than ascribed to the prevailing coaching type, characteristic for interaction between individual athlete and his/her coach. Further, differences between athlete's personality characteristics in regard to different coaches' type were calculated using one-way ANOVA and post-hoc multiple comparisons.

Results

Table 1: Means and standard deviations of five ICID components

		athletes		Slovene adolescents*	
	N	Mean	Std. Deviation	Mean	Std. Deviation
Conscientiousness	42	2.37	.93	4.69	.71
Extraversion	42	4.44	.69	4.89	.65
Disagreeableness	42	3.73	.80	3.41	.67
Openness/Intellect	41	4.50	.78	4.90	.75
Neuroticism	41	3.63	.81	3.40	.76

Note*: Personality structure of Slovene adolescents measured with ICID was assessed by Zupančič, Gril and Kavčič (2006).

Results of hierarchical cluster analysis showed three coaching types. First type is named adaptable democratic coaching style in a positive motivational climate, second coach as educator in a negative motivational setting and third coach as friend/confidant in a laisser-faire setting.

Adaptable democratic coaching style in a positive motivational setting (type 1): Coach has democratic relationship with his/her athletes and tries to adapt as much as possible to the characteristics of the individual athlete. Coach works with athlete considering his/her personality, age, developmental stage of athletic career, cognitive abilities, athlete's needs and motives, athletic abilities and athlete's sport-non-related aspects of life (i.e., education). Coach creates a positive motivational climate, with positive feedback and emphasize on positive aspects of training process. It is important that athlete understand the process of learning and enjoys in sport. Coach actively collaborates with parents and tries to stimulate athlete's positive characteristics and abilities. Coach is achievement oriented and expects from his/her athletes to achieve good athletic results as well as development of athletic abilities.

Coach as educator in a negative motivational setting (type 2): Coach is democratic on a declarative level as athletic situations frequently demand his/her autocratic behavior. Coach motivates athletes with negative incentives and perceives his/her athletes as relatively unmotivated. He/she sees own role as an educator, i.e., has an influence on the development of athlete's behavior and its modification. Coach perceives his/her role as someone who stimulates athlete's positive self-esteem, fairness and motivation. He/she transfers own experiences and knowledge to athletes.

Coach as friend/confidant in a laisser-faire setting (type 3): Coach behaves equally to all of his/her athletes and treats them regardless of their personality characteristics. He/she perceives that athletes don't need to be disciplined at any time. He/she perceives his/her role as a friend and a confidant to athletes, i.e., athletes always have someone to share their problems with. Coach emphasizes his/her positive personality characteristics as being hardworking, fair and strict.

In later analysis, each athlete was ascribed to the prevailing coaching type, that is characteristic for interaction between each athlete and his/her coach. Results showed that coaches didn't use same coaching types to all of his/her athletes. This confirms hypothesis that coaches adapt their behavior regarding their perception of athlete's personality traits. Results of one-way ANOVA and post-hoc multiple comparisons confirmed that but only in regard to conscientiousness ($F_{2, 39} = 5.06$; $p < .05$; type 1: $M = 2.57$; $SD = .80$; type 2: $M = 1.68$; $SD = .96$; type 3: $M = 2.73$; $SD = .84$). Post-hoc multiple comparisons showed that there is a significant difference in perceiving athletes conscientiousness between coaches of type 1 and type 2 ($p < .05$), and coaches of type 2 and type 3 ($p < .05$). Coaches of type 1 and type 3 perceive conscientiousness of their athletes in a similar way.

Discussion

Comparing personality structure between athletes and a sample of young Slovene adolescents (Zupančič, Gril, & Kavčič, 2006) there is a significant difference in attributed conscientiousness. Coaches ascribe their athletes less conscientious than mothers do for their young teenagers. Cluster analysis of semi-structured interview on coach's perceptions of individual characteristics of an athlete and his/her particular behavior showed three different coaching types: adaptable democratic coaching style in a positive motivational climate, coach as educator in a negative motivational setting and coach as friend/confidant in a laisser-faire setting. Coach's leadership style depends on the way he/she interacts to athletes and on his/her decision making processes. Coach's social interactions consist of several different processes: coach's instructiveness, supportiveness, and coach's rewarding behavior (Barić, 2007). According to Chelladurai (1993) social process of decision making refers to the extent to which the coach allows athletes to participate in the cognitive processes of making a decision. Therefore coaches can be divided into two types: autocratic (coach makes decision alone, doesn't allow athletes' participation) and democratic (coach includes athletes in decision making processes). Results of the study are somewhat congruent with those of Chelladurai (1993) adding information on coaches' perception of athletes' personality characteristics.

Results also showed that coaches adapt their coaching behavior according to their perception of athlete's individual characteristics (personality). This actually represents situational leadership – coach ascribes different types of behavior for different athletes. Results show that coaches are more aware of athlete's conscientiousness. Type 3 coaches (i.e., coach as friend/confidant in a laisser-faire setting) perceive their athletes as significantly more conscientious as type 1 coaches (i.e., democratic coaches who tend to adapt to athletes' individual characteristics). That means that coaches who tend to be friends and confidants with their athletes see them as more persistent, organized, self-disciplined, highly concentrated and goal oriented than democratic coaches. In fact coaches educators who tend to use negative motivational strategies perceive their athletes as least conscientious in comparison to the other two styles. When ascribing other personality domains, there were no significant differences between three types of coaches. Results are in line with mutual influence leadership theories that focus on the dynamics of the coach-athlete relationship, stressing the link between the two rather than either particular role.

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GROWTH, WEIGHT STATUS AND MOTOR PERFORMANCE IN ITALIAN PRIMARY SCHOOL CHILDREN

Andrea Ceciliani, Stefania Toselli, Gabriele Semprini, Franco Merni, Rocco Di Michele & Patricia Brasili

Abstract

The predominant sedentary lifestyle of the present child population involves a reduction of the motor capacities and variations of the weight status. The aim of this study was to assess the relationships between motor performance and weight status in primary school children from Bologna (Emilia Romagna, Italy). The body weight (BW) and height (H) was assessed in 717 children (M: 368; F: 349), aged 6 to 11 yrs. The weight status was classified according to cut offs proposed by Cole et al. (2007). All the children performed then 8 motor tests: Handgrip Test for Maximal Isometric Strength (HG), Sit and Reach (SR), Dynamic Balance Test (DBT), Eye-hand Coordination Test (ECT), Standing Long Jump (SLJ), Upper Limb Explosive Strength Test (UST), Dotting Test (DT), Comma Test (CT). Three way Analysis of Variance (ANOVA) was used to analyze the differences in each test performance between genders, age groups (6,7,8,9,10,11 yrs), and weight status groups (underweight, normal-weight, overweight). Gender differences have been found in 7 out of 8 tests. Overweight children performed better than the other groups in 2 strength tests and worse in 1 strength test, whereas no differences were observed in the coordination ability test between the normal-weight and underweighted children. Normal-weight children performed better only in 1 test out of 8. Generally the score of the tests showed a trend to improve with increasing age. Some tests showed a trend to stabilize at the age of 8 and 9. The results showed that overweight children were disadvantaged in activities where the subject is engaged to develop force against gravity. Conversely, in static tests where it is not demanded an action against gravity; the overweight children show better performances. Normally the males perform better compared to females, with the exception of the SR test, and in CT, where greater precision and executive rhythm are required.

Introduction

The attention towards youth physical activity and sport assumes importance involving topics that interest today's youth generations.

The sedentary lifestyle, the insufficient daily physical activity (PA), the insufficient motivation to the sport practice (Engstrom, 1990, in Telama, Ikeda, & Aoyagi, 2009); Norton, Dollman, & Klanarong, 2001; Westersthal, Barnekow-Bergvist, & Hedberg, 2003), the emerging problem of the children's obesity (Lobstein & Frelut, 2003), and the risk of cardiovascular and metabolic disease (diabetes) in children (Ekelund et al., 2007), have increased the research attention in the field of children's motor development.

In particular, overweight and obesity represent an alarming fact for the present youth populations, and for the future adult generations (Parsons, Power, Logan, & Summerbell, 1999).

In this research field, we can find different research topics: the importance of regular PA associated with the health status (Biskanaki, Panagiotou, & Papadopoulou, 2004; Duger, Bumin, Uyanik, & Aki, 1999; Sallis, Prochaska, & Taylor, 2000; Strong, Malina, & Blimkie, 2005; Yang, Telama, & Viikari, 2006); the correlation between children's obesity and children's energy consumption (Eisenmann, 2006; Jackson-Leach & Lobstein, 2006; Norman, Belloco, & Vaida, 2003; Przeweda & Dobosz, 2003); the correlation between weight status, growth and motor performance (Benefice, 1992; D'Hondt, 2008; Slining, Adair, Davis Goldman, Borja, & Bentley, 2010).

Currently, it is clear the importance assumed by monitoring and controlling the children's motor development as a right strategy devoted to promote the physical activity in a long term, and establishing the performance standards in various age ranges (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009; Dolenec & Burnik, 2002; Boreham, & Riddoch, 2001). The performance level in the different abilities changes in the early childhood, thus it is important to know how the evolution of coordination, strength, and flexibility relates to age, gender, and weight status in the primary school period.

The purpose of the current paper was to explore the association between weight status and motor performance in a sample of children from Bologna (Italy). The data analysed here belong to a longitudinal study, still in progress, involving primary and secondary school children, and aiming to evaluate the relationships between physical and motor variables during the physical development stage.

Methods

Sample

The sample included 717 children (M. 368, F. 349) from primary schools of Bologna, North Italy, aged 6 to 11 (Tab.1). Height and weight were measured and the BMI (Lobstein & Frelut., 2003) was derived. According to their BMI, the children were categorized into normal-weight (NW), overweight (OW) and obese using the International Obesity Task Force (IOTF) thresholds for gender and exact age. Underweight (UW) was assessed using the thresholds of Cole et al. (2007). For the purposes of this study, overweight and obese children were included into the same group. The mean height and weight values, for each gender and age class, were similar to the 50th percentile of the tables of Cacciari et al. (2006), that are relative to the Italian population.

Table 1: Size of Subsamples in the Different Age and Gender Groups

		Age (years)						
		6	7	8	9	10	11	Total
Gender	Male	45	82	57	73	61	50	368
	Female	45	81	56	59	64	44	349
Total		90	166	113	132	125	94	717

The study protocol was approved by the teaching body of the schools attended by the participating children. The parents were informed of the research aims and procedures through appropriate preliminary meetings and gave their written consent to the participation of their sons.

Variables

All the operators participated to preliminary training sessions on the executive modalities of the tests. Furthermore, survey procedures have been executed with the supervision of a member of the University staff. Each test was repeated two or three times and the best performance was recorded.

Table 2: Variables

Test	Measured ability	Measur. unit
Body Weight		kg
Height		cm
Handgrip* (HG)	Maximal Isometric Strength	kg
Upper Limb Throw** (UST)	Explosive strength of arms	cm
Standing Long Jump* (SLJ)	Explosive strength of legs	cm
Comma Test** (CT)	Precision and frequency of hands movements	Score
Dotting Test ** (DT)	Frequency of hands movements	Score
Eye-hand Coordination*** (ECT)	Sight ability	Score
Dynamic Balance Test** (DBT)	Dynamic Balance	s
Sit and Reach* (SR)	Flexibility	cm

*Adam et al., 1988; ** Carbonaro et al., 1988; *** Brace, 1966, modified

All the variables were selected according to a testing protocol already used in previous studies carried out on Italian children (Manno et al., 1985; Merni, 1982). All the children performed the test battery reported in Table 2, that was previously validated on a reduced sample (Camorani, Merni, & Ceciliani, 2005).

Test descriptions

Hand-grip (HG) for Static strength: a calibrated hand dynamometer with adjustable grip (Takei scientific instruments) was used (Eurofit, 1988).

Upper Limb Throw (UST) for explosive strength of upper limbs: subjects had to throw a basketball ball as far as possible (cm.), from a sitting position on the floor, the back against the wall and with two hands from the chest (cm.). (Carbonaro et al., 1988).

Standing long jump (SLJ) to assess explosive strength of lower limbs: the subjects attempted to jump as far as possible, with swinging of the arms and bending of the knees to provide forward drive, landing on both feet without falling backwards. A two foot take-off and landing jump was used and the longest distance jumped was recorded (cm.). (Eurofit, 1988).

Comma Test (CT) for precision and frequency of hands movements: subject seated on a chair must write on a white paper on the desk groups of 4 vertical hyphens crossed from 1 horizontal hyphen. The time test was of 30 seconds; every 5 seconds the operator said “down” and children start a new line of hyphens (6 lines in total). Number of corrected hyphens was recorded (score).

Dotting Test (DT) for frequency of hands movements: subject seated on a chair must write on a white paper on the desk the maximum number of dots. The time of the test was of 10 seconds. Number of dots was recorded (score).

Eye Hand Coordination Test (ECT): The children had to hit (with a tennis ball) a squared target (1 m x 1 m) placed on the wall to 3 meters from the throwing line. The target was subdivided in three concentric sectors (center, intermediate, peripheral). The inferior side of the target was placed to 1 meter from the floor. Total score was recorded, as a sum of 10 trials, with the following criteria: 3 point for the center sector, 2 point for the intermediate sector, 1 point for the peripheral sector, 0 point when the ball was out of the target.

Dynamic Balance Test (DBT): participants had to walk forward on a square beam (side length: 70 cm; thickness: 4 cm; height 10 cm.) with two stance for each side. The trial finished when the subject returned to the start side. Starting with one foot on the beam, time (accuracy: 1/100 seconds) was recorded from the second foot take-off from the ground, and stopped at its foot-strike on the fifth side. A clockwise and counter-clockwise trial was performed (Carbonaro et al., 1988).

Sit & Reach (SR) for flexibility: participants sat on the ground with straight legs and had to reach forward as far as possible. A standard reach box was used, measurements in cm. (Eurofit, 1988).

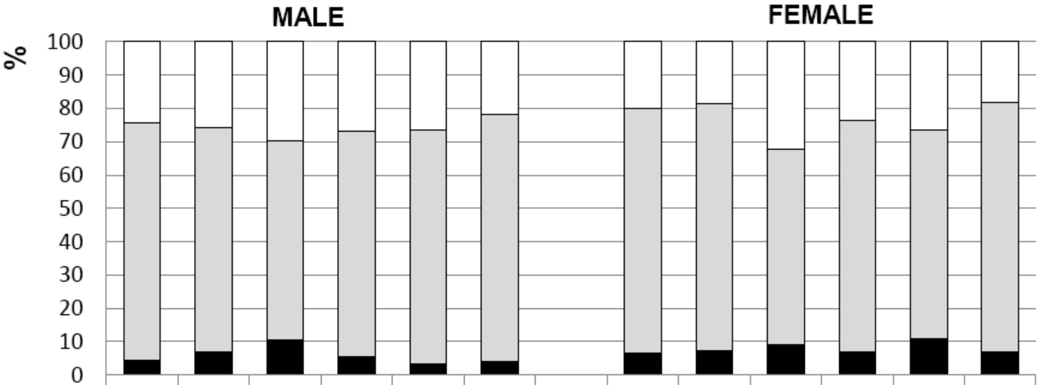
Data analysis

The data were analyzed with the SPSS 15.0 statistical package. The data distribution was analyzed through the following indices: mean, standard deviation, minimum, maximum, skewness, kurtosis. Kolmogorov-Smirnov tests were performed to verify the normality of distributions. *Levene's* tests were performed to define the homogeneity or heterogeneity of variances. Three-way ANOVAs were used to analyze the differences in each performance test between genders, age and weight status groups. Tukey post-hoc tests were performed to uncover which groups differed. Significance was set at alpha=0.05.

Results

For the weight status (Figure 1), males showed a higher percentage of underweight at 8 years, whereas females showed a higher percentage of underweight at 10 years. Normal-weight males and females showed a similar trend as a function of age: their percentage decreased up to 8 yrs, and then it showed an increase. Both males and females at 8 years showed the highest percentage of overweight children.

Figure 1: Prevalence of weight status



	6	7	8	9	10	11		6	7	8	9	10	11
□ OW	24,4	25,9	29,8	26,8	26,7	22,0		20,0	18,5	32,1	23,7	26,6	18,2
□ NW	71,1	67,1	59,6	67,6	70,0	74,0		73,3	74,1	58,9	69,5	62,5	75,0
■ UW	4,4	7,1	10,5	5,6	3,3	4,0		6,7	7,4	8,9	6,8	10,9	6,8

Strength tests

In maximal isometric strength (HG) and upper limbs explosive strength tests (UST) significant differences between genders, age and weight states were observed. As evident from tables 3, 4 and figure 2, overweight children showed better performances compared to the other two categories, whereas underweight children showed the worst performances that are significantly different compared to normal-weight only for HG. Concerning the age groups, a significant increase can be noticed from each group to the immediately upper one, except than for 8 vs. 9 yrs (for the HG test) and for 10 vs. 11 years (for the UST test). Male children, independently from age and weight status, performed better than females. The differences were marked for UST ($p<0.001$), and at the significance limit for HG ($p<0.05$).

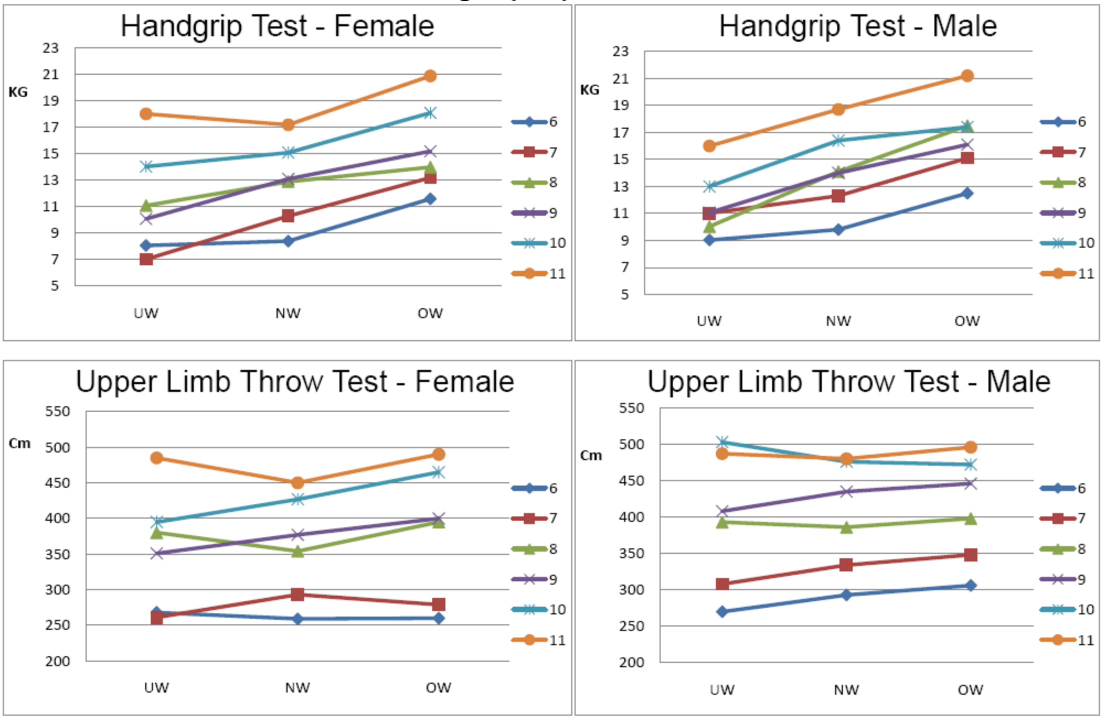
Table 3: Three-way ANOVA (P-values) for gender, age, WS

			Weight status Post-hoc(Tukey)		
Performance Test	GENDER	AGE	UW vs NW	NW vs OW	UW vs OW
HandGrip	**0.039**	**0.001**	**0.002**	**0.001**	**0.001**
Upper Limb Throw	**0.001**	**0.000**	NS	**0.009**	**0.029**
Standing Long Jump	**0.001**	**0.001**	NS	**0.012**	NS
Comma	**0.014**	**0.001**	**0.032**	NS	NS
Eye-hand Coordination	**0.001**	**0.001**	NS	NS	NS
Dotting	**0.001**	**0.001**	NS	NS	NS
Dinamic Balance	NS	**0.001**	NS	NS	NS
Sit and Reach	**0.003**	NS	NS	NS	NS

Table 4: Three-way ANOVA – Age post-hoc (P-values)

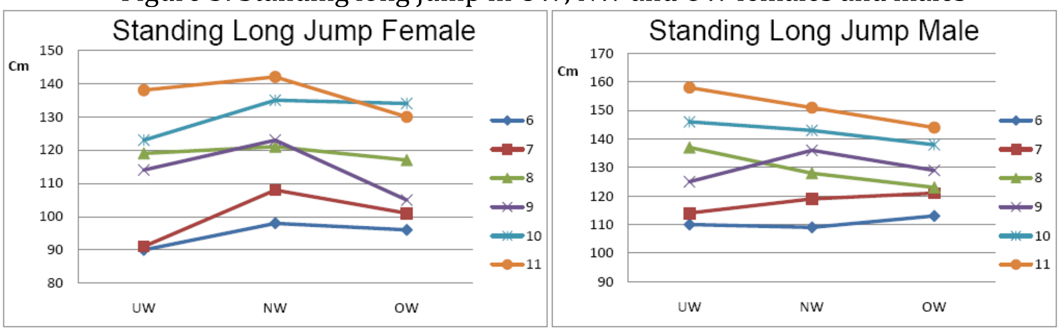
Performance Test	6-7 y.	7-8 y.	8-9 y.	9-10 y.	10-11 y.
HandGrip	**0.001**	**0.001**	NS	**0.001**	**0.001**
Upper Limb Throw	**0.007**	**0.001**	**0.033**	**0.001**	NS
Standing Long Jump	**0.011**	**0.001**	NS	**0.001**	**0.001**
Comma	NS	**0.001**	NS	**0.001**	NS
Eye-hand Coordination	**0.001**	**0.001**	NS	**0.001**	NS
Dotting	**0.001**	**0.001**	NS	NS	NS
Dinamic Balance	**0.018**	**0.001**	NS	**0.001**	NS
Sit and Reach	NS	NS	NS	NS	NS

Figure 2: Handgrip test and Upper limb throw test in Underweight (UW), Normal weight (NW) and Overweight (OW) females and males



In the Standing long jump test (SLJ), males showed significantly higher values than females (Table 3 and Figure 3). Concerning the age classes (Table 4), significant differences are observable in all the classes, excluded 8-9 yrs. The performance in normal-weight children was significantly higher than in overweight children. Underweight children showed no significant differences compared to the other groups (Table 3 and Figure 3).

Figure 3: Standing long jump in UW, NW and OW females and males



Coordinative tests

In the precision throw and in the upper limbs frequency of movements test (DT) males showed better results than females ($p<0.001$) (Table 3 and Figure 4), whereas no significant difference were found concerning the weight status (Table 3). In these tests (Table 4), the results improved considerably between 6-7 yrs and 7-8 yrs ($p<0.001$), whereas less evident improvements can be observed in the successive age groups.

In the comma test (Table 3 and Figure 5), females performed better than males ($p<0.05$). Concerning the weight status, significant ($p<0.05$) differences can be noticed between underweight and normal-weight, with the first performing better than the second. Considering the age classes (Table 4), various outcomes appeared with a significant increase between 7-8 vs. 9-10 yrs and no significant differences between the other age classes.

Figure 4: Dotting test and Precision throw test in UW, NW and OW females and males

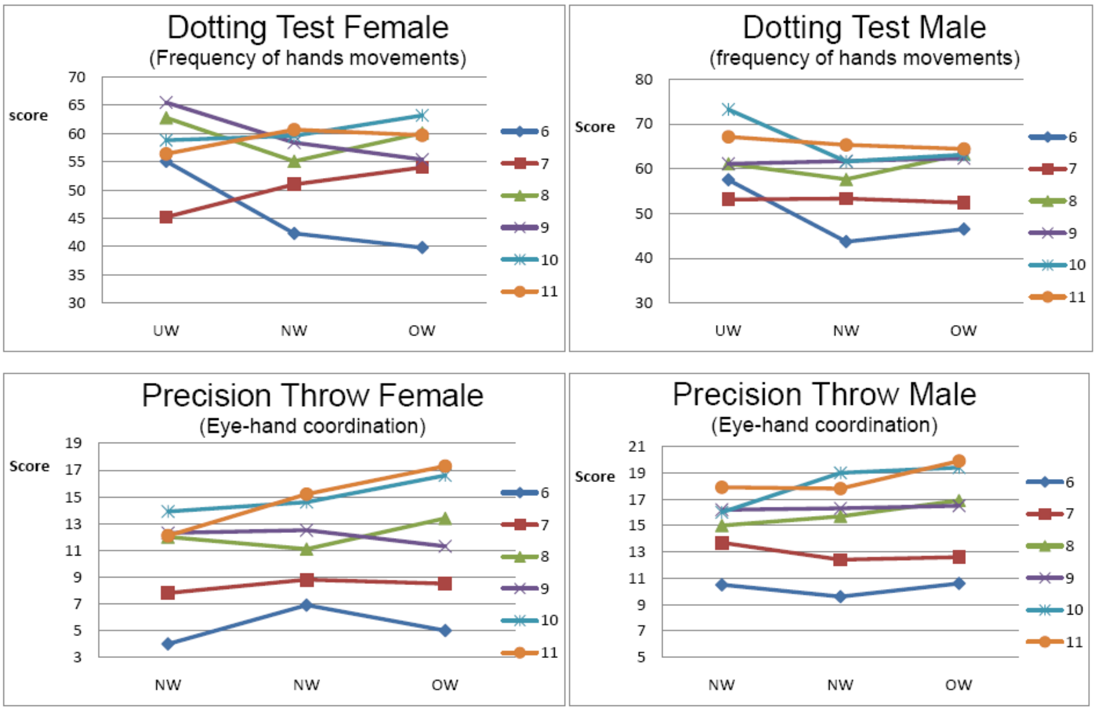
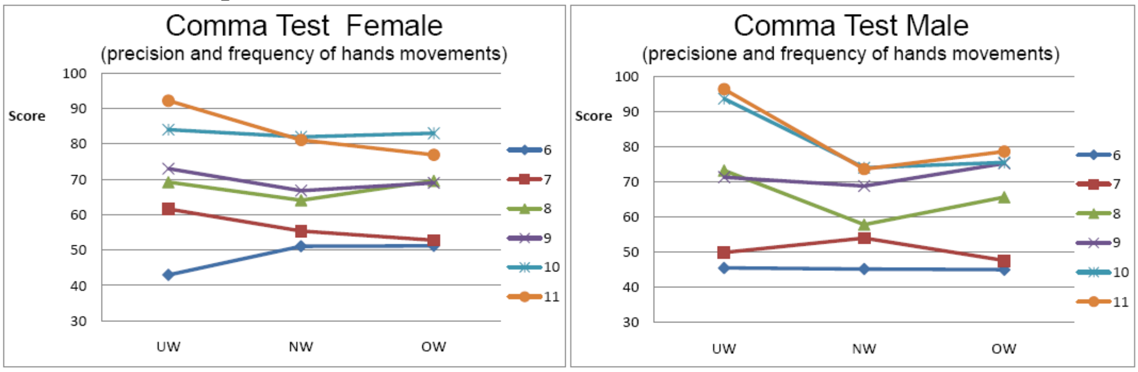


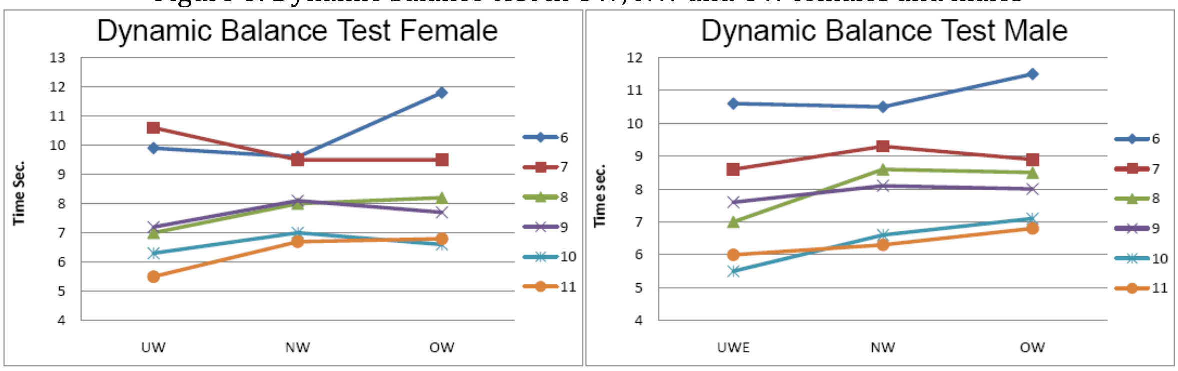
Figure 5: Comma test in UW, NW and OW females and males



In the flexibility test (S&R), females showed better results than males ($p<0.05$) (Table 3). The test outcome is not affected by the weight status and age (Table 3 & 4).

In the dynamic balance test (Figure 6) no gender and weight status differences were observed (Table 3). Concerning the age groups (Table 4), significant increases can be observed between the 6-7 ($p<0.05$), 7-8 ($p>0.001$), and 9-10 yrs classes ($p<0.001$).

Figure 6: Dynamic balance test in UW, NW and OW females and males



Discussion

Gender differences have been found for 7 out of 8 tests (Tab.3). Males performed better in HG ($p<0.05$), UST($p<0.001$), SLJ ($p<0.001$), DT ($p<0.001$) and ECT ($p<0.001$), whereas females showed the better results in SR ($p<0.05$) (Cornbleet & Woolsey, 1996) and CT ($p<0.05$) (Pollatou, Karadimou, & Gerodimos, 2005). No gender differences were found for DBT.

Overweight children performed better in HG ($p<0.001$) and UST ($p<0.05$) than normal- and underweight children. Normal-weight children performed better in SLJ ($p<0.05$) and underweight children in CT ($p<0.05$) (Table 3).

Once again, it is evident that males, generally, are highly motivated in prevalently motor tasks. Conversely, females perform better in activities in which precision, executive rhythm and ability to lengthen the muscles are fundamental to carry out the motor task. The present data confirm the trend of overweight and obese children to achieve the best performances in maximum isometric strength (HG) and explosive strength (UST), namely activities in which the exercise intensity does not involve the cardio-circulatory and respiratory apparatus (Berndtsson, Mattsson, Marcus, & Larrson, 2007; Cooper, Poage, Barstow, & Springer, 1990; Morinder, Larsson, Norgren, & Marcus, 2009; Sothern, Loftin, Blecker, & Udall, 2000), or the antigravitational action applied to the whole body displacement. These evidences allow to affirm that a ponderal excess does not negatively affect the muscle functionalities and the expression of rapid and explosive strength as in throwing (UST) (Biskanaki et al., 2004; Korsten – Reck et al., 2007). This concern seems to be confirmed also by the worst performances observed in underweight children in the maximal isometric strength test. In other words, our results indicate that the body mass does not limit the local strength expressions, but a lower body mass negatively affects the performances involving absolute (in this case isometric) strength. On the contrary, in agreement with previous studies (Deforche et al., 2003; Mink, Ruiter, Van Mechelen, Kemper, & Twisk, 2000), overweight children show worse performances in tasks in which the displacement of body mass is required, as in the SLJ.

Non-significant differences among weight states have been observed In coordinative tests. This seems to confirm that the weight status has not an influence on motor tasks with high coordinative requirements. It is worth noting that in the comma test, underweight children show performances significantly better compared to normal-weight.

Age differences (Table 4) concern all the age classes except 8-9 (HG, SLJ, ECT, DBT, DT, CT) and 10-11 years (UST, ECT, CT).

The evolution of the different capacities with age shows a plateau in the 8-9 yrs class for which, in almost all the tests, no significant differences are shown. This plateau was noted also in other studies on the infantile motor performance (Branta, Haubenstricker, & Seefeldt, 1984; Denckla, 2008), and seems to indicate a pause, that is however not evident for all the considered variables (Table 4), especially in coordinative tests (DT, CT, ECT, DB). In DT a performance levelling-off can be observed even after 9 years.

The present's results suggest the presence of a sensible phase, for given capacities, up to 7-8 yrs and, in a less extent, in the following years. It is worth noting the different outcome of the strength capacity: the upper limbs explosive strength shows a constant increase up to 10 years, whereas for the lower limb strength and the maximum isometric strength, the increasing trend seems to restart after the stabilization in the 8-9 yrs class (Table 4). These outcomes, if confirmed by the longitudinal study, will allow more precise interpretations of the interrelationships between somatic growth, weight status and motor performance.

In static or segmental activities, obese children show similar performances compared to normal-weight children. This supports the idea that, for overweight and obese children, motor programs involving dynamic activities and whole-body displacement are needed. This kind of activities should stimulate appreciable energy consumption and facilitate weight loss. Parents and educators have to consider these indications to entice the children to practice, in the extra-school time, simple activities involving high energy consumption such as walking, running, and cycling.

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THE RELATIONSHIP BETWEEN EXERCISE NEEDS AND CLASS SATISFACTION FOR DANCE SPORT PARTICIPANTS AT UNIVERSITY GENERAL PHYSICAL EDUCATION CLASS

Yun La Cho

Abstract

The purpose of the study is to examine the relationship between exercise needs and class satisfaction in dance sport participants at a university level general physical education class. To accomplish the purpose of the study, dance sport participants at university are subjected to questionnaire. The subjects were selected based on a convenience sampling totaling 273 and are used for final data analysis. The results were analized utilizing SPSS 17.0 for multiple regression analysis. Results show that the exercise needs of university dance sport participants influences that of class satisfaction. The exercise needs consist of sub-factors including need to boast, needs of purification, and the desire of maintaining their physical appearance. Needs to boast influences the class management and instruction while the needs of purification influences class management, class instruction, and class environment. Lastly the needs to maintain an ideal physical appearance influences both class instruction and class environment.

Introduction

The university general physical education class requirement has been changed from a core course to an elective course. Similarly, curriculum requirement also have changed from a school-based systme into a student-cenetered, which takes away from the necessity and importance of university education and can not play a role properly as a university physical education (Lee Dong Jun, 2006). Since we cannot leave the problem of university physical education go unsolved any longer, this study will examine the need for exercise and class satisfaction by focusing on participants taking part in a dance sport class that is offered at the general physical education department. Exercise needs is the one reason people want to participate in exercise and their motivation for participation stems from potential feelings of personal superiority related to enjoyment, happiness, curiosity, and experience (Horn, 1992). It is identified that internal motivation for participation influences on class satisfaction as a social-psychological variable (Seo Hui Jin, 2003; Raedeke & Burton, 1997). Specifically, the study of Seo Hui Jin (2003) reports that the differences of exercise needs are based on gender and the level of educationof adolescent, and that the possibility of reasoning is realizable in relation to diverse motivation of exercise needs of university students. Accordingly, this study surmises that the relationship between exercise needs and class satisfaction for dance sport participants at the university can reactivate general physical education class requirement, so participants can improve the quality of their life throughout enjoyable leisure experiences. In addition, this study will provide the opportunity to enhance the status of university physical education classes.

Reserch methods

Dance sport participants at universities in Seoul and Gyeonggi Province were subjected to a questionnaire. Among the collected data, 273 participants were used for practical analysis based on convenience sampling and the individual characteristics are shown on Table1. Based on the theories and precedent studies of various useful academic disciplines, the questionnaire consists of 2 individual characteristics of gender and year of schooling. Exercise needs were examined by using a questionnaire from Seo Hui Jin (2003) based on needs for sport participation, and class satisfaction was analized by using a questionnaire from Gi Jung Eun (2006). By utilizing SPSSWIN 17.0, frequency analysis, exploratory factor analysis, reliability analysis, and multiple regression analysis were implemented.

Table 1: Individual characteristics

Character	Classification	Frequency	Ratio(%)
Sex	Male	119	43.6
	Female	154	56.4
Grade	Freshman	75	27.5
	Sophomore	91	33.3
	Junior	54	19.8
	Senior	53	19.4

Results

As mentioned on Table 2, the need to boast is a sub-factor of exercise needs influences class management and class instruction. The needs of purification, however, influences class management, class instruction, and class environment. It was also found that the needs for a desired physical appearance only influences class management and class environment. Regarding the explanatory power of the exercise needs, class management accounts for 19.0%, class instruction 26.3%, and class environment 18.3%.

Table 2: Influence of exercise needs on class satisfaction

Variables	Class management			Class instruction			Class environment		
	b	β	t	b	β	t	b	β	t
Needs to boast	.150	.151	2.609*	.347	.390	7.062***	.093	.104	1.790
Needs of purification	.291	.282	4.868***	.181	.196	3.546***	.183	.197	3.378***
Need for better physical appearance	.202	.177	3.120**	.087	.086	1.583	.300	.292	5.117***
R^2	.190			.263			.183		
F	21.073***			31.947***			20.129***		

*p<.05, **p<.01, ***p<.001

Discussion and conclusion

This study examines the relationship between exercise needs and class satisfaction for dance sport participants at a university general physical education class and the result is that exercise needs for university dance sport participants influences class satisfaction. This result supports the facts that exercise needs directly influences satisfaction of general physical education in the study of the relationship among exercise needs, satisfaction of general physical education, and intention to exercise continuance by Jang Seung-Won (2007). In addition, physical appearance has a close relationship with self-confidence and sense of accomplishment which partially supports the study of Frederick(1993) and Wilson, Longley, Muon, Rodgers & Murray (2006) which stipulates that satisfaction from body shape will result in not only enjoyment but also attention from others. The result also supports the study of Ju Yong Hae (2009) which establishes that fundamental exercise needs by dance sport participants, and individual motivation factors positively influence class satisfaction leading to exercise continuance.

Accordingly, both professors and school curriculum designers at a university should make an effort to recognize the importance of general physical education and promote it while providing services and programs that can lead to exercise satisfaction and develop dance sport continuously.

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CANONICAL RELATIONS BETWEEN BASIC KINETIC ELEMENTS AND MORPHOLOGICAL CHARACTERISTICS

Miroslav Dodig

Abstract

The basic kinetic elements, with their quantitative and qualitative diversity, determine the kinetic structure, which is manifested in overcoming resistance on a particular path in a particular time. The kinetic structure in an individual or repeating motion partly also depends on the anthropometrical characteristics of the body, namely volume, mass, transversal and longitudinal dimensionality of the body. The main objective of this research is directed at determining the quality and the degree of correlation between basic kinetic elements with morphological characteristics. The research was conducted on a sample comprised out of 124, 15 year old, male respondents. A total of 21 kinetic measures obtained with the help of adequate instruments and with the use of the ergometrical method has been used for evaluating basic kinetic elements. For the purpose of evaluating morphological characteristics in a way prescribed by the International Biological Program, 15 anthropometrical measures were utilized. The canonical analysis revealed a very close correlation between the system of basic kinetic elements and the system of morphological characteristics. Due to a well-structured area, five significant canonical dimensions were successfully extracted. Generally, there are significant canonical relations between basic kinetic elements, namely resistance and amplitude in motion, with morphological characteristics. However, this is not the case with manifested reactions of time in motion. The determined correlation and relations of these areas are essentially rooted in basic biomechanical laws on the influence of the length of levers, angular speed and body mass, or the influence of body height on the efficiency of the functioning of the kinetic chain in relation to various functional mechanisms for the regulation of basic kinetic motions.

Introduction

Due to the qualitative and quantitative diversity of expressing basic kinetic elements of the effectorial system within one global kinetic exit as resistance, path and time, there is a possibility of forming a whole range of relations with morphological characteristics. Furthermore, since basic kinetic elements of the effectorial system and anthropometrical dimensions represent a source of a part of mutual variability, and with regard to the explanation of the basic kinetic elements phenomenon, there is a possibility of forming a whole range of interdependent relations. This research has been conducted with a primary objective of determining relations, degree and quality of correlation between basic kinetic elements of the effectorial system with morphological characteristics. The underlying conception under which basic kinetic elements have been defined is founded in a multi-variant configuration of basic kinetic elements within the kinetic structure formed in individual and repeating motion (Dodig, 1983, 1987, 1994, 2002, 2008, Dodig & Pistotnik, 2009). Accordingly, basic kinetic elements – time, amplitude and resistance, with their distribution and configuration, determine the efficiency and type of the kinetic structure and give the possibility of observing elements with the morphological area. By preferring a specific role of anthropological dimensions in the realization of basic kinetic elements of the effectorial system, it is justified to expect their contribution in the source of variability of basic kinetic elements. Such mainly theoretical conception of a part of the variance of basic kinetic elements will be significantly explained by a parallel analysis with the anthropological dimensions which are determined by the longitudinal, transversal and circular dimensions of the skeleton as well as by the factor of subcutaneous fat tissue (Kurelić, Momirović, Stojanović, Šturm, Radojević, & Viskić-Štalec, 1975). The main objective and task of this research is to determine the mutual relations of composition, structure, inner unity and complex of basic kinetic elements and morphological characteristics of the organism.

Methods

Participants

A sample of respondents was chosen for this research out of 15-years-old male population. The planned and formed sample of 124 respondents is sufficient for any correlation coefficient equal or higher than 23 to be considered different than zero with a margin of error of less than .01 or a confidence level of .99.

Instruments

Variables were chosen for evaluating relations between basic kinetic elements of the effectorial system and anthropological dimensions. A sample of measuring instruments was formed according to the objectives and tasks of the research. Variables were chosen for evaluating the basic kinetic elements of the effectorial system and anthropometrical dimensions.

Based on that, the variables for evaluating basic kinetic elements have been determined:

1) For evaluating resistance in motion in the case of individual movement: l. lifting with legs from a squat position (EPDNKG), 2. pressing with arms from a lying position (EPDRKG), 3. pulling with arms from a lying position (EPPRKG).
2) For evaluating amplitude in motion in the case of individual movement: l. lifting with legs from a squat position (EPDNM), 2. pressing with arms from a lying position (EPDRM), 3. pulling with arms from a lying position (EPPRM).
3) For evaluating time in motion in the case of individual movement with weight: l. lifting with legs from a squat position (EPDNS1), 2. pressing with arms from a lying position (EPDRS1), 3. pulling with arms from a lying position (EPPRS1).
4) For evaluating time in motion in the case of individual movement without weight: l. lifting with legs from a squat position (EPDNS2), 2. pressing with arms from a lying position (EPDRS2), 3. pulling with arms from a lying position (EPPRS2).
5) For evaluating resistance in motion in the case of repeating movement: l. lifting with legs from a squat position (ESDNKG), 2. pressing with arms from a lying position (ESDRKG), 3. pulling with arms from a lying position (ESPRKG).
6) For evaluating amplitude in motion in the case of repeating movement: l. lifting with legs from a squat position (ESDNM), 2. pressing with arms from a lying position (ESDRM), 3. pulling with arms from a lying position (ESPRM).
7) For evaluating time in motion in the case of repeating movement with weight: l. lifting with legs from a squat position (ESDNSI), 2. pressing with arms from a lying position (ESDRS1), 3. pulling with arms from a lying position (ESPRSI).

Longitudinal, transversal and circular dimensions of the skeleton and subcutaneous fat tissue define anthropometrical variables:

1) For evaluating longitudinal (L) skeleton dimensionality: 1. body height (AVT), 2. leg length (ADN), 3. arm length (ADR), 4. biacrominal range (ASK).
2) For evaluating transversal (T) skeleton dimensionality: 5. elbow diameter (ADL), 6. wrist diameter (ADRZ), 7. knee diameter (ADK).
3) For evaluating volume and body-mass: 8. body weight (AT), 9. average thoracic perimeter (AOG), l0. stretched upper arm perimeter (AON), 11. bent upper arm perimeter (AONK), 12. lower leg perimeter(AOP).
4) For evaluating subcutaneous fat tissue: 13. skin fold of the back (AKNL), 14. skin fold of the abdomen (AKNT), 15. skin fold of the lower leg (AKNP).

Procedures

The procedure for estimating with basic kinetic elements was carried out with the help of a measuring system that has been built and adapted according to the drawings at the Faculty of Maritime Studies in Rijeka. The measuring and collecting of information was carried out with the use of a measuring instrument called *KINESIOMETER* (Dodig, 1987), which has been connected to a computer and has enabled the measuring of analog values of movement or inactivity of parts of the body or the whole body. Transmission of information and the coding was carried out through an analog – to – digital converter (ADC). The position of a certain movable body part or the whole body can be determined with the use of the kinesiometer with a rotational linear potentiometer, which measures the changeable resistance. For each motion, basic kinetic elements, namely resistance (kg), time of motion (s) and the amplitude or motion path (m) were isolated with the use of the kinesiometer.

The procedure for estimating morphological characteristics was carried out consistently with the objective and tasks of the research and according to the method recommended by the International Biological Program. Furthermore, the measuring instruments were proposed according to that model. Tests that have been used for the purposes of this research were already validated in a range of previous studies and they were chosen in a way that they cover virtually all dimensions of the hypothetical model. The procedure for evaluating anthropological measures is created on the basis measuring particular anthropometrical values.

The problem of correlation of the areas referred to above was solved with the help of the canonical correlative analysis, the algorithm and program called COCAIN. The program has been written in 5.2/m version of the SS language (Momirović, Gredelj, & Herak, 1980) library SRCE SS – MIKRO. The basic logic of the algorithm and program is founded on an orthogonal parsimonic transformation of canonical dimensions of two sets of variables, previously transformed into standard main components. The method aims to the simple form of structure of the canonical factors, avoiding singular sets of variables. The underlying criteria for extracting and interpreting canonical dimensions is based on the determination that only those canonical dimensions are important, which are joined to the canonical correlations the squares of which are bigger than the average coefficient of determination of any analyzed set of variables determined on the basis of another set. The retained canonical dimensions were transformed into an orthogonal parsimonic position that enables a simpler interpretation of the canonical factors.

Results

Significant correlations, represented in the matrix of cross-correlations (table 1), were obtained with the optimal linear combination of variables of basic kinetic elements and variables of morphological characteristics.

Table 1: Matrix of cross – correlations variables of basic kinetic elements and morphological characteristics

	AVT	AT	AND	ADR	ASK	ADL	ADRZ	ADK	AO
EPDNKG	.13	.40	.08	.09	.12	.31	.20	.33	.39
EPDNM	.85	.55	.76	.72	.52	.44	.35	.39	.38
EPDNS1	.22	-.05	.31	.19	.02	.06	.05	-.05	-.12
EPDNS2	.36	.19	.33	.31	.16	.13	.18	.03	.16
EPDRKG	.16	.55	.17	.09	.18	.41	.35	.42	.62
EPDRM	.64	.47	.59	.61	.48	.39	.27	.28	.33
EPDRS1	.04	-.10	.13	.01	.05	-.01	.12	-.05	-.16
EPDRS2	-.05	-.15	.09	-.02	-.03	-.07	.01	-.15	-.22
EPPRKG	.24	.58	.18	.19	.23	.43	.27	.41	.59
EPPRM	.54	.36	.50	.39	.34	.25	.24	. 31	.27
EPPRS1	-.04	-.17	-.13	-.08	-.08	-.09	.02	-.16	-.13
EPPRS2	.08	.03	.03	.00	-.05	.01	.02	-.11	.05
ESDNKG	-.08	.18	-.11	-.13	.13	.04	.07	.06	.26
ESDNM	-.01	.16	-.03	-.04	.18	.00	.07	.04	.21
ESDNS1	-.14	.03	-.13	-.16	.09	-.06	.03	-.04	.10
ESDRKG	.18	.34	.15	.11	.08	.26	.17	.07	.16
ESDRS1	.05	.01	.05	.07	.15	.40	.26	.40	.45
ESPRM	.33	.34	.33	.31	.13	.28	.20	.30	.29
ESPRS1	.25	.27	.26	. 24	.09	.24	.17	.22	.20

	AON	AONK	AOP	AKNL	AKNT	AKNP
EPDNKG	.47	.50	.39	.19	.12	.07
EPDNM	.24	.24	.32	.00	.04	.07
EPDNS1	-.15	-.11	-.21	-.08	-.16	-.14
EPDNS2	.07	.03	.13	.07	.10	.05
EPDRKG	.68	.73	.51	.24	.17	.12
EPDRM	.23	.24	.24	.12	.11	.09
EPDRS1	-.16	-.14	-.16	.01	-.07	-.03
EPDRS2	-.17	-.20	-.21	-.08	.00	.02
EPPRKG	.59	.64	.48	.23	.21	.17
EPPRM	.22	.23	.26	.01	-.03	-.01
EPPRS1	-.16	-.15	-.22	-.08	-.09	-.10
EPPRS2	-.07	-.09	-.07	.08	.03	-.01
ESDNKG	.25	.27	.18	.13	.03	-.01
ESDNM	.14	.17	.14	.08	-.01	-.02
ESDNS1	.07	.11	.06	.02	-.08	-.09
ESDRKG	.41	.40	.31	.10	.11	.10
ESDRM	.14	.12	.12	-.03	.02	.03
ESDRS1	.04	.03	.01	-.04	.03	.03
ESPRKG	.50	.50	.46	.12	.07	.08
ESPRM	.33	.32	.33	.04	-.01	.02
ESPRS1	.28	.26	.25	.02	-.02	.01

Legend: EPDNKG - lifting with legs from a squat position, EPDRKG - pressing with arms from a lying position, EPPRKG - pulling with arms from a lying position, EPDNM - lifting with legs from a squat position, EPDRM - pressing with arms from a lying position, EPPRM - pulling with arms from a lying position, EPDNS1 - lifting with legs from a squat position, EPDRS1 - pressing with arms from a lying position, EPPRS1 - pulling with arms from a lying position, EPDNS2 - lifting with legs from a squat position, EPDRS2 - pressing with arms from a lying position, EPPRS2 - pulling with arms from a lying position, ESDNKG - lifting with legs from a squat position, ESDRKG - pressing with arms from a lying position, ESPRKG - pulling with arms from a lying position, ESDNM - lifting with legs from a squat position, ESDRM - pressing with arms from a lying position, ESPRM - pulling with arms from a lying position, ESDNSI - lifting with legs from a squat position, ESDRS1 - pressing with arms from a lying position, ESPRSI - pulling with arms from a lying position, AVT - body height, ADN - leg length, ADR - arm length, ASK - biacrominal range, ADL - elbow diameter, ADRZ - wrist diameter, ADK - knee diameter, AT - body weight, AOG - average thoracic perimeter, AON - stretched upper arm perimeter, AONK - bent upper arm perimeter, AOP - lower leg perimeter, AKNL - skin fold of the back, AKNT - skin fold of the abdomen, AKNP - skin fold of the lower leg.

By observing that part of the cross-correlations matrix in which the variables of basic kinetic elements of the amplitude in motion are located, one can notice that there is a bipolarity relating to the amplitude in motion in case of individual movement and to the amplitude in motion in case of repeating movement. It should be pointed out that mutual correlation of the variables of the amplitude in motion on one hand and variables of time in motion on the other hand is highest in the treated area, which is particularly emphasized in the area of time in motion in case of repeating movements. Variables of basic kinetic elements intended for the measurement of resistance in motion show a similar behavior, with a difference that bipolarity is less emphasized and correlation is higher. A somewhat weaker correlation of variables of the amplitude in motion with variables of resistance in motion relates mainly to the motion occurring in individual movements, while there is a significantly high correlation with the variables of resistance in motion occurring in repeating movement. With basic kinetic elements of time in motion, the correlation of variables is relatively weak. It is obvious that the variables of time in motion in the case of no weight don't have much in common with the variables of time in motion in the case of movements with weight. Generally, it can be noticed that there is a higher correlation of variables that were the carriers of information of basic kinetic elements in repeating movements. That is logical because there is a higher correlation for realization of motion in repeating movements; this correlation emerging as an answer of the regulatory mechanism to the number of motion repetitions. Some variables significantly depart from the rest and that primarily relates to the element of time in motion. This is probably the case of the significant quantity of specific variance, which gives certain independence to basic kinetic element of time in motion.

A global analysis of the part of the matrix of cross-correlations of morphological characteristics reveals the existence of a relatively good correlation. That particularly relates to those anthropometrical variables intended for evaluating longitudinal dimensionality of the skeleton, voluminousity and transversal dimensionality of the skeleton. A somewhat weaker correlation can be found with variables intended for measuring the subcutaneous fat tissue. Noticeably high correlation between variables which were used for evaluating longitudinal dimensionality, mass and voluminousity of the body is completely understandable. Anthropometrical variables intended for measuring longitudinal and transversal dimensionality of the skeleton show similar behavior. The correlation between the sets of variables intended for evaluating subcutaneous fat tissue and variables for evaluating measures of the body volume is very high, what reveals their supplementarity. Variables for measuring subcutaneous fat tissue have the weakest correlation with the variables of longitudinal and transversal dimensionality of the skeleton. In addition, significant correlations of previously defined longitudinal dimensionality of the skeleton, body volume, subcutaneous fat tissue and transversal dimensionality are clearly noticeable.

Regarding morphological characteristics of the presented set, there is a high correlation and the group predetermination. Within the morphological area there are groups with emphasized and similar factorial structures, which were already obtained in previous studies (Kurelić et al., 1975). The cross-correlations matrix implies that there are significant satisfactory and positive correlations of these two areas. Out of all morphological characteristics, the variables of longitudinal dimensionality show the highest correlation with basic kinetic elements. Such grouping of correlations is justified, especially since it is known that the amplitude in motion occurring in individual movements is conditioned upon morphological characteristics. This is obviously the case of length of levers, that is the length of an anatomically determined path. The variables of resistance in motion have realized a similar, significant and high correlation of basic kinetic elements with the morphological characteristics. Since the overcome resistance in motion is in major part determined with the structure for generating intensity and the duration of energy releasing, the morphological characteristics, particularly volume, body mass and transversal dimensionality of the skeleton, represent the factor which significantly participates in the realization of motion with increased demands for overcoming resistance.

Variables of time in motion have shown a somewhat weaker correlation in these two areas. However, those morphological variables that are used for measuring subcutaneous fat tissue show the weakest cross-correlation in the entire area. A planned analysis of the relation between basic kinetic elements and morphological characteristics is not possible solely on the basis of linear characteristics of variables. That is particularly indicated by the structure of the cross-correlation matrix from which it can be seen that the variables of basic kinetic elements and variables of morphological characteristics are arranged in sets which will later, very faithfully, reproduce a factorial structure. It is obvious that the analyzed areas are not mutually independent and that basic kinetic elements considerably depend on a certain optimal combination of morphological characteristics.

For the purpose of studying the coordinates of the areas of basic kinetic elements and morphological characteristics, important main components of the cross-correlation matrix were used. Therefore, the problem of determining canonical correlations between systems was reduced to solving characteristic equations on the basis of significant characteristic roots and associated characteristic vectors of the cross-correlations matrix. On the basis of criteria that extracted only those canonical dimensions associated with canonical relations the squares of which are larger than the average determination coefficient (table 2), the structures of main components have been formed based on residual variance in each following succession of the extraction of characteristic roots of the cross-correlation matrix.

Table 2: Main components of the cross – correlation matrixof basic kinetic elements and morphological characteristics

	Ro	Ro^2	h^2
1.	.9263	.8581	.6651
2.	.8532	.7280	.4559
3.	.6495	.4219	.3943
4.	.6186	.3826	.0595
5.	.4989	.2489	.0558
6.	.4608	.2123	.1666
7.	.4313	.1860	.1130
8.	.3950	.1561	.0500
9.	.3604	.1299	.1247
10.	.3381	.1143	.0853
11.	.2700	.0729	.0975
12.	.2380	.0566	.2491
13.	.2100	.0441	.0390
14.	.1548	.0240	.0622
15.	.1366	.0187	.0218

Legend: Ro – Canonical Correlations, Ro^2 – Roots of Canonical Equation, h^2 – Communalities Hotelling

The number of significant main components representing mutual covariability of basic kinetic elements and anthropometrical variables, and the percentage of the mutual variance of basic kinetic elements variables and anthropometrical variables (table 3), was reproduced with five characteristic roots of the cross-correlations matrix. For the exploitation of the mutual variance of the analyzed area, five canonical roots where sufficient to explain the covariability between the system of 21 variables of basic kinetic elements and 15 anthropometrical measures. Since the system of variables is well structured, the number of extracted significant characteristic roots was optimal, considering the total quantity of variance and the number of variables. Canonical dimensions in the area of main components were deduced by the transformation of standard main components and orthogonal transformations (table 4 and 5). The first main component exhausts 24% of the total variability of the whole system of variables. The first pair of canonical variables can be very simply interpreted considering the variables show a high mutual correlation. Accordingly, the correlation of .92 with the logical positive value can be fully explained since it approximates the relations of amplitudes in motion occurring in individual and repeating movements and the length of limbs. In the light of the above, the first canonical dimension is formed in the area of basic kinetic elements and morphological area.

Table 3: Eigenvalues (hotelling) cross – correlations matrix of basic kinetic elements and morphological characteristics

	LAMBDA	%	ACCUMULATED
1.	.8581	.2348	.2348
2.	.7280	.1992	.4340
3.	.4219	.1154	.5495
4.	.3826	.1047	.6542
5.	.2489	.0681	.7223*
6.	.2123	.0581	.7804
7.	.1860	.0509	.8313
8.	.1561	.0427	.8740
9.	.1299	.0356	.9095
10.	.1143	.0313	.9408
11.	.0729	.0200	.9608
12.	.0566	.0155	.9763
13.	.0441	.0121	.9883
14.	.1240	.0066	.9949
15.	.0187	.0051	1.0000

Legend: LAMBDA – characteristic roots of the cross – correlation matrix, % - part of common, ACCUMULATED – number of significant main components representing mutual covariability

* - salients marked with asterix, last counted eigenvalues

Table 4: Simple structure in variables of morphological characteristics

	SDM	EMD	TDIM	TCIM	TDRM
AVT	(.96)	.19	-.08	-.13	.00
AT	.50	(.72)	.08	-.15	.18
AND	(.91)	.13	-.01	.23	-.04
ADR	(.82)	.18	.23	-.18	.12
ASK	(.56)	.24	.27	-.11	.09
ADL	.41	(.53)	.04	.17	.30
ADRZ	.31	(.37)	-.11	.17	.03
ADK	.34	(.56)	.34	.05	.07
AOG	.27	(.78)	-.15	-.16	.20
AON	.11	(.84)	-.02	.10	.15
AONK	.09	(.90)	.08	.13	.10
AOP	.23	(.71)	.18	-.22	.01
AKNL	-.03	.32	-.03	.01	(.57)
AKNT	.03	.27	.05	-.01	(.67)
AKNP	.08	.18	.01	-.01	(.46)

Legend (see Table 1): **SDM -** spatial dimensionality of motion, **EMD -** energetic motion dimensionality, **TDIM -** time dimensionality of individual motion, **TCIM -** time in case of individual movements, **TDRM -** time dimensionality of repeating motion

Table 5: Simple structure in variables of basic kinetic elements

	SDM	EMD	TDIM	TCIM	TDRM
EPDNKG	.06	(.60)	-.15	-.11	-.01
EPDNM	(.94)	.11	.03	.04	.03
EPDNS1	.25	-.09	(.56)	-.04	.00
EPDNS2	(.41)	-.03	.05	.29	.07
EPDRKG	.05	(.93)	.04	-.04	.07
EPDRM	(.71)	.13	.03	-.03	-.23
EPDRS1	.06	-.15	(.38)	-.06	-.10
EPDRS2	.02	-.23	(.40)	-.10	-.18
EPPRKG	.17	(.74)	-.25	.05	-.08
EPPRM	(.55)	.20	.16	-.11	.22
EPPRS1	-.06	-.14	-.02	(.33)	-.03
EPPRS2	.07	-.08	-.10	(.52)	-.04
ESDNKG	-.16	(.37)	-.25	.02	.28
ESDNM	-.05	.21	-.30	-.03	(.32)
ESDNS1	-.20	.19	-.20	-.12	(.38)
ESDRKG	.13	(.52)	.07	.17	.04
ESDRM	(.32)	.08	.03	.09	.10
ESDRS1	.07	.00	.09	-.04	-.05
ESPRKG	.27	(.61)	.00	.11	.16
ESPRM	.32	(.38)	.11	-.15	.23
ESPRS1	.25	(.32)	.15	-.14	.18

Legend (see Table 1 and 4)

The amplitude in motion occurring in individual movement represents a limiting area in which the length of levers – limbs has a significant importance. Here the efficiency of exploitation depends on their length and accordingly their contribution is considerably higher. However, the motion amplitude realized in repeating movements represents the path traveled in that motion, which is defined as a successive repetition of individual movements and is limited by the mechanism for generating intensity and the duration of energy releasing which also effected their decreased projections on the first canonical dimension. Consequently, it is more probable those persons with a larger longitudinal dimensionality will achieve better results. Clearly, the first canonical dimension in the area of basic kinetic variables and anthropometrical variables can be interpreted as a spatial dimensionality of motion. Long limbs, in another words long levers, not only make it more possible to realize the motion amplitude in individual movements because of their length, but they also produce a biomechanical functioning of the kinetic chain during the realization the motion amplitude in repeating movements. Because of long limbs, the resistance that has to be overcome has to have a significantly larger trajectory during motion, so as to ensure the optimal biomechanical functioning of the kinetic chain, than in the case of the short lever system. Since with all treated movements in this study, it is mostly the case of straight-lined movement with overcoming outer resistance, it is certain that precisely long levers of one kinetic system are the most efficient. Exactly in this kinetic-morphological combination of the first canonical factor, the limb length finds its full justification.

The second pair of canonical dimensions also has a relatively high coefficient of canonical correlation of .85 and absorbs 20% of the total variance of the whole system. Despite of their structures which are not balanced sufficiently, it is possible to interpret this simply. The basic kinetic elements factor, namely overcome resistance in motion occurring in individual and repeating movements, is considerably better defined and has the characteristic of a very substantial latent dimension, unlike the anthropometrical factor which is above all a single or perhaps a dual factor rather than one pure, substantial, latent dimension. Since this is the case of overcome resistance in motion occurring in individual and repeating movement and since efficiency has been measured with measures for overcome maximal resistance, it is logical that the respondents with larger volume and body-mass and larger transversal dimensionality of the skeleton achieve better results. Therefore, the high correlation can be explained since the treated area approximates the relation of overcome maximal resistance occurring in individual and repeating movements, volume, body-mass and transversal dimensionality of the skeleton.

What is important, reliable and solely distinctive for this pair of canonical factors is the positive influence of the dimension of volume, body-mass and transversal dimensionality of the skeleton on the outcome of motion in which a certain maximal outer resistance occurring in individual and repeating movement has to be overcome. The fact that the morphological complex which favors the generating of resistance in motion is acting as the second generator of covariability of morphological characteristics of transversal and circular dimensionality, shows that the resistance overcome in motion fairly depends on the morphological characteristics. The second canonical factor of variables of basic kinetic variables and anthropometrical variables represents the energetic motion dimensionality. This dimension is similar to a certain dimension close to the general factor of this area or at least to the main component of the area. What is essential is that it passes through the area of variables considerably closer than the vectors which represent the group of measures of the amplitude and time in motion.

The third component exhausts 11% of the total variance out of the total covariability of the whole system of variables with mutual correlation of .65. Considering the information structured upon residuals of the variance of the first and second components, the third main component can be considered significant. The structure of the third main component is defined by the projections of variables of time in motion, in particular the time of performance of motion with upper limbs with and without weight in individual and repeating movements. In addition, there is a strong projection of the variable which is manifested by time in motion with lower limbs with weight in individual movement. Interestingly, the projections of anthropometrical variables on this isolated canonical dimension are very weak. The best, however not sufficiently low projections are those of the variables of arm length, pelvis width and knee diameter. The third factor in the area of basic kinetic variables and anthropometrical variables represents the time dimensionality of individual motion. This factor reliably exists as time in motion occurring in individual movements with lower and upper limbs. A very small presence of projections of anthropometrical variables on the third isolated canonical factor shows that time in motion occurring in individual movements of lower and upper limbs does not significantly depend on morphological characteristics. In any case, the third canonical dimension belongs exclusively to the covariability within the complex of time in motion occurring in individual movements, and has no significant influence on the time in motion occurring in repeating movements.

The fourth component exhausts 10% of the total covariability out of the whole system of variables with the correlation of .62. The practical value of this dimension is very small because it emits too little useful information. In fact, variables that measure motion time in case of individual movements of the upper limbs and just one unconvincing anthropometrical variable have significant projections on this dimension.

The fifth main component exhausts significantly less of the total variance compared to the fourth (6,8%), with the correlation coefficient of .50, which is a border value, but a much better defined one. The variables of motion time in repeating movements and all variables of the morphological area, which cover the sub-space defined with the subcutaneous fat tissue, have significant projections on the isolated fifth main component. Fourth and fifth main components have emerged as a consequence of hyperfactorization. However, a canonical dimension representing time dimensionality of repeating motion could be formed with their compressing.

The connection within the third, fourth and fifth pair of canonical variables shows that basic kinetic elements manifested as time in motion contributed to that. Since they are oriented topologically, it is important to notice that in all cases variables that measure time in motion, realized with and without weight, were projected onto the same factor. The obtained results unquestionably show that morphological characteristics influence the relation of the majority of basic kinetic elements. Basic kinetic elements and anthropometrical characteristics are closely connected, with that connection demanding a mutual study of these two areas when basic kinetic elements are at stake. The said assertion is also confirmed by the obtained correlation coefficients between pseudocanonical variables of the set of basic kinetic elements and of the set of anthropometrical variables, obtained after transformation of the structural matrixes to a simpler form (table 6). Since latent dimensions were formed on a mutual variability in which the vectors of variables stretch the same area, it is possible to determine the relations of those factors and main components of the analyzed sets. The influence of particular morphological structures on a particular actual existence of the structure of basic kinetic elements was determined on that basis.

Table 6: Matrix canonical coefficients corelations between pseudocanonical dimension of basic kinetic elements and morphological characteristics

	SDM_M	EMD_M	$TDIM_M$	$TCIM_M$	$TDRM_M$
SDM_K	.8901	.1318	.0224	-.1001	-.0015
EMD_K	-.0413	.8504	-.1210	.1510	-.0401
$TDIM_K$	.1025	-.1917	-.2105	.5208	-.1306
$TCIM_K$	-.0256	-.0232	-.5742	-.2032	.1604
$TDRM_K$	.0104	-.0106	-.1806	-.0914	-.5119

Legend (see Table 4): Index $_M$ - dimension morphological, Index $_K$ - dimension kinetic

The research of relations of basic kinetic elements with morphological dimension was carried out by the condensation and transformation of the obtained results to the varimax position. The factorial structure of the canonical dimensions in the varimax position has not significantly changed. It is noticeable that the canonical configuration of the varimax factor intensifies and emphasizes the contribution of particular factors, whereas the first dimension is still dominant and makes the complete insight into the relation structure possible. The structure of the first pseudo-canonical factor isolated in the area of basic kinetic elements and morphological characteristics intensifies the relation between the motion amplitude in individual and repeating movements and the longitudinal dimensionality of the skeleton. High correlation coefficients of the pseudo-canonical variables show a significant unity and consistence of structure, which determines a stable existence of this factor. The second isolated factor in the treated area shows similar behavior, with high correlation coefficients between pseudo-canonical variables. The third and fourth canonical factors have a significantly weaker structure, with a low, but satisfactory correlation coefficient between the pseudo-canonical variables. Therefore, this is the case of domination of time in motion occurred in individual movement, with an insignificant influence of morphological characteristics on time in motion occurred in individual movements. The fifth factor, which in fact has a satisfactory unity and consistence of structure that secures the existence of this factor, has the lowest correlation in the area of pseudo-canonical variables. Generally, the morphological characteristics are extremely significant for the realization of basic kinetic elements. They represent an actual biomechanical basis for overcoming resistance and motion amplitude, and partly time in motion occurred in repeating movements, either as a factor that facilitates or as the factor that makes difficult the realization of basic kinetic elements. Having that in mind, morphological characteristics can be extremely significant for realization of motion in which one's own body or its part is moved, or some other object in space is moved, and in all cases where a certain resistance in motion has to be overcome independent of the motion time occurred in individual movements.

Discussion

The main objective of this research is directed to studying the quality and degree of correlation between basic kinetic elements and morphological characteristics. The research was conducted on a sample of 124, 15-years-old, male respondents. A total of 21 kinetic measures obtained with the help of instruments and with the use of the ergometrical method has been used for evaluating basic kinetic elements. Variables where chosen so they hypothetically cover basic kinetic elements in kinetic structures manifested in individual and repeating movement, defined as time, resistance and amplitude in motion. For the purpose of evaluating morphological characteristics in a way prescribed by the International Biological Program, 15 anthropometrical measures were utilized. Variables where chosen so they hypothetically cover the morphological area, defined as longitudinal dimensionality of the skeleton, transversal dimensionality of the skeleton, subcutaneous fat tissue, volume and body-mass. The correlation between basic kinetic elements with morphological characteristics has been computed with a series of two canonical-correlative analyses – COCAIN. The canonical analysis has shown a very high correlation of the kinetic elements system and the morphological characteristics system. A well-structured area made the extraction of five important canonical dimensions possible.

The first canonical dimension is made out of a pair of canonical variables, which are clearly determined by the amplitude in motion and the longitudinal dimensionality of the skeleton. Out of the total variability, this dimension exhausts 24% of the total variance, which are mutually highly correlated and fully explain the obtained projections, since they approximate the relations of long limbs in the motion amplitude. The second par of canonical dimensions is also correlated with relatively high canonical correlation coefficients, which exhaust 20% of the total variance of the system.

The variables of resistance in motion and the variables of circular and transversal dimensionality of the skeleton contribute the most, or in other words show the strongest projections. The area approximates the relation of volume, body-mass and transversal dimensionality of the skeleton and the overcome maximal motion resistance. The third, fourth and fifth canonical dimensions are defined with time variables, that is the motion duration which is topologically oriented. It is obvious that basic kinetic elements manifested as time in motion don't depend significantly on morphological characteristics. Generally, basic kinetic elements, namely resistance and amplitude in motion have significant canonical relations with morphological characteristics, which is not the case with time in motion. The determined correlation and relations of these areas are essentially rooted in basic biomechanical laws on the influence of the length of levers, angular speed and body mass, or the influence of body height on the efficiency of the functioning of the kinetic chain in relation to various functional mechanisms for regulation of basic kinetic motions.

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FACTORIAL STRUCTURE OF BASIC KINETIC ELEMENTS

Miroslav Dodig

Abstract

Quantitative and qualitative diversity of expressing basic kinetic elements in the kinetic structure is manifested in overcoming resistance on a certain path in certain time. Basic kinetic elements – time (s), amplitude (m) and resistance (kg), with their distribution and configuration determine the efficiency and type of the kinetic structure and enable the observation of those elements with other anthropological areas. The basic goal of this research is directed towards defining the latent structure of basic kinetic elements with the help of a specially prepared instrumentarium, with the use of the ergometrical method and on the basis of a factorial analysis of the elements of resistance, amplitude and time in individual and repeating motion. The quality and the degree of correlation between basic kinetic elements was determined and a factorial structure was obtained for 124, 15 year old, male respondents. Considering the type of research, this sample can be considered representative. A total of 21 kinetic measures, obtained with the use of instruments and the use of ergometrical method, were used for evaluating basic kinetic elements. Variables were chosen in such a way that they hypothetically cover basic kinetic elements in kinetic structures manifested in individual and repeating movement, defined as time dimensionality of the kinetic structure and tensodynamic dimensionality of the kinetic structure. For a better insight into the general behavior of analyzed variables, the methods of data processing were encompassed through calculation of regresional analysis series, so as to determine the complex and the latent structure of basic kinetic elements (factorial analysis Little Jiffy, Mark IV was used). The analysis of the factorial structure of basic kinetic elements was carried out in a manifest area of variables. Six factors have been extracted on the basis of characteristic vales of the matrix of covariance of the analyzed space with the use of Guttman - Kaiserov criterion. Isolated factors in this area have a phenomenological determination: a) latent dimension of pulling in kinetic structure (defined with resistance, amplitude and time in kinetic task – pulling), b) latent dimension of pressing in kinetic structure (defined with resistance, amplitude and time in kinetic task – pressing), c) latent dimension of repeating in kinetic structure (defined with resistance, amplitude and time in kinetic task – repeating), d) latent dimension of accumulating and releasing of energy in kinetic structure (defined with resistance, amplitude and time in kinetic task), e) latent dimension of generating and releasing energy in the kinetic structure (defined with resistance within kinetic tasks realized in individual movement), f) latent dimension of special determination of the kinetic structure (defined with the amplitude within kinetic tasks realized in individual movement). The latent structure of basic kinetic elements was analyzed. Latent kinetic dimensions were extracted and interpreted as mechanisms for regulating intensity of exitation, a mechanism for regulating synergy and regulating muscle tone and integrative mechanisms for regulation, control and coordination of the mentioned regulative subsystems in the kinetic structure.

Introduction

Due to the effort to treat the motion of an organism from the standpoint of kinetic laws, particularly dynamic characteristics, a conception that can be operationalized in the direction of characteristics of basic kinetic elements of the effectorial system emerged. One of the characteristics of the effectorial system is that it can generate and release energy with the goal of overcoming resistance on a certain path in certain time, within a particular kinetic exit manifested as motor structure. For that reason resistance, amplitude and motion time constitute basic kinetic elements that are manifested in each motion. With their distribution and configuration, they determine the type and efficiency of a kinetic exit and enable the observation of those elements with other anthropological areas. The kinetic exit of the effectorial system is expressed as a structural complex of basic kinetic elements. Therefore, resistance, amplitude and time in motion constitute basic kinetic elements manifested in each motion. Basic kinetic elements often, both explicitly and implicitly, represent the exit out of the effectorial system as a certain value that, kinetically speaking, belongs to a different modality of motion. From both theoretical and practical standpoint it is important to understand that for performing a certain motion, it is necessary to overcome certain resistance; this resistance being overcome on a certain path in certain time. Accordingly, basic kinetic elements have the following determination: resistance in motion is defined with the resistance that is overcome during motion and expressed in kilograms (kg), amplitude in motion is defined with a path traveled during motion, expressed in meters (m) and time in motion, is defined with the time during motion, expressed in seconds (s). The process of forming the kinetic exit out of the effectorial system is subordinate to the laws on processes of integration and differentiation of basic kinetic elements of the effectorial system. The integration process is expressed through the mutual connection between basic kinetic elements that develop independently from the exit kinetic structure. The differentiation process is clearly expressed with the domination of particular basic kinetic elements in the exit kinetic structure. The basic goal of this research is directed towards defining the latent structure of basic kinetic elements with the help of a specially prepared instrumentarium, with the use of the ergometrical method and on the basis of a factorial analysis of the elements of resistance, amplitude and time in individual and repeating motion.

Methods

For this research, the sample of respondents was chosen out of a 15 and 16 years old male population. Due to the mode of measuring and the methods applied in the research this sample was comprised out of 124 respondents. The planned sample of 124 respondents was sufficient for any correlation coefficient equal or higher than .23 to be considered different than zero with a margin of error of less than .01 or a confidence level of .99.

Variables were chosen for evaluating the factorial structure of basic kinetic elements. A sample of measuring instruments was formed according to the objectives and tasks of the research. Variables were chosen for evaluating basic kinetic elements of the effectorial system.

The measuring and collecting of information was carried out with the help of a measuring instrument called *KINESIOMETER* (Dodig, 1983, 1984, 1987), which was connected to a computer and enabled the measuring of analog values of movement or inactivity of parts of the body or the whole body.

The transmission of information and the coding was carried out through an analog – to – digital converter (ADC). By use of the kinesiometer with a rotational linear potentiometer, which measures the changeable resistance, the position of a certain movable body-part, or the whole body can be determined.

By use of a kinesiometer, basic kinetic elements manifested as resistance (kg), motion time (s) and the amplitude or motion path (m) have been isolated for each motion. Basic kinetic elements defined with resistance, amplitude and time are generated as coincidental values of appropriate kinetic structures in individual and repeating motion:

Figure 1: Illustration of body position on the device for motion: A – weight lifting with legs from a squat position B – pressing with arms with weight from position of lying on the back C – pulling with arms a position of lying on the chest

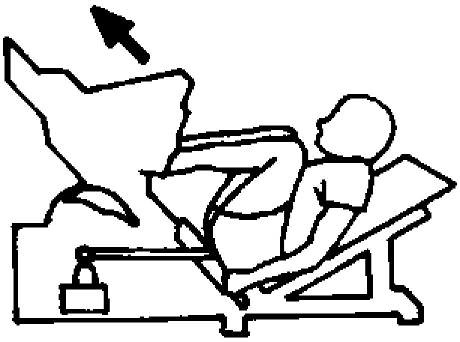


Figure 2: Determined analog values of motion in weight lifting with legs from a squat position; A – in individual and B – in repeating motion

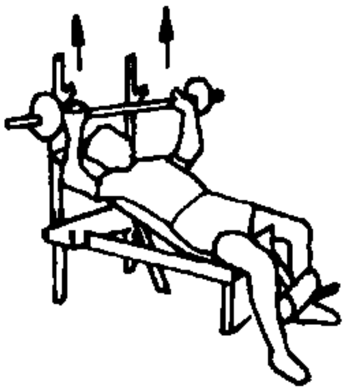


Figure 3: Determined analog values of motion in weight pressing with arms from the position of lying on the back; A – in individual and B – in repeating motion

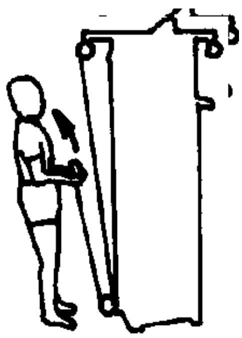
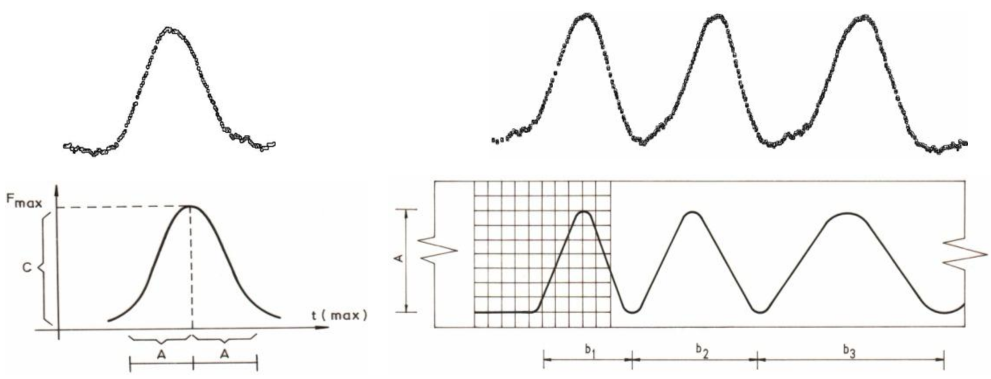


Figure 4: Determined analog values of motion in weight pulling with arms from the position of lying on the chest; A – in individual and B – in repeating motion.



A B

Basic kinetic elements of resistance (kg), time (s) and amplitude (m) were individual with the use of the method for reading records:

1) For evaluating resistance in motion in the case of individual movement: l. lifting with legs from a squat position (EPDNKG), 2. pressing with arms from a lying position (EPDRKG), 3. pulling with arms from a lying position (EPPRKG).

2) For evaluating amplitude in motion in the case of individual movement: l. lifting with legs from a squat position (EPDNM), 2. pressing with arms from a lying position (EPDRM), 3. pulling with arms from a lying position (EPPRM).

3) For evaluating time in motion in the case of individual movement with weight: l. lifting with legs from a squat position (EPDNS1), 2. pressing with arms from a lying position (EPDRS1), 3. pulling with arms from a lying position (EPPRS1).
4) For evaluating time in motion in the case of individual movement without weight: l. lifting with legs from a squat position (EPDNS2), 2. pressing with arms from a lying position (EPDRS2), 3. pulling with arms from a lying position (EPPRS2).
5) For evaluating resistance in motion in the case of repeating movement: l. lifting with legs from a squat position (ESDNKG), 2. pressing with arms from a lying position (ESDRKG), 3. pulling with arms from a lying position (ESPRKG).
6) For evaluating amplitude in motion in the case of repeating movement: l. lifting with legs from a squat position (ESDNM), 2. pressing with arms from a lying position (ESDRM), 3. pulling with arms from a lying position (ESPRM).
7) For evaluating time in motion in the case of repeating movement with weight: l. lifting with legs from a squat position (ESDNSI), 2. pressing with arms from a lying position (ESDRS1), 3. pulling with arms from a lying position (ESPRSI).

In order to achieve the main objective of this research a method was chosen for processing data of the factorial structure of variables of basic kinetic elements with the use of an algorithm of the structural model defined with the factorial analysis. A factorial structure of basic kinetic elements of the effectorial system was determined with the help of the program called Little Jiffy by Mark IV Kaiser and Rice (1974). After calculation of the determination coefficients, the multiple correlation square (communalities - Guttman, 1956), variances – co-variances and the intercorrelations matrix rescaled on an anti-image metric, the values and vectors of the intercorrelation matrix were determined. The vectors of the said matrix, the number of which is defined by the Guttman lowest number of significant latent dimensions (equal or higher than 1), were transformed to the orthoblique position (quartimax criterion was satisfied). A percentage of contribution to the total quantity of the explained variance has been extracted for every dimension out of the matrix of latent dimensions' intercorrelation (orthoblique factors). The matrix of the complex rescaled the image variable - transformed into a factorial matrix for the matrix of image co-variances (a basis for the interpretation of latent dimensions). Factorial values were obtained with the use of the standard regressive procedure. An actual existence of the latent dimensions was performed through the reliability index.

Results

The characteristics of basic kinetic elements variables were determined with the use of standard descriptive procedures. The results can be found in table 1. All values of the central and dispersive parameters confirm the hypothesis on normality of the distribution of variables of the set of basic kinetic elements, except the variable (EPPRM), which measured the amplitude in kinetic structure of pressing with arms in individual movement. The variables show statistically significant values of the Kolmogorov - Smirnovljev test (the test determines maximal absolute differences between actual and theoretical cumulative frequencies). The test EPDRKG (MAX D = .031) shows the highest normality of the distribution curve in the area of kinetic structures realised in individual movement, while all other tests show a statistically significant, but weaker results of the test. The distribution of results in the complex of variables of kinetic structures realized in repeating movements does not depart significantly from the normal distribution. The test ESDRM (MAX D = .o41) has shown the best curve of distribution of results in the complex of variables realized in repeating movements, while other tests don't show as good results, but they remain within the set hypothesis.

The matrix of intercorrelations of the results of tests for evaluating basic kinetic elements, in other words, the matrix of the cosines of angles between vectors that define area is shown in Table 2. The set of variables of basic kinetic elements of motion represents a relatively homogeneous area. The structure of the correlation coefficients is mostly adequate for the structure correspondent to hypothetical presumptions on the existence of basic kinetic elements of motion. The data contained in the matrix of intercorrelations of basic kinetic elements shows a dominant significance of correlation in the complex of basic elements of motion. By observing the segments of the intercorrelation matrix in which the tests of basic kinetic elements of resistance in the kinetic structure realized in individual and repeating movements are located, it can be seen that the correlations are considerably higher than with other basic kinetic elements. One mutual structure for generating energy in the realization of motion is responsible for variability and covariability of tests of the basic kinetic element manifested as resistance in motion. Furthermore, there is a certain correlation between the variables of resistance in motion and variables of amplitude in motion, while there is a somewhat weaker correlation with the variables that measured time in motion.

Table 1: Central and dispersive parameters of variables basic kinetic elements

VARIABLES	XA	XD	SIG	MIN	MAX	KS
EPDNKG	46.23	1.70	9.57	25.00	75.00	.104
EPDNM	1.28	.02	.13	.96	1.56	.047
EPDNS1	1.40	.03	.19	.96	1.88	.121
EPDNS2	.74	.01	.08	.56	.96	.071
EPDRKG	43.52	1.52	8.56	25.00	65.00	.031
EPDRM	.71	.02	.10	.41	1.00	.033
EPDRS1	1.08	.04	.21	.68	1.92	.076
EPDRS2	.41	.01	.05	.26	.60	.064
EPPRKG	45.25	1.28	7.21	30.00	65.00	.119
EPPRM	.95	.01	.08	.72	1.08	.342
EPPRS1	.87	.02	.13	.64	1.44	.070
EPPRS2	.43	.01	.05	.32	.56	.074
ESDNKG	490.49	52.05	293.34	120.34	2340.00	.102
ESDNM	13.20	1.13	6.35	3.36	40.32	.090
ESDNS1	21.36	2.03	11.45	5.00	68.50	.126
ESDRKG	485.61	34.94	196.92	120.00	990.00	.043
ESDRM	8.27	.61	3.43	2.16	17.26	.041
ESDRS1	18.59	1.19	6.73	5.40	42.04	.061
ESPRKG	545.82	39.71	223.77	160.00	1485.00	.114
ESPRM	11.43	.77	4.36	3.92	26.46	.073
ESPRS1	16.17	1.09	6.15	4.96	37.40	.086

Legend: EPDNKG - lifting with legs from a squat position, EPDRKG - pressing with arms from a lying position, EPPRKG - pulling with arms from a lying position, EPDNM - lifting with legs from a squat position, EPDRM - pressing with arms from a lying position, EPPRM - pulling with arms from a lying position, EPDNS1 - lifting with legs from a squat position, EPDRS1 - pressing with arms from a lying position, EPPRS1 - pulling with arms from a lying position, EPDNS2 - lifting with legs from a squat position, EPDRS2 - pressing with arms from a lying position, EPPRS2 - pulling with arms from a lying position, ESDNKG - lifting with legs from a squat position, ESDRKG - pressing with arms from a lying position, ESPRKG - pulling with arms from a lying position, ESDNM - lifting with legs from a squat position, ESDRM - pressing with arms from a lying position, ESPRM - pulling with arms from a lying position, ESDNSI - lifting with legs from a squat position, ESDRS1 - pressing with arms from a lying position, ESPRSI - pulling with arms from a lying position.

Table 2: Intercorrelation matrix and uniquity (in diagonal) of variables basic kinetic elements

VARIABLES	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. EPDNKG	(.17)									
2. EPDNM	.14	(.26)								
3. EPDNS1	-.04	.34	(.55)							
4. EPDNS2	-.22	.37	.25	(.67)						
5. EPDRKG	.64	.18	-.05	-.13	(.21)					
6. EPDRM	.05	.62	.32	.38	.08	(21)				
7. EPDRS1	-.09	.10	.25	-.01	.05	.01	(.47)			
8. EPDRS2	-.21	-.10	.13	.11	-.24	.01	.14	(.71)		
9. EPPRKG	.64	.26	-.02	-.03	.71	.17	-.07	-.19	(.15)	
10. EPPRM	.24	.53	.11	.17	.30	.21	.04	.01	.23	(.33)

VARIABLES	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
11. EPPRS1	-.18	.02	-.01	.06	-.20	-.08	.11	.17	.09	.16	(.55)
12. EPPRS2	-.21	.04	.13	.11	-.07	.01	.05	.28	.04	.10	.38 13.
ESDNKG	.48	-.12	-.15	-.15	.40	-.01	.02	-.14	.41	.01	-.09
14. ESDNM	.12	-.02	-.10	-.02	.26	.03	.11	-.08	.25	.04	.10
15. ESDNS1	.11	-.13	.01	-.04	.23	-.05	.14	-.06	.19	-.02	-.02
16. ESDRKG	.34	.17	-.13	-.07	.40	.11	-.34	-.03	.38	.15	-.05
17. ESDRM	.05	.23	-.02	.12	-.06	.41	-.35	.05	.06	.02	-.01
18. ESDRS1	.04	.07	-.07	-.07	-.07	.02	-.11	.10	-.01	-.07	.05
19. ESPRKG	.41	.26	-.05	.01	.49	.17	-.09	-.10	.39	.07	-.29
20. ESPRM	.21	.27	-.03	.09	.27	.17	-.11	-.01	.05	.20	-.29
21. ESPRS1	.18	.20	-.03	.01	.23	.12	.01	.10	.03	.09	-.17

VARIABLES	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
12. EPPRS2	(.70)									
13. ESDNKG	-.05	(.06)								
14. ESDNM	.08	.87	(.05)							
15. ESDNS1	.08	.86	.94	(.06)						
16. ESDRKG	-.02	.31	.26	.17	(.17)					
17. ESDRM	-.05	.19	.20	.12	.72	(.07)				
18. ESDRS1	-.09	.18	.20	.17	.69	.83	(10)			
19. ESPRKG	-.09	.31	.24	.16	.53	.37	.30	(.04)		
20. ESPRM	-.07	.14	.14	.07	.43	.38	.31	.89	(.06)	
21. ESPRS1	-.03	.16	.17	.11	.44	.40	.40	.85.	.89	(.11)

By observing that part of the intercorrelation matrix in which variables of basic kinetic elements manifested as amplitude in motion are located, a bipolarity relating to the motion amplitude in individual movement is noticeable (ESDNM, ESDRM, ESPRM). Such grouping of correlation is justified, especially when it is known that the amplitude in motion in case of individual movement is partly conditioned upon morphological characteristics (length of levers), in another words upon the length of the path which is partly determined anatomically. When the motion performed in repeating movement is at stake, the motion amplitude represents a path that is in good part conditioned upon the structure for generating and duration of energy releasing. It should be pointed out that the mutual correlation of the variables of amplitude in motion on one side, and variables of time in motion on the other side is highest in the treated area, what is particularly emphasized in the area of variables of time in repeating movement (ESDNS1, ESDRS1, ESPRSl). The reason for that could probably be found in the fact that time in motion is a limiting factor in realization of the motion amplitude and is a generator of the position of the amplitude in motion, in particular with repeating movement. A somewhat weaker correlation of variables of motion amplitude and variables of resistance in motion relates to variables in individual movement. The correlation in the area of variables in repeating movements is high.

The matrix of intercorrelations of the located variables of the basic kinetic element of time in motion indicates that there is a weak correlation of the complex of variables of time in motion in case of individual movement (EPDNSl, EPDRS1, EPPRSl, EPDNS2, EPDRS2, EPPRS2), while a somewhat higher correlation exists in the case of variables of time in motion in case of repeating movement (ESDNS1, ESDRS1, ESPRSl). That also applies to the correlation with other variables. The main reason of weak correlation lies in the choice of variables that measured time in movements with and without weight in the area of motion elements. It is obvious that variables of time in motion without weight don't have much in common with variables of time in motion with weight, as well as with other variables of this area. However, variables of time in motion in case of repeating movement show a very high correlation within their basic elements. The correlation of variables of time in individual movement has emerged as a consequence of influence of regulatory mechanisms towards synergic regulation and regulation of muscle tone in alternative movement. Furthermore, with repeating movements, besides the above mentioned, this is probably a case of the structure for regulating duration of exitation and energy releasing, which directly depends on the activities of motor units in the effector.

The matrix of intercorrelations of variables in the segment in which variables of basic kinetic elements realized in repeating movements are located indicates a high correlation within the topological determination of variables. The highest correlation of basic kinetic elements exists in the kinetic structure of lifting with legs and pressing with arms. Generally, it can be noticed that there is a higher correlation of basic kinetic elements in variables that have been carriers of information in repeating movements. That is also logical, because, in the case of motion in repeating movements, there is a higher correlation that emerges as an answer of regulatory mechanisms so that the motion is realized. Since the informational values of the set of variables depend upon the uniquity that ensures significant independence for each variable, the specific and the error variance are small and they contribute the most to the mutual variance. In regard to the uniquity (Table 2 in diagonal), a disparity in some parts of the analyzed area can be noticed. Variables that measure time in motion realized without weight in individual movement are particularly distinctive because of their size. Other variables show extremely low values of unique variances, what ensures a large quantity of mutual information. This is valid for variables of resistance and amplitude realized in individual and repeating movement and variables of time in repeating movement. Some variables significantly depart from others, which is primarily true for the basic kinetic element manifested as time in motion. Those variables have somewhat lower correlation with other variables of basic kinetic elements, but they have a higher uniquity. This is probably the case of a larger quantity of specific variance that gives a certain independence to the basic kinetic element manifested as time in motion.

The evaluation of average correlation of each test with the others (RMC), the determination coefficients of tests (SMC) and their representativity coefficients (SMC) are listed in table 3. The average correlation between tests of basic kinetic elements is at a satisfactory level (.26) and it stems from average correlations of individual tests with the set of other tests. Several tests of basic kinetic elements have a relatively low mutual correlation, while the others are within reasonable boundaries. That relates to the tests of basic kinetic elements that measured time in kinetic structures realized in individual movement and that have lower average correlations compared with other measuring instruments. Basic kinetic elements of kinetic structures realized in repeating movements and basic kinetic elements of resistance and amplitude in kinetic structures realized in individual movements have a higher correlation. That indicates that the vectors of analyzed variables are arranged within the relatively wide hyper cones of the area.

The variability of determination coefficients, which represent a system evaluation of communalities of the SMC columns in the table are particularly high and emphasized in the area of basic kinetic elements realized in repeating movements. That is obviously the sign showing that those tests constitute relatively homogeneous vector beams that are topologically arranged. This indicates that basic kinetic elements with which resistance, time and amplitude in repeating movements take part in their variance have higher, and basic kinetic elements with which resistance, time and amplitude in individual movements take part in their variance have lower variance in the image area, what leads to a more insecure existence. This particularly relates to the basic kinetic elements of time in individual movement and indicates that those variables are burdened with a high specific variance and that those kinetic elements have major independence. However, regardless of that, basic kinetic elements of resistance, time and amplitude represent relatively homogeneous vector beams with regard to their communalities. The obtained values of communalities are lower than expected in that part of variables of basic kinetic elements realized in individual movement. It follows that the specific variance of the tests used is really high, so there is a small possibility of obtaining a well-defined latent dimension of time in individual movement. The applied method tends to imprecisely locate those latent dimensions that are defined with very complex variables.

Table 3: Average correlations, determinancy coefficients, representativeness coefficients and harris' values of matrix covariance for basic kinetic elements

	RMS	SMC	MSA	HVV
1. EPDNKG	.29	.83	.83	65.62
2. EPDNM	.26	.74	.72	40.78
3. EPDNS1	.15	.45	-.71	19.03
4. EPDNS2	.16	.33	.84	12.23
5. EPDRKG	.31	.74	.81	8.05
6. EPDRM	.22	.78	-.88	3.92
7. EPDRS1	.14	.51	-.86	3.60
8. EPDRS2	.13	.28	.58	2.83
9. EPPRKG	.28	.85	.60	2.20
10. EPPRM	.18	.66	-.91	1.85
11. EPPRS1	.16	.45	.51	1.53
12. EPPRS2	.13	.30	.81	1.08
13. ESDNKG	.35	.95	.80	1.07
14. ESDNM	.32	.94	.82	.90
15. ESDNS1	.31	.94	.84	.86
16. ESDRKG	.31	.63	.96	.72
17. ESDRM	.31	.93	-.91	.51
18. ESDRS1	.28	.90	-.84	.48
19. ESPRKG	.38	.96	.94	.43
20. ESPRM	.35	.94	.84	.43
21. ESPRS1	.33	.89	.81	.25

Legend (see Table 1): RMS1 – root – mean – square correlation – original correlation, SMC1 – squared multiple correlation - cofficient of test determination, MSA1 – measure of sampling adequaci - their coefficients of representativeness, HVV1 – characteristic values of covariant matrix – Haris eigenvalues

The representativity of the analyzed set of tests for evaluating basic kinetic elements is satisfactory (.92). One part of the measuring instruments has low representativity coefficients. This indicates that the tests are burdened with partial co-variances, so the structure of latent dimensions will be weakly defined in one part. It is obvious that good factorial analytical information are missing in the part of the treated area. The sensitivity of the MSA towards the number of variables, number of respondents and the general correlation level contributed to that. On the basis of characteristic values of the matrix of co-variances of analyzed tests it can be concluded that elements there are 6 dimensions in this area of the system of variables of basic kinetic; the dimensions arising from the applied GUTTMAN - KAISEROVOG criterion (Table 3).

Variance of the fifth and the sixth main component in the Harris area is extremely low, so their existence is very questionable. This is probably the consequence of the hyperfactorization effect, which is common with this criterion (Kaiser, 1970). Kasier, however, abandoned the criterion which was recommended in the version of Little Jiffy algorithm called Mark I (a criterion analog to the DMEAN criterion of Momirović and Štalec (1972), for the number of significant image factors) due to the danger of hyperfactorisation. Zakrajšek and Momirović (1972) found that the PB criterion also brings to the detainment of too small number of factors. It seems that the Guttman – Kaiser strategy is still the most suitable and the most rational in explorative factor researches. This method gives excellent solutions if the analyzed vectors really constitute independent sets. However, if the variables are factorically complex, this type of the orthoblique solution can bring to a very non-adequate position of the coordinate axis. It turned out that the orthoblique, as a rule, behaves better compared to other methods for determining inclined simple structures. A certain number of tests of basic kinetic elements manifested as time in individual movement are exaggeratly complex, which caused not only difficulties in positioning of hyperplans during transformational procedures but also the determination of latent positions that belong to the same area by their mathematical definition and which have, unfortunately, a very different scope of regulation.

The matrix of the complex obtained through orthoblique transformation and with the use of the index of factorial simplicity of the analyzed basic kinetic elements (Table 4) indicates a good degree of simplicity of the factorial structure (.84). The result could have probably been better if the complexity of tests of basic kinetic elements which measured time in individual movement was smaller. The simple structure obtained in this way provides a satisfactory level of credibility, but the interpretation of factors should be taken with a certain amount of caution.

Table 4: Complex matrix and factor simplicity indices for basic kinetic elements

	PFKS	PFKS	RFKS	AFKS	GFKS	SFKS	IFS
1. EPDNKG	.15	-.48	-.03	.64*	.49*	.02	.45
2. EPDNM	.13	.26	.06	-.62*	.45*	.45*	.32
3. EPDNS1	-.05	.25	-.10	-.37	.10	.30	.22
4. EPDNS2	.02	.26	-.02	-.35	-.05	.41	.34
5. EPDRKG	.28	.01	-.22	.09	.66*	-.06	.44
6. EPDRM	-.01	-.01	.18	.04	-.02	.80*	.76
7. EPDRS1	.03	.58	-.32	-.61*	.20	-.10	.34
8. EPDRS2	-.01	.23	.06	-.41	-.04	-.09	.21
9. EPPRKG	-.04	-.04	.01	.05	.87*	-.00	.88
10. EPPRM	.04	.40	-.08	-.66*	.55*	.13	.78
11. EPPRS1	-.39	.46	.18	-.75*	.45	-.27	.35
12. EPPRS2	-.08	.53	-.07	-.66	.25	-.10	.34
13. ESDNKG	.02	.47*	.03	.52*	.06	.02	.81
14. ESDNM	.02	.93*	.01	.03	.01	.02	.65
15. ESDNS1	-.04	.92*	-.03	.08	-.05	-.03	.49
16. ESDRKG	.11	-.04	.62*	.01	.33	-.16	.84
17. ESDRM	.01	-.05	.92*	.10	-.06	.16*	.82
18. ESDRS1	-.02	.09	.92*	-.17	.10	-.27*	.63
19. ESPRKG	.92*	-.05	-.01	.08	.11	-.01	.96
20. ESPRM	.99*	.04	-.01	-.07	-.15	.04	.86
21. ESPRS1	.93*	.14	.07	-.19	-.10	-.10	.64

Legend (see Table 1): PFKS – pulling factor in the kinetic structure, PFKS – pressing factor in the kinetic structure, RFKS – repetition factor in the kinetic structure, AFKS – factor of accumulating and releasing energy in the kinetic structure, GFKS – factor of generating and releasing energy in the kinetic structure, SFKS – factor of spatial determination of the kinetic structure, * – salients marked with asterix, IFS – indeks of factorial simplicity, for each variable

On the basis of coordinates of vectors of variables in the factorial space, as well as the intercorrelation of isolated latent dimensions, an interpretation of factors was carried out. The matrix of the structure is shown in table 5, while the matrix of intercorrelations of the latent dimensions is shown in table 6. The percentage of the contribution of variance of each latent dimension in the total extracted variance and the index of reliability of the obtained orthoblique factors are listed in table 7.

Table 5: Factor structure for basic kinetic elements

	PFKS	PFKS	RFKS	AFKS	GFKS	SFKS
1. EPDNKG	.34	.14	.05	.56	(.75)	.07
2. EPDNM	.28	-.08	.17	-.24	.34	(.68)
3. EPDNS1	-.05	-.05	-.07	-.22	.01	(.36)
4. EPDNS2	.03	-.03	.04	-.25	-.06	(.45)
5. EPDRKG	.41	.24	-.06	.47	(.76)	.10
6. EPDRM	.18	.01	.26	-.11	.20	(.81)
7. EPDRS1	-.08	.12	(-.27)	-.09	-.01	-.01
8. EPDRS2	-.05	-.07	.04	(-.24)	-.21	-.03
9. EPPRKG	.24	.22	.04	.47	(.88)	.20
10. EPPRM	.14	.04	-.01	-.10	.34	(.35)
11. EPPRS1	(-.28)	.01	.02	-.18	.01	-.08
12. EPPRS2	-.08	.08	-.07	(-.14)	-.02	.03
13. ESDNKG	.24	.88	.21	(.90)	.46	-.08
14. ESDNM	.20	(.96)	.22	.73	.27	-.03

15. ESDNS1	.12	(.95)	.16	.73	.21	-.12
16. ESDRKG	.44	.21	(.66)	.28	.36	.01
17. ESDRM	.39	.19	(.93)	.11	.08	.23
18. ESDRS1	.33	.20	(.88)	.11	.01	-.12
19. ESPRKG	(.96)	.20	.38	.29	.43	.14
20. ESPRM	(.94)	.12	.39	.08	.15	.15
21. ESPRS1	(.90)	.16	.44	.08	.12	.05

Legend (see Table 1 and 4)

Table 6: Intercorrelations factors of basic kinetic elements

		PFKS	PFKS	RFKS	AFKS	GFKS	SFKS
1	PFKS	1.00					
2	PFKS	.18	1.00				
3	RFKS	.41	.21	1.00			
4	AFKS	.21	.74	.13	1.00		
5	GFKS	.32	.26	.06	.52	1.00	
6	SFKS	.14	-.06	.11	-.18	.25	1.00

Legend (see Table 4 and 5)

The first factor in the coordinate system obtained through orthoblique transformation is mainly defined by basic kinetic elements, the variance of which depends upon topological determination defined with the kinetic structure of pulling with arms in repeating movement. The character of this factor is manifested with basic kinetic elements of resistance, time and amplitude in the kinetic structure. On the basis of the complex of kinetic dimensions, it is completely obvious that the isolated latent dimension is responsible for 35% of the mutual variance of kinetic variables and represents a very stable latent dimension.

Table 7: Reliability index and mutual variance percentages belonging to basic kinetic elements factors

	q	w2
1	.82	34.79
2	.92	26.83
3	.69	15.49
4	.98	10.32
5	.88	8.54
6	.52	4.03

Legend (see Table 6): q1 – domain validity (indeks of realiability of the factors), W^21 – relative contributions of factors (percentagees)

The processes occurring in the kinetic structure of pulling with arms in repeating movement and which define this dimension, are comprised of long-term, mainly submaximal repetitive myometrical and plyometrical contractions of agonists. The control of the muscle tone of agonists and antagonists is crucial for efficiency, since the limbs move balistically in the trajectory due to the impulse of the agonist, depending on the resistance that needs to be overcome and on the relaxation of the synergist. The kinetic structure on the realized amplitude is not defined and results in the variability of the length of performed motion, which is partly limited with energetic possibilities.

Therefore, the duration of exitation in those primary motor centers which innerve muscles of the upper limbs and the ability of inhibition of inhibiting impulses that stem from lower regulative systems are crucial mechanisms in the complex of this latent dimension. Besides, the energetic characteristics of the effector and the sensitivity of the nervous system to the signals coming from them are also primary and significant. Given that, it can be assumed that a certain integrative mechanism takes part in including various functional structures in the realization of basic kinetic elements in kinetic structure of pulling with arms in repeating movement. Considering the function of particular parts of the nervous system, this is probably the case of integrative and coordinating function of the reticular formation. The integrating function of the reticular system and the significance of that system for coordinating and automatic regulation indicate that this system structures into a unique whole also basic kinetic elements in the kinetic structure. The integration of basic kinetic elements (resistance, time, amplitude) into a unique whole depending on their variability and covariability is manifested as a manifest kinetic structure. Considering configuration, relations and projections of basic kinetic elements, this isolated dimension could be interpreted as a pulling factor in the kinetic structure.

Basic kinetic elements that are located in the factorial area closest to the well defined other orthoblique factor are homogeneous in their kinetic structure. Basic kinetic elements belonging to the kinetic structure of lifting with legs realized in repeating movement have shown maximal projections of vectors on this dimension. Variability of the factor that is defined by the kinetic structure lifting with legs is realized in repeating movement and determined on the basis of variability and covariability of basic kinetic elements within that structure. That indicates to the topological determination of this dimension. Since the intentional subject of measurement is directed to resistance, time and amplitude in the mentioned kinetic structure, it is reasonable to assume that functional characteristics are also significant besides topological. Those characteristics relate to activating a great number of motor units and detainment of that activity throughout a longer period of time with the repetitive type of muscle activity. The main reason for high projections on this isolated factor is conditioned upon the mechanism for regulating intensity and duration of exitation, what is connected with the ability of centers to postpone the irradiation of inhibitory processes in the realization of the mentioned kinetic structure.

A larger number of movements which are performed in two opposite directions in the realization of this kinetic structure depends upon the ability of a certain regulatory system to change the role of the synergist with every direction alteration and to change the role of active muscle groups and take those roles for each change of innervation. The control of the muscle tone of agonists and antagonists is also significant for the realization of the mentioned kinetic structure. That points to the significant role of integrative mechanisms that are usually responsible for control and coordination of the mentioned regulatory subsystems, which take part in solving the kinetic structure by pressing with legs, realized in repeating movement. This is probably the case of integration of the function in the reticular formation directed towards coordinating the mechanisms for regulating basic kinetic elements and their automatic regulation in the complex of kinetic structure pressing with legs, realized in repeating movements. Consequently, the structure of this isolated dimension allows for the factor to be interpreted as the pressing factor in the kinetic structure.

Maximal projection of the vectors of variables on the third orthoblique factor has an extremely simple structure. It is defined by basic kinetic elements whose variance depends upon topological determination of the kinetic structure of lifting with legs realized in repeating movement. Primary determination for variability within this isolated factor is determined with possibilities that in realization there is a maximal exploitation of resistance, amplitude and time during motion. Continuous overcoming of resistance in a longer period of time by using a force on a certain path in the kinetic structure of lifting with legs realized in repeating movement significantly influences the variance of the results of tests that are saturated with the mentioned factor. A dimension isolated in such a way is showing a behavior similar to the first isolated dimension, which is defined by basic kinetic elements within the kinetic structure of pulling with arms. It should be also pointed out that besides big biomechanical congruenity of the structures of the first and third isolated factors, both factors exist as firm independent structures. The formed, almost identical, structure of movement (with a difference in alternative in overcoming resistance) shows that processes of integration of mechanisms for regulation of particular kinetic elements in the kinetic structure play an important role. It seems that precisely integrative and coordinating function of the reticular formation is responsible for the differentiation of kinetic structures and for integration of basic kinetic elements within kinetic structures that are manifested in repeating movements. On the basis of the manifest content within this factor this latent dimension could be called the repetition factor in the kinetic structure.

The fourth orthoblique factor has an extremely complicated and complex structure. Variables the vectors of which show maximal projections on this dimension are determined with basic kinetic elements. Their variability depends upon resistance in kinetic structures with a strong accent on lower limbs. Functional structure and complex of this latent dimension is determined by mechanisms for regulating intensity and duration of exitation in the direction of releasing maximal energy for overcoming resistance in kinetic structures realized in individual and repeating movements with an accent on lower limbs. This factor is not only not defined well, but it is also not secure and unreliable if it is not the case of a single or a dual factor that owes its existence to the hyperfactorization effect. However, this is obviously the case of a group factor of resistance, above all responsible for the ability of developing a big muscle force, in other words muscle stamina in overcoming resistance. The dimension has a tendency to act as a bipolar factor and to differentiate resistance with all kinetic structures realized in motion with legs in repeating movement. Precisely this data justifies the interpretation of the fourth dimension as a factor of accumulating and releasing energy in the kinetic structure.

Variables of basic kinetic elements which define the fifth orthoblique factor are those the variance of which depends upon the ability of generating and releasing energy. In case of those variables, precisely that regulation is what is crucial in the context of overcoming resistance. A group of kinetic structures the vectors of which have a maximal projection on this dimension is very homogeneous regarding their manifest content what verifies their hypothetical purpose. The characteristic of this factor is expressed with the basic kinetic element of resistance in all kinetic structures realized in individual movement. Functional determination is manifested with a short-term mobilization of maximal energy in the direction of overcoming resistance in kinetic strictures realized in individual movements. By looking more closely to the purpose of this dimension, it can be noticed that kinetic structures realized in individual movement with the goal of overcoming resistance have highest coordinates and/or correlations with the isolated dimension. It can be assumed that because of high covariability of these variables, the factorial axis is inclined toward their vectors in which the effect also depends on the short-term mobilization of maximal energy. As a consequence, there is a significant influence of this latent dimension on the momentary activation of a large number of motor units in movements which are performed in myometrical or plyometrical regime, as well as on the alternative activation of synergists in movement, the manifest characteristic of which is overcoming resistance in kinetic structures realized in individual movement. Therefore, precisely overcome resistance in kinetic structures is the main generator of variance of this latent dimension which could be called the factor of generating and releasing energy in the kinetic structure.

The sixth latent dimension in this area has a very simple structure. Basic kinetic elements, variability and covariability of which is due to the amplitude in kinetic structures realized in individual movements, have high projections on the sixth orthoblique factor. The function in the complex of the sixth orthoblique factor is rotated in the direction of overcoming the amplitude during motion. The extracted latent dimension the existence of which is very realistic and which is significantly influenced by the anthropometrical dimensions in particular the longitudinal dimensionality of the skeleton, indicates that length of limbs – levers has a significant influence on the kinetic structure in the process of its realization. The position of this factor is defined by the amplitude in kinetic structures realized in individual movement and partly shows striking and equally high parallel projections of two tests which measured time in the kinetic structure of lifting with legs, performed with and without weight. Besides the biomechanical characteristic in the relation within this dimension, which is determined by the position of time in amplitude in movement (time is in the function of path), a functional effective relating to alternative activation and deactivation of synergists important in realizing the mentioned kinetic elements is also significant. The structure of this dimension allows that this factor be interpreted as the factor of spatial determination of the kinetic structure.

Intercorrelations of isolated latent dimensions are within expected and satisfactory boundaries. There is a presence of a high correlation between the factor interpreted as latent dimension responsible for the kinetic structure pulling in repeating movement, and the factor interpreted as the dimension responsible for the kinetic structure of pressing in repeating movement. Besides, there is a strong correlation of this isolated factor and a factor interpreted as latent dimension responsible for generating and releasing of energy in individual movement. This correlation is completely expected since this is the case of movements in two opposite directions which were determined biomechanically. The resistance is being overcome with the agonists' impulse, the resistance moving throughout the trajectory in a certain path for certain time with the help of relaxed antagonists. However, a timely contraction of antagonists allows the stopping of weight and also movements (with alternative activating of agonists) and a new half cycle with initial acceleration begins. This is the case of mobilization and releasing energy that is not only dependent on the active muscle mass and functional characteristics of the effector, but also on the operation of facilitating and integrative mechanisms responsible for generating muscle force and for the duration of muscle contraction, what justifies this correlation.

The correlation in the segment of the area of the second factor is noticeable between the second isolated factor interpreted as latent dimension responsible for the kinetic structure of pressing in repeating motion and the fourth isolated factor interpreted as dimension responsible for alternative releasing of energy in overcoming resistance in the kinetic task of pressing with legs, this dimension being the largest in the whole kinetic space. The main reason for such a high correlation between the mentioned factors should firstly be looked for in the structure of their topological determination. Furthermore, there is a significant although small correlation with dimensions responsible for pressing and pulling with arms in repeating movements, and a somewhat bigger correlation with the factor interpreted as dimension responsible for generating and releasing of energy in the realization of kinetic structure.

The correlation within the area covered by the third factor interpreted as latent dimension responsible for realization of motion repetition in the kinetic structure is noticeable only with the factor that defines the kinetic structure pulling in repeating motion and with the factor that defined kinetic structures of lifting in repeating movements. The level of correlation is obviously bigger with the factor of kinetic structure of attraction in repeating movement what is also logical considering the mechanisms for regulating and controlling the tone of both agonists and antagonists and the change of the role of synergists and generating and releasing energy.

Besides the high correlation between the factor which takes the fourth place in the kinetic space and is interpreted as dimension responsible for accumulating and releasing energy, and the factor defined as the factor of suppressing in the kinetic structure in repeating motion, there is a high and significant correlation with the fifth factor that is interpreted as latent dimension responsible for generating and releasing energy in individual motions. However, there is also the correlation with the factor defined by the kinetic structure of pulling with arms in repeating motion and the factor responsible for longitudinal dimensionality of motion (motion amplitude) in individual movement. Considering the dominant role in the regulation of this factor the function of which is relatively specific and the scope of regulation wide, the correlation with other factors is justified. This goes along with the claim that this factor owes its existence to the existence of a particular central regulatory mechanism, or that it is just an effect of the coordinated function of different subsystems, especially those with a wide scope of regulation.

The position of the fifth factor in the structure of intercorrelation matrix is considerably determined with coefficients of correlation with other factors of the kinetic space. Having in mind that the fifth factor is interpreted as dimension responsible for generating and releasing energy in individual movements, a high correlation with the fourth factor is reasonable. Factors defined with the structure of pulling in repeating movement, lifting with legs in repeating movement and the factor defined with the factor of spatial determination are significantly correlated with this dimension. It is completely obvious that the correlation has emerged as a result of the influence of mechanisms for regulating short-term mobilization and releasing of energy. This dimension is characterized by the development of maximal short-term muscle force (momentary activation of a large number of motor units), in particular with those kinetic tasks which in their initial phase presuppose generating of a large starting force for moving a certain object in each succession. Precisely because of that characteristic the correlation in the complex of this segment of kinetic space is understandable.

The sixth factor has the weakest correlation in the area of isolated kinetic factors, this factor being interpreted as latent dimension responsible for spatial determination of the kinetic structure. The only considerable correlation that this factor shows is that with the factor responsible for generating and releasing energy in individual movement, what was expected because the length of the amplitude in individual movement represents a path on which energy is generated and released. On the basis of results of the research on the factorial structure of basic kinetic elements, the interpretation of isolated factors and their correlation is difficult what makes difficult also defining the structure of basic kinetic elements. Considering the obtained results, it is possible to create a categorization of dimensions, particularly with regard whether basic kinetic elements in kinetic structures are realized in individual or repeating movement. The significance of basic kinetic elements in kinetic structure realized in repeating movement does not boil down only to the role of particular elements but also to the process of their integration during motion. That integrative function is effectuated on the basis of an excellent correlation between the cortex and subcortical cultures.[7] However, that connection mainly relates to the integration of different subsystems which are located at the subcortex level. This structure, which is probably justifiably located in the area of reticular formation, is primarily responsible for the integration of mechanisms for regulation of basic kinetic elements in different kinetic tasks realized in repeating movements. Integration processes relate to cooperation of mechanisms for regulating a large number of various motor units, mechanisms for regulating the length of activating motor units and mechanisms for regulating determination of time of activating motor units. Mentioned mechanisms belong to one functional complex, or rather one kinetic task realized in repeating movement. Those mechanisms in that way determine their topological determination.

The essential role of this integration process is to organize regulatory mechanisms as a whole and to bring various subcortical centers responsible for regulation of basic kinetic elements to an optimal state for a particular kinetic task, whether with facilitatory or/and inhibitory processes. In fact, this is the case of changing the state of primary units on which the efficiency of regulation of each particular kinetic element of a certain kinetic structure realized in repeating movements depends. It is unquestionable that basic kinetic elements manifested as resistance realized in kinetic structures in repeating movement depend on mechanisms for regulating the activation of a large number of motor units in short periods of time. Basic kinetic element manifested as time realized in repeating movement depends on the mechanism responsible for slowing down the processes of irradiation of inhibition in the active centers and the mechanism for regulating time intervals in which motion is performed in successions.

Primary dimensions of basic kinetic elements in kinetic structures realized in individual movements are differentiated with regard to their scope and significance of regulation, but also with regard to their contribution in defining factors. Therefore, unlike kinetic tasks realized in repeating movement, where basic kinetic elements are topologically determined and dependent upon the integration process, primary characteristics of kinetic tasks realized in individual movements are differentiated principally by basic kinetic elements. That shows that only one basic kinetic element is dominating in kinetic tasks and therefore, the mechanism of only one regulatory level takes part in realization of individual movement. A single regulatory system responsible for the energetic component of the kinetic exit is present. The function of this energetic component is primarily to regulate performance of tasks, the dominant characteristic of which is overcoming resistance in individual movement. A mechanism for activating a large number of motor units in a short interval of time is responsible for that mode of regulation.

[7] The role of the cortex in this context of regulation boils down to the analysis of tasks, choice and forming of programs before starting to perform the kinetic task and on the dominant characteristic of this structure in the direction of integration of parts of different subcortical structures.

Besides this mechanism for regulation, there is one more which relates to alternative activation of synergists in the regulation of the activity of agonists and antagonists that ensure the performance of the kinetic task, the dominant manifest characteristic of which is time and amplitude in individual movement. There is no doubt that the latent dimensions isolated in the area of basic kinetic elements realized in kinetic structures of repeating movements exist. However, the existence of latent dimensions isolated in the area of basic kinetic elements realized in kinetic tasks of individual motion with regard to the total quantity of the explained variance is obscure, although logically it can subsist.

Conclusion

Basic and fundamental concept upon which basic kinetic elements are defined is rooted in the multivariant configuration of basic kinetic elements within kinetic structure, realized in individual and repeating movement. By accepting this notion on the role and significance of basic kinetic elements in determining the kinetic structure realized in individual and repeating movement, the leading basic kinetic element can be determined for that structure. That approach abandons the classical conception under which the evaluation and measurement of motor abilities is performed according to motor manifest reactions and gives the possibility of evaluating the movement structure or a motor task with the help of basic kinetic elements and the possibility of determining the same according to the leading basic kinetic elements in the kinetic structure. The role of basic kinetic elements depends on configuration and integration of elements in the complex of a coherent system of the kinetic exit, the efficiency of which can be more or less expressed in solving motor tasks.

The research has been conducted so that relations, degree and quality of basic kinetic elements of the effectorial system are determined. The concept based on the multivariant configuration of basic kinetic elements within the kinetic structure realized in individual and repeating movement was accepted as a fundamental concept on which basic kinetic elements were defined. The quality and degree of correlation between basic kinetic elements were determined with 124, 15-years-old, male respondents. This sample can be considered representative for this type of research. A total of 21 kinetic measures, obtained with the use of instruments and the use of ergometrical method, were used for evaluating basic kinetic elements. Variables were chosen in such a way that they hypothetically cover basic kinetic elements in kinetic structures manifested in individual and repeating movement, defined as time dimensionality of the kinetic structure and tensodynamic dimensionality of the kinetic structure.

For a better insight into the general behavior of analyzed variables, the methods of data processing were encompassed through calculation of regresional analysis series, so as to determine the complex and the latent structure of basic kinetic elements (factorial analysis LITTLE JIFFY, MARK IV was used). The analysis of the factorial structure of basic kinetic elements was carried out in a manifest area of variables. Six factors have been extracted on the basis of characteristic vales of the matrix of covariance of the analyzed space with the use of Guttman Kaiserov criterion. Isolated factors in this area have a phenomenological determination:

1) Latent dimension of pulling in kinetic structure (defined with resistance, amplitude and time in kinetic task - pulling)
2) Latent dimension of pressing in kinetic structure (defined with resistance, amplitude and time in kinetic task - pressing)
3) Latent dimension of repeating in kinetic structure (defined with resistance, amplitude and time in kinetic task - repeating)
4) Latent dimension of accumulating and releasing of energy in kinetic structure (defined with resistance, amplitude and time in kinetic task)
5) Latent dimension of generating and releasing energy in the kinetic structure (defined with resistance within kinetic tasks realized in individual movement)
6) Latent dimension of special determination of the kinetic structure (defined with the amplitude within kinetic tasks realized in individual movement).

The latent structure of basic kinetic elements was analyzed. Latent kinetic dimensions were extracted and interpreted as mechanisms for regulating of exitation intensity, a mechanism for regulating synergy and regulating muscle tone and integrative mechanisms for regulation, control, coordination of mentioned regulatory subsystems in the kinetic structure. By accepting this conception on the role and significance of basic kinetic elements in the realized motion in individual and repeating kinetic structure, the leading basic kinetic elements can be determined in the kinetic structure. That approach abandons a classical concept under which motor tasks were evaluated and measured according to manifest reactions, and ensures that the movement structure or a motor task is evaluated with the help of basic kinetic elements and determined according to the leading basic kinetic element in the kinetic structure.

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THE PROCESS OF CIVILIZING YOUNG ENGLISH FOOTBALLERS

Shlomit Guy

Abstract

Up until the end of the 1980s, English football (soccer) was hardly perceived as a source of English national pride. Principally seen as vulgar and violent, it was rather associated with the working class. In the wake of two tragic sports events (the Heysel and Hillsborough incidents in 1986 & 1989 respectively), significant political pressure called for the (western) 'civilization' (to use Norbert Elias` canonic term; Elias, 1978) of the English football's norms of conduct. The `civilization process` in the English football can be described as a reform of the game's behavioral norms, in which new definitions of delicacy and refined behavior found expression, and slowly attenuated the disgust and shame of the game's previous incarnation. Interestingly, this `new` structure of feelings and behavior, which had been socially encouraged since the beginning of the 1990`s, was rapidly embraced by the rebellious working class men (Armstrong, 1998). Eventually, by the mid-nineties, English football had been reinvented as a civilized and western leisure activity, a source of pride for the British Empire. Today, the English football has many scenes in which what can be called 'civilized behavior' is performed. It has, however, one special sphere in which that behavior is actually being taught. This paper will focus on the teaching practices undertaken in this spirit in the academies of the Arsenal and Chelsea football clubs in London, England. Those academies, operating in England for the last decade, foster young gifted boys from ages 6 to 16, destined to become future professional football players. I will argue that while those academies' official aims are the training of young boys to become professional football players, they are also imprinting models for appropriate western, civilized behavior. The young trainees are encouraged to embody and perform an ideal model of the (western and civilized) 'English footballer': Playing fairly, showing respect and a gentleman-like behavior, and conduct a healthy lifestyle. Furthermore, "aristocratic philosophy" values find their way into the boy's training whenever the latter emphasizes aesthetics, elegance and a harmonious demeanor. In this paper I will show how this Ideal model is declared in the managers' syllabi, and how the trainers implement that construct in practice.

Introduction

Up until the end of the 1980s, English football (soccer) was hardly perceived as a source of English national pride. Principally seen as vulgar and violent, it was rather associated with the working class. In the wake of two tragic sports events (the Heysel and Hillsborough incidents in 1986 & 1989 respectively), significant political pressure called for the (western) 'civilization' (to use Norbert Elias` canonic term; Elias, 1978) of the English football's norms of conduct. The `civilization process` in the English football can be described as a reform of the game's behavioral norms, in which new definitions of delicacy and refined behavior found expression, and slowly attenuated the disgust and shame of the game's previous incarnation. Eventually, by the mid-nineties, English football had been reinvented as a civilized and western leisure activity, a source of pride for the British Empire.

Today, the English football has many scenes in which what can be called 'civilized behavior' is performed. It has, however, one special sphere in which that behavior is actually being taught. This paper will focus on the teaching practices undertaken in this spirit in the academies of the Arsenal and Chelsea football clubs in London, England. Those academies, operating in England for the last decade, foster young gifted boys from ages 6 to 16, destined to become future professional football players. I will argue that while those academies' official aims are the training of young boys to become professional football players, they are also imprinting models for appropriate western, civilized behavior. The young trainees are encouraged to embody and perform an ideal model of the (western and civilized) 'English footballer': Playing fairly, showing respect and a gentleman-like behavior, and conduct a healthy lifestyle. Furthermore, "aristocratic philosophy" values find their way into the boy's training whenever the latter emphasizes aesthetics, elegance and a harmonious demeanor. In this paper

I will show how this Ideal model is declared in the managers' syllabi, and how the trainers implement that construct in practice.

In order to further establish this argument, I will divide this paper in two. First, I will ask what English football is and what norms a player needs to embrace in order to be perceived as an ideal English footballer. To answer that question I will look at the educational system English football has created and professionalized over the last years - the football academies. Secondly, I would like to examine the exceptional cases, those of Cristiano Ronaldo, while he was playing for Manchester United and Ashley Cole, who trained in the Arsenal academy. Those players do not perceived as ideal football players, regardless of their technique abilities. Young good boys, having been raised in English football academies, are expected to embrace and perform English and civilized behavior and not aspire to resemble players like Ronaldo and Cole.

Methods

This paper is based on fieldwork I conducted in England between the years 2006-2008, in the Arsenal FC and Chelsea FC football academies. As part of my research, I watched young football players train and play in these academies, as well as interviewed coaches, teachers and managers. In order to understand the image of the `ideal football player` young children are expected to become, I also attended premier league matches and interviewed professional footballers and managers.

Discussion

What does an 'English footballer' mean? Each football club in the first four leagues has a football academy in which about two hundreds boys, ages six to eighteen, are being trained on a daily basis. Although the academies' official aims are the training of young boys for professional football careers, they also implement models for appropriate western, 'civilized behavior', including playing fairly, showing respect and a gentleman-like behavior. In the entrance to the Chelsea` academy, for example, eight words are carved in stone. Those words are: excellence, pride, style, professionalism, passion, integrity, leadership and unity. A young player entering the academy is expected to embrace and perform these values in order to become a future professional English football player. When I asked one of the coaches in the Arsenal academy what he teaches his trainees, he answered: we teach them how to play as a team and practice tactical abilities. But most importantly: we teach them how to be nice young lads. "What are nice young lads?"' I asked. Nice young lads respect the ball; respect their uniform and the game of football. They respect their elders, respect the boys they play with and against and respect the referees. You know: nice young lads", he concluded with a tone meant to make me understand that this was obvious.

Nice young lads are expected to look and behave appropriately. In the beginning of every football season the boys are required to sign a code of conduct. Among others, the code specifies that the player must: look smart in order to play smart: shirt inside the shorts and socks pulled up. Make sure his boots are clean. After the game: shake hands firmly and thank the opponents and referees.

While playing, young football players must remember and practice the values and norms of conduct. One Sunday afternoon I watched a game played by the Arsenal ten years old boys. While attacking the opponents Tom, a blond-hair blue-eyed boy, kicked towards the goal. Unsure if the ball will enter; Mark came to his help and added a final touch to score a goal. Tom was upset and called toward Mark: it`s my goal! It would have been mine, even if you wouldn`t have touched the ball". Mark didn`t reply to this provocative call, and neither did the coaches or the parents watching the game. Nevertheless, everybody was embarrassed by what they understood to be an individual and anti-teamwork act. It took little Tom only a few seconds to realize what he had done. A Few minutes later, Tom was attacking the opponents again. After he went past the defenders and then the goalie, standing alone in front of the goal post, he passed the ball to Mark, assisting him in scoring a second goal. His mistake was now forgiven.

Professional first-team games today are broadcast and watched by millions around the world. English football players are thus expected to play by and perform the values and codes of conduct I specified earlier. While on the pitch, football players are expected to play fairly, to show respect to referees and opponents and to perform an overall civilized and gentleman-like behavior. Unlike the past, the physical game is a lot less valued or accepted by referees, media and football fans. English football players today are expected not only to win a game but also to consider the way a game is won. In 1999 Arsene Wenger said: there is no disgrace in wanting to win, but it has to be done – the right way –within the spirit of football. As we enter the 21th century football has a spirit footballers must keep.

Outside the pitch as inside it; football players are now expected to embody an ideal image of a family man. They are expected not to drink alcohol irresponsibly, start a fight bar or cheat on their wives. Unsurprisingly, football players tend to do such things, but when they are caught, by the media mostly, their reputation as professional English athletes is often hurt.

During the last ten years there was only one player who consistently refused to embrace and practice the values and norms of conduct expected from an English football player. Cristiano Ronaldo is a Portuguese football player, who played for Manchester United during the years 2003-2009. Ronaldo is considered by many professionals to be one of the greater players in the premier league in the last decade, probably the greatest. Ronaldo won three championship titles with his football club, and was personally named "the best football player in Europe" and the "best football player in the world" in 2008. English football commentators often relate to Ronaldo as the ultimate player: "He can score with his right leg, he can score with his left, and he can score with his head. He`s a perfect player", I heard them say more than once. But Ronaldo was never a beloved player in England. Very much admired, but never really loved. The reason for that was his behavior in and outside the football pitch. In the pitch Ronaldo was considered an egotistic player, always looking to score a goal, rarely assisting his friends. On many occasions Ronaldo staged a foul in order to gain a free kick for his team. In many other occasions he argued with the referees regarding a foul that was or was not whistled on his behalf. In doing so, Ronaldo constantly broke many values such as: teamwork, respect towards authority and maybe the most sacred of them all- the value of fair play.

Outside of the pitch, Cristiano Ronaldo was constantly involved in scandals. In 2007 he was involved in a sex scandal, and stories about multiple women followed his stay in the kingdom. Football fans, colleagues and media admired Cristiano Ronlado. He was the ultimate football player. But Ronaldo was never an ideal model of an English footballer, as he refused to embrace cultural values and norms of conduct characterizing English football in and outside the pitch.

The French football player Thierry Henry played for the arsenal football club during the years 1999-2007. In contrast with Cristiano Ronaldo, he was always perceived as the ultimate English football player. Playing fairly, respecting authority figures and working for the team, Henry was an ideal model fans and media could idolize. Outside of football, Henry was a family man who cherished his privacy. Henry was also volunteering for Unicef- fifa, a foundation helping underprivileged young children through football.

Even after leaving Arsenal to play for Barcelona FC, Henry remained loved and admired. His image was printed everywhere in the Arsenal museum and he was regarded by the Arsenal fans as "our player". All that had changed a year ago, when Thierry Henry used his hand in a game in order to help the French national team defeat Ireland in the preliminary stages of the 2010 world cup. Refusing to admit to the referee that the determining goal was scored illegally, and thus breaking the fair play norms, Henry was not again an ideal English football player, children need to look up to.

English footballers, brought up in the English football academies, are expected to embrace and perform civilized behavior. In an interview I held with the Arsenal academy manager, I asked him about the football player Ashley Cole. Cole was trained in the Arsenal local academy and is playing for Chelsea FC, occasionally getting into trouble in and out of the pitch. He was married to a pop-star and their lives were often covered in the tabloids. On the pitch Ashley Cole often loses his temper, as had happened in 2007 in a game against Tottenham FC. At the end of the first half Cole brutally tackled a rival player and received a yellow card. Disagreeing with the referee, Cole turned his back toward him and walked away. Chelsea and Tottenham fans were both upset and embarrassed by that behavior. "I know what you think…", said Mr. Smith, the Arsenal academy manager; "but we are proud of Cole for being a first league and national team player. Of course, we've learned our lesson, and today we educate our trainees to respect authority and codes of conduct. We also have special lessons meant to educate the boys to manage their future money and manage the media. Our future players will not make Cole's mistakes again". He then moved in his chair in obvious discomfort. Silently, he added: "just with the women they choose to marry, I don't know what to do…"

This statement promotes the understanding that an English football player is a culturally achieved category one has to earn by embracing values and specific code of conduct in and outside the football pitch.

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FACTOR STRUCTURE OF MOTOR ABILITIES OF 6.5-YEAR-OLD BOYS AND GIRLS

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Abstract

Taking into consideration the current theoretical knowledge as well as the experiences acquired through practical work with pre-school children, it can be concluded that the structure of latent motor ability dimensions differ a lot both among school children and adults. Unfortunately, the knowledge of latent motor ability dimensions of pre-school children is still insufficient, which can primarily be attributed to development features, as well as to the specific ways of working with this particular population. The aim of this paper is to contribute to a better definition of latent motor ability structure of both boys and girls. The sample contained of 106 6.5-year-old boys and 121 girls, tested with a batch of 18 composite tests for evaluation of six hypothetical latent motor dimensions, three for each of them (coordination, flexibility, power, agility, accuracy and balance). Having performed the rotation of initial coordinate system according to Varimax criterion six factors extracted among boys were defined as: general motor ability factor, coordination, balance, undefined factor x, undefined factor y, flexibility. The total of 65% of latent space variance was explained. 64% of variance was explained for girls. Latent motor ability structure consists of seven factors as follows: general motor ability factor, coordination, balance, undefined factor x, undefined factor y, accuracy and undefined factor z. From everything above mentioned it can be seen that the latent structure of boys and girls differs according to the number of extracted factors and their possible interpretation.This research confirms that in this period of development certain latent dimensions were defined, but they can be expected to a greater extent among school children. It was also confirmed that the latent dimension structure of the children of this age also varies according to gender.

Introduction

One of the tasks that kinesiologists/educators face in their work with pre-school children undisputedly is the need to influence the optimum growth and development of specific antrophological dimensions. Especially sensitive period for children's development is pre-school age. In order to do it appropriately, participants in an educational process should especially meticulously plan the work in order to encourage integration and development of all antrophological dimensions.

Late research of the structures of specific antrophological dimensions among children has shown that it is constantly changing both quantitatively and qualitatively. Changes happen within the dimensions themselves, but also in their mutual relations, which is primarily conditioned by the beginning and end of specific development periods. Interaction of specific features and abilities defines the child's development, both physically, emotionally and intellectually. Since the child's development should be encouraged as effectively as possible, arises a need for defining their kinanthropic dimensions. The notion "kinanthropic dimension" comprises those antrophological dimensions which are more or less influenced by a transformation process, and because of that, more often the subject of research in basic and applied kinesiological disciplines. This primarily refers to antrophometric features, as well as motor and functional abilities. The research conducted so far on the younger, middle and older age populations shows that the mentioned antrophological dimensions are inter related and influence each other in a larger or smaller extent.

Motor abilities may be defined as latent motor structures which are responsible for the infinite number of manifest motor reactions, which may be measured and described (Mraković, 1992).

There were more attempts to define the structure of latent motor ability dimensions of pre-school children. The main problem of most research with samples consisting of children is the nonexistence of adequate measuring instruments to be used. The tests used in research of motor abilities of adults were not appropriate to be used with pre-school children. Practice has shown that the certain number of tests used for adult population, with satisfactory metric features, are not appropriate to be used with pre-school children, neither the way of conducting them, nor the goal intended to be achieved by establishing the latent dimension.

Another problem that occurs in research of certain antrophological dimensions among children is the change of latent structure during growth and development. Children, before they start going to school go through two developmental periods. The first developmental period is the period from birth to a child's third year of age, whereas the second period finishes when the child is about six years old. Today's research of motor abilities show that latent structure is getting more complex as years are passing by (Katić, Dizdar, Viskić-Štalec, & Šumanović, 1997; Kosinac & Katić, 1999; Mraković, Findak, Metikoš, & Neljak, 1996).

The group of authors led by Raitmajer (1989), proposed a set of composite tests for assessment of motor abilities among children between four and seven years of age as follows: nine tests for assessment of explosive strength, six tests for assessment of static strength, six tests for assessment of repetitive strength, three tests for assessment of speed, twelve tests for assessment of coordination, three tests for assessment of accuracy, six tests for assessment of balance, three tests for assessment of flexibility. By using the proposed tests, Raitmajer (1993) assessed of motor ability factor structure on the sample of 183 girls aged from 5 to 5.5. After the results were analysed, 13 relatively badly defined latent dimensions were established, named as: strength, endurance, agility, repetitive strength of arms and legs, movement stereotype reorganisation factor, undefined factor X, explosive strength of hands and arms, explosive strength, ability of quick performance of simple motor structures, undefined factor Y, undefined factor Z, ability of moving in sagittal plane and repetitive body strength. Similar results in structure of latent motor ability dimensions and possible differences between boys and girls were also established by Bala (2002, 2009), Planinšec (2001; 2002a, b), Sääkslahti, Numminen, Varsal and Välimäki (2001), Sabo (2002, 2003) and Zurc, Pišot and Strojnik (2005).

The aim of this paper is to attempt to contribute to better definition of latent motor abilityy structure of boys and girls at the end of the second developmental period and to establish possible differences in latent structure among children, caused primarily by gender.

Methods

Sample

From the population of Zagreb kindergarten children, a sample of 227 children was created, 106 boys and 121 girls. All the children had to meet certain criteria to be included in the research. They had to be 6.5 years old (± 6 months) at the time when the research was conducted. According to legal regulations they had to start going to school that year. During the research the children had to be perfectly healthy. For each of the examinee included in the sample, the parent's/guardian's consent to include their children in the research was obtained, in accordance with the Code of Ethics prepared by the Council for Children as a consultative body of the Government of the Republic of Croatia.

Variables

The sample that was used to assess the structure of latent motor abilities of children consisted of 18 tests, three tests for each hypothetical latent dimension (coordination, flexibility, strength, agility, accuracy and balance). Each test was measured three times and the best result was processed. In such a way negative effect of relatively quick loss of concentration and motivation among children during conducting the measurement was avoided.

Data analysis

For this research statistical programme SPSS 17.0. was used. For establishing latent structure of motor abilities exploratory procedure of factor analysis was used, which established the following: correlation matrix of manifest variables, characteristic values of correlation matrix (λ), percentage of contributions of each characteristic value to the total quantity of variance explained (λ%), cumulative percentages of contribution of each characteristic value to the total quantity of variance explained (cum.%), as well as cumulative value of manifest variables. Furthermore, varimax rotation of original data according to the Keiser criterion was conducted.

Table 1: Sample of variables

Test		Measured capacity	Measuring unit
Pushing a ball with hands	mkgr	Coordination of arms	Seconds
Pushing a ball with feet	mkgn	Coordination of legs	Seconds
Walking backwards on four legs	mkhn	Coordination	Seconds
Twist with a stick	mfip	Flexibility of shoulders	cm
Forward bends sitting	mfsr	Flexibility of legs	cm
Forward bends on bench	mfpk	Flexibility	cm
10 meter running	ms10	Explosive strength	Seconds
Long jump from standing position	mssd	Explosive strength	cm
Body lifts	mspt	Repetitive strength	No. of repetitions
Side steps	maks	Agility	Seconds
Going around stands	maoo	Agility	Seconds
Figure of eight with a bend	maos	Agility	Seconds
Aiming at target	mpgc	Balance	No. of shots
Aiming at a frame	mpgo	Balance	No. of shots
Aiming with a stick	mpcs	Balance	No. of shots
Transversal balancing on one leg	mrju	Balance	Seconds
Balancing on both legs	mrop	Balance	Seconds
Longitudinal balancing on one leg	mrjo	Balance	Seconds

Results

Inter correlation of all variables used in this research is shown in Table 2. So, above the main diagonal there are values of variable inter correlation obtained from the sample of boys whereas below the main diagonal there are values of variable inter correlations for girls. The obtained correlations showed significant correlations between the variables constructed for assessment of coordination, strength and agility. It is supposed that these factors in particular will be extracted. Significant correlations between the variables for assessment of coordination, strength, agility and balance were shown among girls as well.

After matrix factorisation of inter correlation of motor ability variables, six main components were extracted for the boys and seven for the girls. Their values are shown in Table 3.

It is seen that the first two main components more significantly contribute to the percentage of variance explained than other extracted components among boys. Among girls, almost all extracted components equally contribute to the percentage of variance explained. The total percentage of the variance explained with the set of these variables among both boys and girls is similar and amounts to about 65%.

Table 4 shows the values of first main components rotated according to varimax criterion. The results obtained by rotation of original values according to varimax criterion show that after the rotation latent dimensions of motor abilities among boys were better defined. Therefore, the first factor may be defined as the general motor ability factor. The most important variables which defined this factor are the variables for assessment of coordination (pushing a ball with hands and feet, and walking backwards), then variables for assessment of strength (long jump and body lifts) and the tests for evaluation of agility (side steps, figure of eight with a bend and going around stands). Apart from them, this factor is also defined by the aiming at target test.

Second factor is significantly defined by variables for assessment of coordination, and agility. Since these tests are influenced by the mechanism for movement structuring, this factor is called agility. The third factor is significantly defined by variables for assessment of balance, whereas other variables do not participate in its definition more significantly. This factor is defined as balance. The following two factors have badly defined structure, and they are non-interpretable. The last factor is defined by variables forward bend on bench and forward bend with spread legs, whereas the third variable do not participate in its definition. This result confirms the opinion that flexibility of certain parts of body is not significantly interrelated (Agrež, 1976).

Table 2: Correlation Matrix

F\M	Mk gr	mk gn	mk hn	mf ip	m fsr	mf pk	ms 10	ms sd	ms pt	ma ks	ma oo	ma os	mp gc	mp go	mp cs	m rju	mr op	mr jo
mk gr		.70	.38	.12	.05	.16	.11	-.39	-.24	.37	.33	.54	-.17	-.04	-.34	-.09	-0.11	-.11
mk gn	.49		.42	.09	-.01	.13	.11	-.34	-.24	.39	.45	.49	-.23	-.10	-.34	-.13	-0.21	-.22
mk hn	.36	.28		-.02	.08	.19	.32	-.50	-.24	.44	.40	.51	-.14	-.12	-.28	-.21	-0.15	-.35
mf ip	-.16	-.03	-.12		.16	.02	-.06	-.09	.03	-.05	-.13	.02	-.08	-.33	-.10	.03	0.04	.05
mf sr	-.03	.12	.05	-.04		.13	-.22	.08	-.03	-.30	-.18	-.15	-.13	-.06	-.03	-.08	0.04	.15
mf pk	.20	-.02	.11	-.25	.16		.02	-.19	.03	.05	.01	.14	.10	.04	-.10	-.03	-0.07	.11
ms 10	.26	.22	.24	-.10	.03	.17		-.47	-.15	.47	.36	.32	.16	.02	-.05	.05	0.03	-.33
ms sd	-.29	-.24	-.34	.11	-.11	-.25	-.42		.26	-.46	-.43	-.55	.21	.14	.34	.15	0.08	.39
ms pt	-.33	-.23	-.12	.05	-.12	-.12	-.15	.25		-.16	-.23	-.27	.01	-.06	.08	.13	-0.14	-.02
ma ks	.17	.11	.39	-.21	-.11	.13	.31	-.31	-.13		.61	.54	-.02	-.05	-.09	-.03	-0.17	-.32
ma oo	.16	.08	.21	-.01	-.06	.10	.22	-.19	-.07	.28		.55	-.06	.00	-.19	.05	-0.14	-.25
ma os	.19	.08	.36	-.03	-.01	.11	.19	-.39	-.01	.38	.49		-.14	-.10	-.29	-.12	-0.09	-.17
mp gc	-.14	-08	-.17	.17	.01	-.02	.02	.18	.21	-.10	.00	.02		.16	.15	.17	0.16	.23
mp go	-.15	-.04	.02	.10	.08	-.09	-.09	.23	.12	-.17	.06	-.06	.05		.07	.02	0.14	.20
mp cs	-.32	-.14	-.05	-.08	-.17	-.03	.02	.06	.12	.03	.03	-.23	.13	.12		.00	0.03	.08
mr ju	-.18	-.09	-.29	.00	-.09	-.11	-.09	.12	.23	-.03	-.13	-.17	.33	-.07	.10		0.20	.35
mr op	.07	-.03	-.15	.12	-.01	-.02	.04	.21	-.04	-.38	-.07	-.03	.16	-.02	-.05	.06		.26
mr jo	-.06	-.10	-.10	.12	-.11	-.15	-.12	.13	.02	-.07	-.07	-.17	.25	-.03	-.11	.38	.06	

Table 3: Main components, characteristic roots, percentage of variance explained, and cumulative amount of the percentage of variance explained

	M			F		
Component	λ	% of Variance	Cumulative %	λ	% of Variance	Cumulative %
1	3.09	17.17	17.17	2.13	11.85	11.85
2	2.90	16.09	33.26	2.00	11.11	22.96
3	1.70	9.47	42.73	1.71	9.51	32.47
4	1.46	8.12	50.85	1.63	9.06	41.53
5	1.29	7.19	58.04	1.52	8.44	49.97
6	1.23	6.83	64.87	1.31	7.28	57.24
7				1.20	6.65	63.90

Rotation enabled better factor definition among girls. So, the first factor is significantly defined by variables for assessment of coordination and strength. Obviously, beside the mechanisms for movement structuring among girls, for successful performance of certain motor tasks the mechanism for intensity control and excitation duration is also responsible. This factor can be defined as a general motor ability factor. The second factor is defined by variables that are influenced by the mechanism for movement structuring and it can be defined as agility. Variables for assessment of balance highly define the third factor (balance factor). Other factors even after rotation cannot be sensibly interpreted.

From everything previously mentioned, it can be concluded that the latent motor ability structure of boys and girls differs according to the number of factors and their structure.

Table 4: first main components rotated

	M						F						
	1	2	3	4	5	6	1	2	3	4	5	6	7
mkgr	,83	,09	-,04	-,02	,03	,09	,72	,14	-,11	-,15	,08	-,27	-,10
mkgn	,83	,13	-,11	,00	-,09	-,01	,84	-,06	-,01	,12	-,08	,01	,13
mkhn	,43	,45	-,39	-,06	,08	,27	,48	,38	-,19	,01	-,33	,02	,07
mfip	,10	-,11	,11	-,78	,09	,06	-,09	,17	,11	,56	,30	-,19	,03
mfsr	,06	-,47	-,27	-,22	,25	,38	,07	-,09	-,03	-,18	-,02	-,17	,85
mfpk	,16	,02	,03	,04	-,14	,87	-,04	,18	-,09	-,73	,10	-,03	,26
ms10	-,06	,82	,00	-,03	,16	,09	,48	,34	,06	-,37	,10	,25	-,04
mssd	-,38	-,60	,28	,22	-,16	-,17	-,38	-,35	,05	,42	,26	,11	-,05
mspt	-,30	-,14	,20	-,17	-,68	,09	-,42	,02	,27	,20	-,09	,29	,06
maks	,38	,72	,01	,08	-,13	-,06	,21	,39	,04	-,26	-,58	,08	-,24
maoo	,50	,58	,05	,17	-,05	-,12	,06	,77	-,06	-,01	,03	,06	-,08
maos	,64	,48	-,07	-,01	,08	,06	,06	,82	-,04	-,03	-,22	-,10	,04
mpgc	-,36	,21	,45	,22	,11	,34	-,09	,16	,69	,04	,30	,21	,17
mpgo	-,04	-,10	,10	,75	,18	,10	-,07	,11	-,11	,50	,02	,37	,46
mpcs	-,55	-,02	-,01	,19	-,06	-,09	-,15	-,03	,03	-,05	-,04	,81	-,15
mrju	-,01	,03	,82	-,11	,00	-,07	-,09	-,26	,79	-,05	-,06	,09	-,10
mrop	-,18	-,05	,30	-,05	,73	-,03	,09	-,07	,06	-,01	,85	-,01	-,08
mrjo	,00	-,49	,60	,14	,25	,20	-,07	-,02	,66	,20	-,03	-,36	-,14

Discussion

The obtained results indicate that latent motor ability structure of boys and girls is different both quantitatively (the number of extracted factors) and qualitatively. The percentage of variance explained of motor abilities for both genders is similar. This, on the one hand, confirms that among children of this age significant differences in motor ability structure have not happened yet, whereas on the other hand, it is obvious that various factors are responsible for the manifestation of individual factors among boys and girls. The cause of such results may be found in the dynamics of development of certain antrophological features and abilities. The dynamics of development of certain latent dimensions, and motor abilities at the same time, is primarily caused by individual characteristics of each child.

Current knowledge confirms that this development period is very dynamic, both for the entire development of certain abilities and characteristics, and their development level (law of individual development). It is also known that the development of certain abilities is characterised by constant changing of phases - fast development phase and the phase of rest or even stagnation. On the other hand it is obvious that at the end of the second development period the theory of integral human development is confirmed for both boys and girls (Ismail and Gruber 1971), which is the most present at this age.

The obtained results confirm that, in spite of the established differences in latent motor ability structure it is necessary to conduct unique programmes for each of the genders during organised kinesiological activities. This will facilitate planning and programming of the transformation process to the kinesiologists/educators who are conducting them. In such a way a possible unfavourable impact on the entire development of motor abilities among pre-school children will be avoided. Furthermore, those who conduct the transformation process should take care of the inseparability of bodily, intellectual and emotional development of a child. This refers to conducting research, the main goal of which would be to establish mutual relationship between individual antrophological dimensions among pre-school children.

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SPEED, AGILITY AND EXPLOSIVE STRENGTH AS COMPONENTS OF JAZZ BALLET DANCERS' TRAINING PROCESS

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Abstract

As a priority in the creating and programming training process, it is necessary to know the motor skills that have the greatest influence in achieving better results, and for whose development it should take more time for training. In Jazz-ballet speed, agility and explosive power are these motor skills, so it was necessary to determine the nature of their interrelationship. Consequently, the aim of this study was to determine the interrelationship of motor abilities speed, agility and explosive power at Jazz-ballet dancers. Thus wanted to determine to what extent these motor skills have an influence on achieving results in moving activities to achieve their effect. The sample consisted of the 21 Jazz-ballet dancer ages 12-15 years. The level of motor ability of dancers was determined by usage of standardized motor tests of speed, agility and explosive strength. On the basis of statistical data processing it can be concluded that these three motor skills are high-associated and in the process of programming and planning training processes of Jazz-ballet dancers it should be used more moving activities that improves all three motor skills. These results cannot be generalized, but they can be guidelines in improving the training process of Jazz-ballet dancers.

Introduction

Owing to its rhythm characteristics, esthetic values, movement of entire body with music in a certain tempo, dance contributes to the development of many motor skills (coordination, balance, agility, movement frequency, endurance, explosive strength, flexibility). To what extent does it go the other way around, that is, to what extent does the development of motor ability contribute to dance performance? Since dance is also a competition sport and it strives to reach perfection in performance, and consequently to the accomplishment of superb results, there is a need for a planned and clearly defined elaboration of a training process and its implementation. Hence, the priority in conceiving and programming the training process requires knowledge of motor skills which play a major role in the accomplishment of better results, and which require dedication of most time during the training process.

Apart from motor ability development contribution, dance activity effects are also visible in psyche as it affects intellectual abilities, functional abilities, improves health and helps form numerous social values, enhances artistic creativeness and has an application in sports training, recreation and physical education lectures (Ladešić & Mrgan, 2007). It has been shown that the use of dance training in the cross-country skiers training process, age 12-15, of both genders, has a positive effect on the development of speed and agility, as well as on the mobility of joints and muscles, and lateral bending of the spine (Alricsson, Harms-Ringdahl, Eriksson, & Werner, 2003). Use of dance in curricula at young age, leads to better development of motor abilities of children. Research conducted with young students showed that motor abilities and morphology characteristics influenced dance ability (Vlašić, Oreb, & Leščić, 2009).

Jazz-ballet is a dance characterized by incessant dancing, with a lot of hopping, lateral movement and swift, accurate moves, where motoric ability, speed, agility and explosive strength are decisive for good performance. What is specific in Jazz-ballet dancers' training is the repetition of some choreographic elements, which often include different jumps and touchdowns. Since serious training activities in Jazz-ballet begin at the age of 9 onwards, mainly with girls, it is necessary to deal with the issue of their correct development and improvement of their motor skills. A research was therefore carried out to prove the positive effects of applying specific exercises of jumpers in athletics on the development of explosive energy, speed and agility in female Jazz-ballet dancers (Jovanović,Tešanović, & Bošnjak, 2010). Hence, the objective of improving the training process and the accomplishment of better results in this research was aimed at exploring the extent to which the said motor skills influenced one another.

A hypothesis was established accordingly, to show a statistical significance in correlation between the motoric abilities of speed, agility and explosive strength.

The aim of the research was to determine the correlation between speed, agility and explosive strength in Jazz-ballet dancers, so as to determine the way the said motoric abilities of the dancers influenced their performance.

Methods

Sample

The examination sample included 21 female dancers aged 12-15, who took active part in Jazz-ballet competitions and comprised the representation of Bosnia and Herzegovina in modern dances. Prior to the commencement of the research, they had been subjected to a systemic medical examination, which established that they were healthy and capable of enduring all the strain foreseen in the research. To date, none of them has had an injury of the locomotor system.

Variables

The level of motoric ability of the dancers was determined via the application of a set of 9 standardized motoric tests for explosive strength (longitudinal jump from the spot, triple jump from the spot, Sergeant-test and throwing medical ball from the lying position), speed (running 20m and running 40m), agility (t-test, envelope-test and six-angle-direction test). The tests were conducted in the morning hours after adequate warming up and stretching. The sequence of the applied variables was established in accordance with the significance of motor abilities in the accomplishment of the Jazz-ballet results and according to the effort that the muscle had to exert in order to resolve the task: explosive strength variables were tested first, then the speed variables, and then agility. Prior to any test, the dancers were given an explanation and illustration how the tests were to be done correctly, with an emphasis on the proper performance, due to getting as plausible results as possible.

Table 1: Sample of variables

Test	Measured capacity	Measuring unit
Running 20m	Sprint speed	Seconds
Running 40m	Sprint speed	Seconds
Sergeant - test	Power of legs	cm
Throwing medical ball from the lying position	Power of the shoulder girdle and arms	cm
Longitudinal jump from the spot	Power of legs	cm
Triple jump from the spot	Power of legs	cm
T-test	Speed of alternate movement , agility	Seconds
Envelope-test	Speed of alternate movement , agility	Seconds
Six angular direction -test	Speed of alternate movement , agility	Seconds

Data analysis

To process the data, we used the statistics package SPSS 11.0 for Windows. The ratio between explosive strength, speed and agility was determined by the application of correlation, and on the basis of Pearson's coefficient.

Results

Table 2 lists descriptive indicators of dancers' motor skills, pointing out to a medium value of achieved results with the range of results varying from the worst to the best.

What this research aimed to examine was the correlation between the motor skill of speed, agility and explosive strength, that is, to what extent they influenced each other. Table 3, lists the internal relations of individual tests.

Analysis of the results from table 3 shows correlation between the variable of speed – running at 20 meters with and all the other variables bar the agility variable - the six angular direction-test. The speed variable, running at 40 meters shows statistically significant correlation with all other variables that were used, whereby the biggest correlation is with the variables of agility – T-test and explosive strength. Throwing medical ball from the lying position, whereas the smallest correlation is that with the agility variable - the six angular direction-test. The agility variable T-test shows statistically significant correlation ($p \leq 0.01$) with all variables, whereby the biggest correlation is that with the Running at 40m - 0.788; Via the envelope-test 0.819 and the Triple jump from the spot 0.703. The agility variable – Envelope test shows a statistically significant correlation with the variables of the T-test (0.819) and Running at 40m (0.670) at the $p \leq 0.01$ level, while there is also a statistically significant correlation with other variables, but at the significance level of $p \leq 0.05$.

Table 2: Descriptive indicators of motor skill of Jazz-ballet dancers

VARIABLES	MEDIUM VALUE
Running 20m	4.03 ± 0.24
Running 40m	7.31 ± 0.44
Sergeant - test	31.00 ± 4.36
Throwing medical ball from the lying position	600.10 ± 153
Longitudinal jump from the spot	158.90 ± 16.81
Triple jump from the spot	483.57 ± 43.0
T-test	11.6381 ± 1.01
Envelope-test	24.8271 ± 1.46
Six angular direction -test	13.0929 ± 2.60

Table 3: Correlation analysis of data

	Running 20m	Running 40m	T-test	Envelope-test	Six angular direction-test	Surgeon test	Throwing medical ball from the lying position	Longitudinal jump from the spot	Triple jump from the spot
Running 20m	1								
Running 40m	.742**	1							
T-test	.668**	.788**	1						
Envelope-test	.523*	.670**	.819**	1					
Six angular direction-test	.219	.416*	.700**	.508*	1				
Sergeant test	.473*	.564**	.572**	.525*	.386	1			
Throwing medical ball from the lying position	.652**	.731**	.576**	.445*	.334	.684**	1		
Longitudinal jump from the spot	.657**	.622**	.641**	.533*	.395	.716**	.468*	1	
Triple jump from the spot	.556**	.696**	.703**	.525*	.328	.625**	.670**	.610**	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Viewed generally, the variable that has the smallest correlation with other variables is the Six angular direction-test, which shows a statistically significant correlation with the T-test (0.700, $p \leq 0.01$), Envelope-test (0.508) and the Running at 40m (0.416) at the level of significance of $p \leq 0.05$, which can be attributed to the specific features of the test, where the person moves in circles in one direction in a small enclosed space. This test, therefore, is not of a great usability value (in terms of matching the movements used in jazz-ballet dance), but only the value for agility assessment, which is corroborated by other agility tests. The explosive strength variable, the Surgeon-test is related to the explosive strength variables: throwing the medical ball from the lying position (0.684), Longitudinal jump from the spot (0.716) and Triple jump from the spot (0.625), and the agility T-test variable (0.572), and the speed variable Running at 40m (0.564) at the significance level of $p \leq 0.01$. There is also correlation with the variables of Running at 20m (0.473), and the Envelope-test (0.525) but at the significance level of $p \leq 0.05$. The explosive strength variables: throwing the medical ball from the lying position, longitudinal jump from the spot and the triple jump from the spot show a statistically significant correlation with the variable – Six angular direction-test, whereas with all the other variables, there is a statistically significant variable at both levels of significance.

On the basis of the results that we got, and the very high degree of correlation, obtained in the tests that individually represented motor abilities, it can be concluded that they have a feature in common which tell us that the used tests realistically assess the motor space they were used for. High correlation between the speed test – Running at 20 meters and Running at 40 meters, and the test for agility –T-test, Envelope-test and Six angular direction-test confirm the thesis that agility is a complex motor ability, and that speed is one of its segments. Given that explosive strength is a demonstration of force in a short unit of time, and that, as such, it influences the development of speed; the set hypothesis is deemed correct.

Discussion

The correct approach to the programming and planning of the training process, starting from contemplating the facts, analysis and determination of essential factors, decisive for the accomplishment of superb results, is the correct way to approach the training process implementation. To find a good direction in the training process, with as little waste of energy as possible, it is necessary to view the correlation between the motor abilities that are decisive for the accomplishment of good results. Since in jazz-ballet they are speed, agility and explosive strength, it was therefore necessary to explore the nature of the correlation between these abilities.

The results of this research show, through a correlation of the variables of agility and explosive strength, that agility, as a complex motor activity depends on explosive strength of the jump type (with a horizontal and a vertical component), and that the dancers with better results in the explosive strength tests will perform better in all types of agility. On the other hand, it showed that speed is a motor activity in narrow correlation with agility and explosive strength, which indicates that dancers with good results in speed tests, will have better results in agility tests and explosive strength tests, that is, those who are faster, will also be more agile and better jumpers. Hence, it became apparent that these three motor activities are narrowly related and that when programming and planning training process for jazz-ballet dancers those movements should be used which improve each other. For example, application of the triple jump from the spot will have an impact on the development of not only explosive strength, but also of agility and speed, or the application of movements with direction changes into the T-test type movement will also help develop agility, explosive strength and speed.

These results cannot be generalized, but they can be guidelines in improving the training process of Jazz-ballet dancers.

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EXCUSING FROM PHYSICAL EDUCATION LESSONS IN THE SECONDARY-SCHOOL SPORT CLASSES

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Abstract

The purpose of this research was to establish the differences between students, enrolled in special sport classes and students in regular classes in secondary schools, regarding their excusing from physical education (PE) lessons. The used questionnaire examines the frequency of excuses, the reasons for genuine and invented excuses and the activities that students carry out when they are excused from active participation in PE lessons. The sample included 560 secondary students, consisting of 210 students, enrolled in sports classes and 350 students in regular classes. The significance of stratification variables (type of class, year of schooling, gender, overall academic success) for the explanation of frequency of excusing from physical education lessons was established by ordinal regression analysis and logit function.The most significant individual factors of frequency of excusing from PE lessons are gender and year of schooling; girls and pupils in their final year of schooling show the highest risk for excusing. Special sport classes have no statistically significant odds ratio for excusing. Median value of students' absence in sport classes is between "1 to 5" and "6 to 10" hours per year, respectively, which is higher than among male students in regular classes but lower than among female students in regular classes.Being excused from PE lessons does not depend on the sports discipline of pupils from sport classes, nor does it depend on the volume of training and the level of success in chosen sport. It depends only on gender. Male students have more odds ratio for frequent excusing. The most frequent actual reasons for excusing are injuries, illness and studying for another subject. When excused from lessons, students in sport classes most often watch the lesson or study for another subject, similar to their peers from regular classes.The system of excusing from lessons is too lenient; teachers also do not provide activities for students during the time of being excused. As injuries and overload of sports activity are an important reason for pupils in sport classes for being excused from lessons, it is suggested that these students should be monitored by a school doctor.

Introduction

Physical education with its diverse motor encouragement has an important influence on the healthy development of children and youth, whereas the learning of different sport skills enables people to participate in sport as a free time activity in all stages of life (Fairclough & Stratton, 2005; Kovač &Novak, 1999; Tomkinson, Leger, Olds, & Cazarola, 2003). Due to various positive effects on growth and development, every young person should be subjected to at least an hour of quality sports activity per day (Fairclough, & Stratton, 2005; Hardman, 2008; Sallis, Prochaska, & Taylor, 2000; Resolution of European Parliament on the role of sport in education, 2007). This is partly fulfilled with physical education in school system, which should be interesting and organised in such way to allow all young people to participate (Biddle, 2003; Corbin, 2002; Hardman, 2008).

In adolescence, young people are less motivated for sport due to major biological, psychological and social changes (Himberg, Hutchinson, & Roussell, 2003), which result also in excusing from physical education lessons (Jurak, Kovač, Strel, & Starc, 2007; Korošec, 2003; Kovač, 1995; Suhadolnik, 2004). In Slovenia, pupils can be according to school legislature excused from participation in lessons in an individual subject either completely or partially for short or longperiod of time (Jurak et al., 2007; Kovač, 1995). In contrast, the physical education curriculum recommends that health matters should not be a reason for pupils being excused from lessons and that teachers should adapt a teaching process to the limitations of every individual pupil (Kovač & Novak, 1999).

In secondary schools, the *Regulations on school discipline in secondary schools (2007)* in detail define the responsibilities of individuals (pupils, parents, form teachers, physical education teachers, headmasters and doctors) in relation to absence and excusing fromacademic subjects. In particular, the school legislature allows pupils who are also sportsmen to miss lessons for longer periods of time due to their sporting commitments, which are linked to preparations and competitions (Jurak et al., 2005; *Regulations on modification of school responsibilities*, 1998; *Regulations on modification of school responsibilities of pupils in secondary school*, 2009).

There are no precise data on the number of pupils who are excused partially or completely from participation in physical education lessons. In 1973, staggering 10% of secondary school population were excused from physical education lessons (Vučetić-Zavrnik, 1974), whereas at the beginning of 1990s approximately 3% of secondary school pupils were entirely excused from these lessons (Kovač, 1995). According to the data by Jurak et al. (2007), 3% of primary and secondary school pupils provided complete or partial doctors letter of excuse from physical education lessonsin 2004; however authors stated that a small random sample of measured subjects (N=1333) did not allow quality generalisation of data. Kolar (2010) analysed the archive of excuse letters at the Health centre for school children and youth in Maribor and found that in 2004/2005 2.6% of secondary school population from Maribor region received complete or partial letters of excuse and in 2008/2009 the proportion was 1.5%. As the study did not include letters of excuse from personal doctors or specialists, the author assumed that the overall proportion of excused pupils was even larger. In both monitored periods, the majority of letters of excuse were issued to girls (62.1% and 67.7%).

Pupils can be excused from individual lessons due to other commitments, e.g. to visit a doctor, to participate in competition etc. Often pupils excuse themselves when they are not ready for tests or when they did not finish their homework and then despite the excuse still participate in a lesson (Lovšin et al., 1988). Although the legislature states that a pupil can be excused only with doctor's letter, which has to include a recommendation about the degree of participation, it has been noticed that also in physical education lessons pupils excuse themselves and consequently do not participate in practical lessons or they do so only in various activities. Jurak et al. (2004) have on a random sample of 718 pupils from 25 secondary schools (230 boys and 488 girls) with different programmes and in different Slovenian regions examined the frequency of excusing, the justification of reasons for being excused when pupils nevertheless participate in other lessons, and the activities of pupils during the time when they are excused from physical education lessons. The authors have noticed that girls are more often excused from lessons, although the type of secondary school programme did not reveal statistically significant differences in frequency of excusing. The most often actual reasons for excuses were illness, in girls also pains when menstruating, as well as lack of sports clothing. A comparison to the study by Vučetić-Zavrnik (1974) revealed that after more than 30 years the materialistic and hygienic conditions do not present important reasons for excusing anymore. Pupils most often tell the teacher the real reason when they cannot present anything justifiable. Staggering 44.3% of pupils provide doctor's letter of excuse at least once a year despite not having a justifiable reason and 52.5% of pupils at least once a year provide false letter of excuse from parents, stating invented health difficulties. Whilst excused from physical education, pupils most often remain passive or study for other subjects. A fifth of girls (18.9%) excuse themselves at every menstruation whereas more than a quarter (26.3%) of girls practices through it. A half of girls (49.8%) practices during the menstruation with same intensity as other girls. Academically less successful pupils excuse themselves statistically most often. All the justified or unjustified reasons apart from one (»teacher has incorrect attitude towards me«) are in negative correlation with the mark in physical education. Authors concluded that the system of excusing from physical education lessons is ill designed and prone toexploitation.

Pupils – sportsmencan be schooled in special sport classes, which are being organised at 11 Slovenian gymnasia. In regular gymnasium classes pupils attend three physical education lessons per week, whereas in sport classes the number rises to 5 to 6 hours per week (Jurak et al., 2005). Additionally, the majority of pupils sportsmen practices between 1 to 5 hours per day (Jurak et al., 2005). Despite the increase in the number of physical education lessons, which should ensure young sportsmen to carry out the part of sports preparation in schools, numerous pupils do not participate in physical education lessons in schools (Jurak et al., 2005). As a result, the purpose of the present study is to examine the excusing of pupils in sport classes of gymnasium programmes. The aim of the study is to find the influence of education in sports classes on the frequency and characteristics of excusing from physical education. In addition, the differences between the pupils of sport classes according to the type of sport, which they practice, the degree of success and the volume of trainings will be examined.

Methods

Sample

The study was carried out in 2005 on a sample of seven randomly chosen secondary schools with sport classes and thirteen randomly chosen regularsecondary schools. The sample of measured subjects was 560 pupils, who all gave a written consent to be included in the study. In order to ensure the honesty of answers, the interviewing was carried out by students of Faculty of sport and the answers to questionnaire were anonymous.

Variables

A questionnaire, used in the research on pupils from higher years of primary school and secondary school pupils excusing themselves from physical education lessons (Jurak et al., 2004), was modified for the purpose of the study. The questionnaire consisted mostly from closed type answers and included the following groups of data:

- General information: type of class (regular, sports), year of education, gender, general academic record.
- Sports activity of pupils in sport classes: type of sport, number of trainings per week, sports success – type of categorisation according to the Slovenian Olympic Committee (2004).
- Excusing: frequency (never, 1 to 5 times a year, 6 to 10 times a year, 11 to 20 times a year, 21 to 30 times a year, 31 to 40 times a year, 41 to 50 times a year, more than 50 times a year); reasons for excuse (five-degree scale; 1: I never excuse myself or miss without a reason, 2: exceptionally (1 to 2 times a year), 3: sometimes (3 to 5 times a year), 4: often (6 to 10 times a year), 5: very often (more than 10 times a year); listed reasons for excusing (five-degree scale; 1: I never used this excuse, 2: only occasionally (1 to 2 times a year), 3: sometimes (3 to 5 times a year), 4: often (6 to 10 times a year), 5: very often (more than 10 times a year); type of activity when excused (six-degree scale; 1: never, 6: very often); excusing during menstruation and the type of excuse when menstruating.

Data analysis

Standard procedures were used to calculate simple descriptive statistics for general data and distribution of variables. Median (Me) and semi-interquartile range or quartile deviations (sIQR) were calculated for all ordinal variables, defining the excusing separately for gender and type of class (regular, sport) following the procedure for grouped data in programme environment R 2.8.1. Importance of stratification variables (type of class, year of education, gender, general academic record) for explaining the frequency of excusing from physical education lessons has been evaluated with ordinal regression analysis with logit correlation function in statistical programme PASW Statistics 17.0.2. Accepted level of risk for denying the zero hypotheses of all statistical tests was set at 5%.

Results

560 (93.3%) out of 600 pupils, who were invited to participate in the study, agreed with answering a questionnaire. Participation was denied only by pupils from regular classes and mostly first year pupils. Out of a total sample, 210 pupils attended sport classes (91 boys and 119 girls) and 350 attended regular classes (71 boys and 279 girls). The sample included 15.4%

of Year 1 pupils, 36.2% of Year 2 pupils, 25% of Year 3 pupils and 23.3% of Year 4 pupils. No statistically significant differences have been revealed in general academic records ($p=0.109$) between the groups of pupils from sport classes ($M = 3.65$; $SD = 1.01$) and regular classes ($M = 3.51$; $SD = 0.87$).

Sports activity of pupils from sport classes was following: pupils compete in 37 sports disciplines (17.9% basketball, 14.3% handball and 10.2% in track and field; over 5% of pupils compete in volleyball, dance – acrobatic Rock'n'Roll, tennis, Latin-American and standard dances). In average the pupils from sport classes train 5.55 times a week (SD=1.69); the largest number of trainings was 10 and the lowest 1 (N=1). The majority of pupils had according to the categorisation of Slovenian Olympic Committee national status (29.5%), followed by junior (20%), perspective (10%), international (9.5%) and world class (2.9%); 28.1% of pupils did not have categorisation or did not answer the question.

Table 1: Medians (Me) and semi-interquartile ranges of variables by tested groups

Variable	sport classes males		sport classes females		regular classes males		regular classes females	
	Me	sIQR	Me	sIQR	Me	sIQR	Me	sIQR
Number of lessons per year, when pupils have attended other lessons yet have been excused from PE lessons	2.38	0.83	2.32	0.94	1.96	0.51	2.42	0.65
Actual reasons for pupils excusing themselves from practising at physical education lessons								
Forgetting sport outfit at home	1.83	0.52	1.41	0.59	1.60	0.64	1.58	0.59
General illness, headache etc.	1.34	0.54	1.90	0.54	1.37	0.55	1.97	0.53
Fear of exercises	1.03	0.27	1.06	0.28	1.04	0.27	1.08	0.29
The exercises are too strenuous	1.02	0.26	1.04	0.27	1.04	0.27	1.09	0.30
Pain and sickness during menstruation	1.03	0.26	1.68	0.62	1.03	0.26	1.98	0.79
Not enough time for personal hygiene after exercise	1.08	0.29	1.03	0.26	1.06	0.28	1.11	0.31
Unsuitability of place for personal hygiene after exercise	1.09	0.29	1.03	0.27	1.05	0.28	1.07	0.28
Unmotivated for exercise because nobody else is motivated	1.36	0.54	1.35	0.57	1.20	0.39	1.41	0.61
Uninteresting contents	1.33	0.66	1.22	0.45	1.15	0.32	1.26	0.54
Studying for other subjects	2.15	0.73	2.05	0.63	1.31	0.61	1.81	0.68
I don't like the schedule of PE (the first or the last lesson)	1.12	0.31	1.11	0.31	1.06	0.28	1.18	0.38
Teacher does not treat me right	1.10	0.30	1.01	0.26	1.05	0.28	1.03	0.27
Unsuitability of the facilities in which PE lessons are carried out	1.05	0.28	1.02	0.26	1.04	0.27	1.05	0.28
Illness	2.28	0.69	2.30	0.61	1.91	0.77	2.20	0.63
Injury	2.58	0.84	2.06	0.60	1.81	0.78	1.62	0.63
Fatigue from training or competitions	1.58	0.69	1.21	0.44				
Keeping strength for training	1.25	0.55	1.11	0.31				
Keeping strength for competition	1.47	0.65	1.28	0.54				
Fear from injuries which could limit competition successfulness	1.18	0.37	1.08	0.29				
Training attendance	1.31	0.77	1.36	0.71				
Transportation to home	1.05	0.28	1.07	0.28				
Instructions (individual teaching)	1.11	0.31	1.04	0.27				
Teachers excusing pupils when they do not have a genuine reason								
I apologise to teacher that I forgot sport outfit	1.74	0.57	1.37	0.52	1.69	0.63	1.56	0.57
I deliver false parents' excuse regarding my health problems	1.50	0.64	1.44	0.61	1.23	0.44	1.45	0.61
I deliver improperly issued medical excuse	1.36	0.54	1.21	0.43	1.19	0.39	1.29	0.52
I tell that I feel sick	1.39	0.54	1.70	0.59	1.33	0.54	1.92	0.53
I tell the actual reason	2.26	0.93	1.87	0.60	1.47	0.74	1.67	0.65

I do not go to PE lesson and my absence is excused by class teacher	1.14	0.32	1.15	0.33	1.13	0.31	1.09	0.30
I do not excuse myself	1.14	0.32	1.09	0.30	1.23	0.46	1.15	0.33
I use bonus (possibility of excusing without justified reason)	1.38	0.63	1.13	0.31				
I tell teacher that I should study for other school subjects	1.64	0.68	1.68	0.60				
I bring letter of excuse from my coach	1.25	0.48	1.21	0.42				
Activities pupils do at physical education lessons when being excused from participating								
I leave the gym or changing room after the lesson starts	1.22	0.49	1.23	0.54	1.31	0.69	1.18	0.38
I talk in the changing room	1.64	0.72	1.45	0.71	1.16	0.33	1.44	0.72
I follow the exercises	2.66	1.18	2.57	1.38	2.06	1.61	3.17	1.65
I study for other school subjects	2.52	0.91	2.97	1.26	2.03	1.18	2.72	1.22
I do what I want but I stay in the gym	1.43	0.73	1.41	0.70	1.46	0.80	1.91	1.01
Teacher uses me as his assistant but only when I am not excused because of medical reasons	1.43	0.70	1.41	0.61	1.42	0.65	1.64	0.73
I learn theoretical contents of PE	1.13	0.32	1.06	0.28	1.08	0.29	1.06	0.28
I'm preparing didactic materials for PE lessons (posters, learning sheets, etc.)	1.06	0.28	1.05	0.27	1.06	0.28	1.06	0.28
I'm involved in various activities, ordered by the teacher: I tidy up certain parts of the gym, I collect rubbish on the outdoor playground etc.	1.28	0.68	1.09	0.29	1.20	0.41	1.23	0.52
I don't go to the gym at all	1.18	0.38	1.26	0.61				
I'm at my sports training	1.35	0.97	1.37	1.00				

The highest value of median for the variable the number of physical education lesson per year, when pupils are excused from practising but participate in other lessons, was revealed in a group of girls from regular classes, followed by the boys and girls from sport classes (see Table 1). The median was in the range between »1 to 5 hours« and »6 to 10 hours« of absence per year.

The most often real reasons for excusing from physical education lessons were for all groups of pupils an illness and injury (see Table 1). In boys and girls from sport classes variable learning for another subject showed a slightly higher value. In regular classes slightly less than 12% of girls do not practice in physical education lessons when menstruating, whereas in the girls from sport classes this proportion is only 2.5%. Slightly more than 4% of girls do not train in the club whilst menstruating. Statistically no significant differences were revealed in the intensity of practicing when menstruating for both the girls from sport and regular classes ($p<0,119$).

The review of letters of excuse in case of unjustifiable reasons (see Table 1) showed that boys and girls most often tell the teacher a real reason for not practicing. The girls from sport and regular classes often use an excuse of not feeling well, whereas the boys state to have forgotten sports clothing.

When excused from practicing, pupils most often watch the physical education lessons or study for another subject; they very rarely learn the theoretical aspects of physical education, prepare didactic materials or help during the lesson (see Table 1).

The presentation of results focuses on determination of effects of certain factors on the frequency of excusing. The results of analysis for differences between the groups of pupils in individual variables, which define real reasons for absence, made up excuses and activities during the excused time, are available from the authors.

The frequency of excusing according to the type of selected stratification variable (type of gymnasium class, year of education, gender and academic record) has been explained with an ordinal regression (see Table 2). The categories of variables with low frequencies have been joined (all the values for frequency of excusing that exceeded 20 times a year and unsatisfactory and just satisfactory academic record). The model included two-way interaction (gender*type of class), as it was the only one to reveal significance. Such formed model showed according to the method -2LL high statistical significance ($p<0.001$), similarly high statistical significance has been revealed with the χ^2 measurement of adapting the model to real data (Pearson=289.4; deviation=279.2); however, their statistical significance has to be considered with reservation due to the large number of low expected cell frequencies. The pseudo R^2 measurements were relatively high (Cox and Snell = 0.102, Nagelkerke = 0.109, McFadden = 0.038). The strongest individual indicators were year of education and gender, with year 1 and male gender having approximately three times lower expectation for excusing than the referential categories (year 4 and female gender). Sport classes have revealed beside constant values of other stratification variables only slightly higher and statistically insignificant expectation for excusing in comparison to regular classes. When the effects of other indicators were nullified, the frequency of excusing is in the highest correlation with the girls from regular classes.

Table 2: Model of ordinal regression for predicting frequency of excusing from PE regarding to type of gymnasium, academic year, gender and academic achievement

Effect	Estimate	SE	Wald	df	Sig.	Odds ratio
type of gymnasium=sports class	.147	.213	.478	1	.489	1.159
academic year=1	-1.041	.291	12.804	1	.000	.353
academic year=2	-.837	.219	14.655	1	.000	.433
academic year=3	.027	.229	.014	1	.907	1.027
gender=male	-1.118	.260	18.528	1	.000	.327
academic achievement=E+D	.735	.325	5.098	1	.024	2.085
academic achievement=C	.398	.258	2.369	1	.124	1.489
academic achievement=B	.198	.247	.646	1	.422	1.219
type of gymnasium=sports class * gender=male	1.006	.379	7.032	1	.008	2.735

Table 3: Model of ordinal regression for predicting frequency of excusing from PE regarding to gender, categorization of sports results, type of sport practiced and number of training sessions per week

Effect	Estimate	SE	Wald	df	Sig.	Odds ratio
gender=male	1.884	.787	5.731	1	.017	6.581
categorization=none	.040	.622	.004	1	.949	1.040
categorization =junior	.557	.677	.678	1	.410	1.746
categorization =national	.109	.595	.033	1	.855	1.115
categorization =perspective	1.459	.844	2.987	1	.084	4.300
sport= Olympic	-.226	.446	.256	1	.613	.798
sport= team	-.608	.447	1.845	1	.174	.545
No. of trainings=1–4	-.744	.425	3.071	1	.080	.475
No. of trainings=5	.714	.362	3.891	1	.049	2.042
No. of trainings=6	-.128	.441	.083	1	.773	.880
gender=male*categorization=junior	-1.435	.982	2.138	1	.144	.238
gender=male*categorization=national	-2.007	.985	4.153	1	.042	.134
gender=male*categorization=perspective	-1.248	.895	1.945	1	.163	.287

Ordinal regression method was used to study the frequency of excusing in the pupils from sport classes according to gender, level of categorisation from Slovenian Olympic Committee, type of sport and the number of trainings per week (see Table 3). Some categories with low number of subjects have been joined: junior and international categorisation, sports in the programme of winter and summer Olympic Games and the groups with the amount of trainings per week (1 to 4 and 7 or more). The model was built on the complete data of 184 pupils (out of 210 pupils from sport classes). Beside predicted variables, the proposed model included also the correlation between the gender and categorisation, which has been revealed as the only significant two-way interaction. Proposed model has, according to the evaluation with criterion -2LL, differentiated from the zero model on the border of statistical significance

(χ^2 =22.9; p=0.062), whereas the degree of correlation for the entire block of predictors with dependant variable, which has been evaluated with pseudo R^2 coefficients, was moderate (Cox and Snell=.117, Nagelkerke=.123, McFadden=.042). The strongest predictor was gender, which showed influence both independently and in correlation with categorisation. This was followed by the frequency of trainings, where the referential categories (7 or more trainings per week) revealed statistically significant difference only with the group of pupils with five trainings per week; additionally, the group with the lowest number of trainings per week (1 to 4) was close to the border of statistical significance. In categorisation only the group of pupils with perspective status came close to borderline statistical significance of 5%; these pupils have in comparison to referential categories (pupils with international and world class status) four times higher odds for being excused more often from the lessons. Type of sport did not show statistical significance, although the trend revealed that pupils from Olympic and particularly team sports get excused less often in comparison to pupils from other sports. For the same values of all the other predictors in the model, male gender has been revealed as an important indicator, as the boys from sport classes are six times more expected to reach one category of frequency of excuses higher than the girls.

Among the special reasons for excuses, connected to education in sport classes, the most often were (see Table 1): training attendance, fatigue due to training or competition and saving energy for competition. Boys and girls from sport classes more often than their peers excuse themselves from physical education lessons in order to study for another subject. The differences in excuses between the genders indicate that girls more often say that they are not feeling well (p=0.016), whereas the boys more often use the agreed bonus of absence hours (p=0.001), state the real reason of excuse (p=0.002) and most often say that they have forgotten their sports clothing (p=0.004).

In average almost every second pupil from sport classes (45.1%) brings a doctors letter of excuse at least once a year without having a substantiated reason for it. A half of pupils (49.3%) produce a false letter of excuse from their parents stating health problems at least once a year. Almost a quarter of pupils (23.5%) get excused from physical education lessons at least once a year by their form teacher, even more often teachers excuse pupils on the basis of letter of excuse from the coaches (31.2% of pupils at least once a year).

Discussion

The results indicate that boys and girls from sport classes get excused from physical education lessons more often than the boys from regular classes on account of injuries and fatigue from training and competitions. This is not the case when compared with the girls from regular classes. In girls the stated reasons for excusing (general ill-being, headache; pains due to menstruation) point to generally worse health status, although the girls do not differ in the variables of motivation for exercising (contents are too strenuous, not in the mood for practicing, the others did not practice, low level of interest for contents on programme). Surprisingly sport class is not an important factor for prediction of frequency of excuses in physical education lessons;similarly the general academic record of pupils is also not an important factor. According to the regression model, the year 4 pupils in sport classes represent the group with the highest risk of frequent excusing from physical education lessons, as they tend to use the time for studying for another subjects (Jurak et al., 2004; Lovšin et al., 1988).

More than half of sportsmen realises the importance of additional practice, offered by sport classes (Güllich, 2004; Jurak et al., 2005) and as a result participate in all the lessons or miss them very rarely. Nevertheless, there is also a small proportion of pupils sportsmen with extremely large number of missed physical education lessons – more than 40 hours a year (pupils have 185 to 210 physical education lessons per year), although there are no common characteristics between them. The reasons for increased absence could not be found, as missing the lessons was not in correlation with any group of sports, categorisation of pupils or the amount of training. The only correlated variable was gender, as boys show highest odds for excusing than the girls.

In contrast with the pupils from regular classes, pupils from sport classes showed more reasons, related to trainings and competitions. A professional question arises: whether the pupils who are due to competitions significantly burdened in a certain period should practice at all in school? Experience from abroad revealed that in some countries pupils sportsmen have modified education process in other subjects, whereas physical education is left completely out of the school schedule (Güllich, 2004; Metsä-Tokila, 2002). In Slovenian education system, a larger number of physical education lessons was introduced on purpose (Kovač, 1998) in order to guarantee professionally led basic training, which is a prerequisite for future specialisation (Šturm, 1995). Young sportsmen usually do not receive basic preparation in clubs, as the coaches tend to start specialised practices too early (Jurak et al., 2005). It would be sensible to analyse in detail the burden placed on individual young sportsmen, as their overloading is often a reason for injuries and early finish of sports career (Balyi, 2001). Data about sports injuries of Slovenian pupils sportsmen were not available; however it can be assumed that their health treatment is not adequate. Namely, sport classes provide sports coordinator, who is teaching physical education and monitoring their sports career, whereas pedagogical coordinator is responsible for balancing the education and sports commitments of the pupils (Kovač, 1998). Health monitoring of pupils in these classes is not provided. The authors suggest that every school with sport classes should also have its own school doctor, who would monitor in-depth health status of pupils sportsmen, prepare the regeneration programme, look after the rehabilitation when injured etc. It is also important to find out the main reasons of injuries.

As an approach to young sportsmen should be humane, it should be wise to consider the preparation of guidelines about the loading of young people (how many hours of training and competitions per week are allowed and what should be the intensity of practicing). Excessive competitive loading of certain pupils could result in injuries and additionally could lead to lack of studying time (Güllich, 2004). Some sportsmen, particularly in team sports, compete in several age categories. They have numerous strenuous competitions per week and they do not have time for regeneration (Güllich, 2004; Jurak et al., 2005); excessive number of competitions also prevents the upgrading of technical and tactical knowledge, which can be an important factor of injury occurrence (Bayli, 2001). Therefore, schools should offer pupils sportsmen beside basic sports training and help in balancing the academic and sports commitments also additional activities, which are necessary for success in sport and which represent more holistic approach to sportsmen. Such activities are for example analysis of sports loading of pupils, scheduling and planning for studying, regular health monitoring, immediate health treatment in case of injuries, participation of doctor, physiotherapist and physical education teacher in rehabilitation, individual nutrition planning etc. (Abbott & Collins, 2004 ; Fry & Duda, 1997).

As the type of gymnasium class is not a significant factor for excusing, it is sensible to use same measures of reducing the excusing in physical education for both regular and sport gymnasium classes. Authors recommend that teaching should be quality, interesting and adapted to pupils, whilst simultaneously teachers should prepare a creative system of participation for those who cannot fulfil the planned programme. A fact that pupils study for other subjects during the physical education lessons (Jurak et al., 2005) points to poor balancing of academic and sports commitments, which is also one of the setbacks noticed in different European countries with organised sport classes (Güllich, 2003). In such cases, the help of pedagogical coordinator or school councillor is required. Despite the injuries, teachers could include these pupils more intensively into lessons. They can be given a role of an assistant, referee or organiser. Teachers should also prepare topics, which could help injured pupils to understand, how for example regeneration works, what causes injuries, which chemical processes occur in the human body during and after the training, what are the risk factors of injuries etc. It is most strongly recommended for teachers to cooperate with doctors and agree on special practices for injured pupils.

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COMMERCIALIZATION OF YOUTH SPORT FROM THE PERSPECTIVE OF SPONSORS' INTERESTS IN SLOVENIA

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Abstract

Sponsorship for companies represents an investment that will result in commercial effects. Such approach has also impact on youth sport, especially on international mobility of most talented players in most commercal sports toward professional leagues. Therefore the purpose of this study was to examine the commercialization of Slovenian youth sport from the perspective of sponsorship potential of Slovenian sport. The sample of measured subjects was a total of 494 potential sponsors/managers of Slovenian companies. A questionnaire was used to examine which sports disciplines are the most interesting for sponsorship. The results of the study revealed that the companies are interested in sponsoring Slovenian sport; however, the range of sports disciplines that interests sponsors is relatively small. Therefore commercialization potential of youth sport in Slovenia is very limited. The most interesting sports for sponsors are basketball, football, alpine skiing, ski jumping and handball. Compared to previous findings, an increase of the interest for football and a decrease for alpine skiing has been noticed. Study was conducted before global economic crises; therefore some important issues have to be considered. One of these is undoubtedly the opportunity for reasonable de-professionalization of youth sport.

Introduction

Sponsorship for companies represents an investment that will result in commercial effects. In order to achieve marketing goals, the companies often cross into public sector by offering financial or material support to individuals and/or organisations in sport, culture or in some other social field (Meenaghan, 1999). As a result, sponsorship has become one of the fastest growing and most lucrative areas within sports management (Chelladurai, 2001). Successful companies have developed their sponsorships to a level that gives them an advantage over competitors. The increase of sponsoring can also be seen in the increase of the proportion of money available for sponsoring in the total advertising budget. In 1987, sponsorship money represented 2.5-3.5% of all advertising investments in the world. This proportion increased to 5.8% in 2001 and should, according to some predictions, climb to 8.5% of all advertising costs by 2010 (see: Seguin et al., 2005). According to the IEG reports (2008), the growth rate of the sponsorship industry in the last two years is around 10% per annum. Such a growth rate is closely related to the increase of media attention to sport, particularly as a result of television broadcasting of sports events. Another important factor is the fact that sponsorship is more efficient than traditional advertising (Jagodic, 2007; Mennea, 1993). According to the development of communication technology, it can be estimated that sponsorship will continue to develop as one of the areas of marketing communication. Some authors (Skaset, 2008; White, 2008) predict increasingly larger influence of sponsors in sport; this could result in changes in the organisation of sports events, which are interesting for sponsors (national and international sports governing bodies will lose their role on the account of professional associations), and changes of the image of sports (the rules of sport will change according to the media demands). Such trends can already be seen in European sport in recent years.

In the conditions of globalisation, a selective professionalism of sport will become increasingly apparent. It can be assumed that in the area of competitive sport, fewer sports will achieve global media attention, as this type of sport is linked to the rules of the mass economy. Media most interesting and thus largest sports will become even larger, the largest companies will acquire even more power over sports services, and future possibilities will be utilised by those with power and suitable infrastructure in given circumstance. The concentration of financial resources is already visible in Slovenian sport (Bednarik, Jurak, Kolenc, & Kolar, 2008). Such trends have also impact on youth sport, especially on international mobility of most talented players in most commercal sports toward professional leagues. This brings out many open questions (Andreff, 2002).

The aim of the present study is to examine the possible commercialization of Slovenian youth sport from the perspective of the changes in sponsorship potential of Slovenian sport in comparison to the previous research.

Methods

The sample included 494 potential sponsors/managers of Slovenian companies, 75.7% were men and 24.3% were women. The sample was formed on the basis of the record of large, medium and small size companies. Out of 1,584 distributed questionnaires, 494 or 31.2% were returned. The sample included 97 managers of large companies, 258 managers of medium-sized companies and 135 managers of small companies, while four managers did not state the size of their company. The data were obtained in year 2003.

Data variables were acquired with a use of the questionnaire "Sport and national identity of Slovenian people *SNI-04 – sponsors*" (Kovač, Starc, & Doupona Topić, 2005). For the purpose of our research importance of individual sport for fulfilling the marketing goals of a company was observed. Rank of sports was compared with findings of Bednarik et al. (1998).

Basic descriptive characteristics were calculated for all variables.The normal distribution was tested with the use of a Kolmogorov-Smirnov test.

Results

Table 1: Importance of particular sport for fulfilling of marketing goals

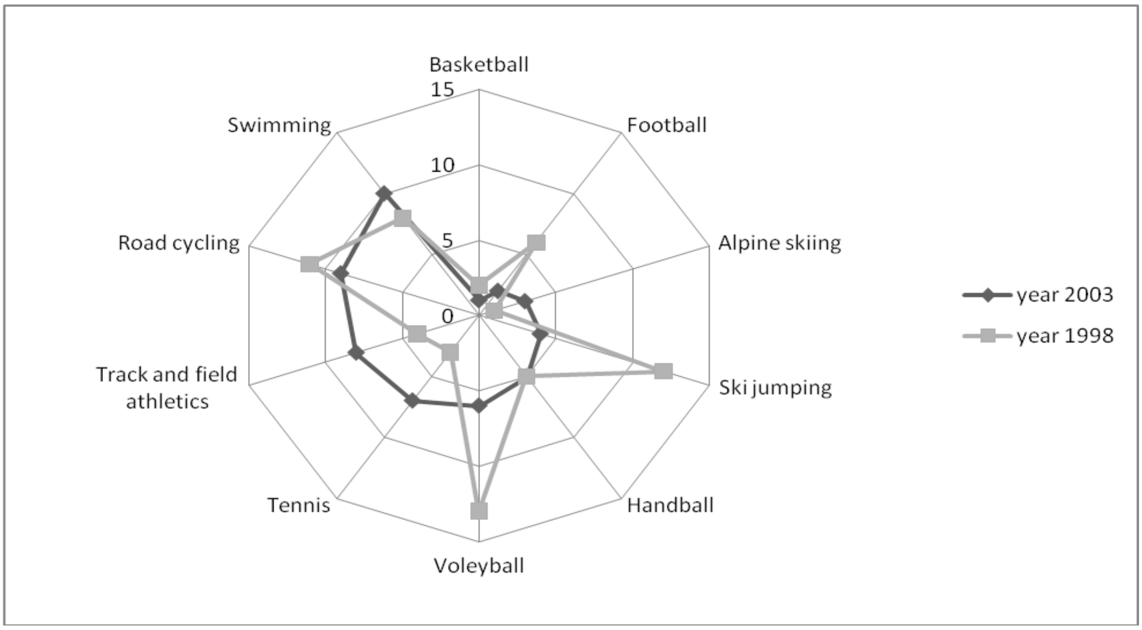
Group	Sport	N	Min	Max	Mean	SD
1	BASKETBALL	157	1	6	3.293	1.773
	FOOTBALL	160	1	6	3.119	1.854
2	ALPINE SKIING	153	1	6	2.824	1.732
	SKI JUMPING	151	1	6	2.808	1.850
	HANDBALL	154	1	6	2.779	1.622
3	VOLLEYBALL	148	1	6	2.615	1.580
	TENNIS	147	1	6	2.612	1.572
	ATHLETICS	154	1	6	2.591	1.631
	CYCLING – road racing	152	1	6	2.480	1.496
4	SWIMMING	148	1	6	2.399	1.479
	ICE HOCKEY	153	1	6	2.340	1.438
	ARTISTIC GYMNASTICS	150	1	6	2.327	1.495
	CROSS COUNTRY SKIING	148	1	6	2.324	1.526
	ROWING	149	1	6	2.302	1.455
	BIATHLON	151	1	6	2.291	1.440
	MOUNTAIN CLIMBING	148	1	6	2.203	1.457
5	GOLF	149	1	6	2.107	1.453
	BEACH VOLLEYBALL	147	1	6	2.095	1.336
	NORDIC COMBINATION	148	1	6	2.095	1.347
	SAILING	148	1	6	2.088	1.350
	SNOW BOARDING	150	1	6	2.080	1.329
	TABLE TENNIS	148	1	6	2.074	1.299
	MOUNTAIN BIKING	148	1	6	2.068	1.254
	CAR RACING – road racing	148	1	6	2.061	1.316
	SPORTS CLIMBING	148	1	6	2.047	1.362
	MOUNTAIN SKIING	148	1	6	2.034	1.372
	CAR RACING - rally	148	1	6	2.027	1.256
	KAYAK-CANOE – white water	150	1	5	2.007	1.179
	EQUESTRIANISM	151	1	6	2.007	1.246
	RHYTHMIC GYMNASTICS	151	1	6	1.987	1.286
	WATER POLO	146	1	6	1.945	1.179
	SQUASH	150	1	6	1.940	1.233
	DANCE – Latin and standard dances	147	1	5	1.918	1.230
	TRIATHLON	147	1	6	1.912	1.152

MOTOR RACING – road racing	146	1	5	1.877	1.126
CYCLING - indoor track	148	1	6	1.858	1.155
KAYAK-CANOE – flat water	148	1	5	1.858	1.082
ACROBATIC SKIING	149	1	6	1.846	1.143
ARCHERY	149	1	6	1.805	1.125
MOTOCROSS	146	1	5	1.801	1.055
DANCE – acrobatic rock & roll	148	1	5	1.770	1.089
SKATING	148	1	5	1.764	1.039
SPEEDWAY	147	1	6	1.762	1.075
AVIATION – gliding	149	1	5	1.758	1.018
CYCLING - bmx	148	1	5	1.730	1.001
AVIATION - parachuting	148	1	5	1.709	0.971
AVIATION – ultra light planes	149	1	5	1.658	0.957
AVIATION – motor planes	148	1	4	1.642	0.919
9-PIN BOWLING	148	1	6	1.642	1.017
AVIATION – classic parachuting	148	1	4	1.622	0.907
AVIATION - para skiing	147	1	4	1.619	0.886
ORIENTEERING	148	1	5	1.615	0.937
AVIATION – para gliding	148	1	5	1.615	0.915
SLEDGING – natural course	148	1	5	1.595	0.887
WEIGHT LIFITING	149	1	5	1.591	0.893
BADMINTON	150	1	6	1.580	0.877
SHOOTING	149	1	5	1.550	0.896
LAWN HOCKEY	148	1	4	1.547	0.803
JUDO	150	1	4	1.547	0.816
RUGBY	149	1	4	1.517	0.827
WRESTLING – Greco-Roman style	145	1	5	1.490	0.834
UNDERWATER SWIMMING– speed event	149	1	4	1.483	0.785
UNDERWATER SWIMMING- fins	147	1	5	1.483	0.831
BOULES	149	1	5	1.477	0.767
KARATE	149	1	4	1.456	0.767
CURLING	148	1	4	1.439	0.740
JIU - JITSU	149	1	4	1.430	0.738
FISHING - casting and fresh water	148	1	5	1.426	0.757
FENCING	148	1	4	1.419	0.690
BASEBALL	149	1	5	1.416	0.708
BOXING	149	1	4	1.416	0.679
FISHING – sea	148	1	5	1.405	0.763
KICK BOXING	148	1	4	1.378	0.674
GO	144	1	5	1.354	0.704
TAEKWON - DO	146	1	3	1.315	0.596
BRIDGE	149	1	5	1.302	0.655

Sponsors have evaluated the importance of individual sports for fulfilling their marketing goals with marks of 1 to 6. The highest average mark, which consequently represents the most interesting sport for fulfilling the marketing goals of individual companies, was by received basketball (3.292, see Table 1). Beside basketball, football and alpine skiing were also listed as the most interesting sports in Slovenia for sponsors. The least interesting sports from the listed possibilities were go, taekwondo and bridge. The results have to be viewed with reservation due to the large number of possible answers for the size of sample.

A comparison of sponsorship interest of the top ten sports for the five-year period (1998-2003; Bednarik et al., 1998) reveals that in a relatively short time changes occurred at the top, as alpine skiing dropped from first to third place. In contrast, basketball and football climbed to first and second places, respectively (see Figure 2)

Figure 2: A comparison of sponsorship interest of top ten sports in Slovenia for 1998 and 2003



Discussion

Only a small group of sports are interesting for Slovenian sponsors in general. Companies are most interested in sponsoring team sports. The reasons presumably lie in the larger number of spectators, continuous recall of consumers due to league competition system and consequently larger target group of consumers, as the most widespread team sports in Slovenia (football, basketball, and handball) also receive a largest media attention. Therefore opportunity or threats for commercialization of youth sport is very limited due to small size of Slovenian sports market.

The results of the interest of Slovenian companies for sponsoring particular sports reveal that at the time of the research at most 16 sports were sufficiently interesting for sponsors; moreover, significant differences have been noticed even among these sports. Sports have been classified into five groups according to the sponsorship interest (see Table 1).

The first group includes the most interesting sports for sponsors: basketball and football. These two sports are also globally most interesting for sponsorship (basketball: NBA, ULEB, FIBA competitions; football: FIFA and UEFA competitions); therefore, it is not surprising that they are highest placed also in Slovenia. Although football is the most widespread and commercial sport in the world (De Knop, Engstroem, Skirstad, & Weiss, 1996), basketball in Slovenia has a long tradition and consistently good competition results on the club and national team levels and is consequently a very popular sport that is covered in the media throughout the year.

The second group includes alpine skiing, ski jumping and handball. The first two sports are traditionally part of the Slovenian environment. Ski jumping is centred on the Nordic skiing centre in Planica and the annual sports events that are held there. Alpine skiing carries a lot of interest from the time of Slovenian skiing legend Bojan Križaj and his successes, which have later been repeated in the following generations. Kovač et al. (2005) found out an important value of national identification with alpine skiing and ski jumping; therefore, large sponsorship interest for these sports regardless of the worse competitive results in recent years does not come as a surprise. These sports also carry strong international media support (TV and radio broadcasts of World Cup competitions and World Championships).

Handball is also strongly integrated into the Slovenian sports environment as a result of strong domestic league system and the international successes of both national team and clubs

(2nd place of Slovenia at the 2004 European Championship in Ljubljana, qualification to the 2004 Olympic games, 1st place of Krim women's handball club at the European Champions League in 2001 and 2003, 1st place of the Celje men's handball club in the European Champions leagues in 2004). This sport also receives a lot of media attention, as the national public TV regularly follows European club competitions for men and women.

The third group includes volleyball, tennis, athletics and road cycling. A common characteristic of these sports is that they achieve good results on the international level and sometimes even the elite top results (e.g. athletes Jolanda Čeplak, Matic Osovnikar, Marija Šestak, Primož Kozmus and cyclist Jani Brajkovič). It is assumed that they stand out due to their international media attention (volleyball and athletics are two of the most widespread sports in the world, tennis is the most media-exposed individual sport with the ATP and WTA series of tournaments, while road cycling receives extreme coverage at the time of professional team races as well as athletics with grand prix meetings).

The fourth group includes the seven remaining sports out of the 16 most interesting sports for sponsors: swimming, ice hockey, artistic gymnastics, cross-country skiing, rowing, biathlon and mountain climbing. Slovenian sportsmen have in recent years achieved extremely good international results in these sports, in some cases even elite top results (e.g. Iztok Čop, world rower of the year in 2005, together with Luka Špik a medal winner at the Olympic Games and World Championships; qualification of Slovenian ice hockey team in the group A World championships; medals won by gymnasts Mitja Petkovšek and Aljaž Pegan at the World and European Championships; medals won by swimmers Peter Mankoč and Sara Isakovič at major competitions; highly successful cross-country skier Petra Majdič). It is characteristic of all these sports, compared to previous groups, that despite the better results of Slovenian sportsmen they do not receive large international media attention. These sports are consequently less commercialised and consequently less interesting for sponsors.

The fifth group includes more than 60 sports with relatively small differences in sponsorship interest in Slovenia. Some of the sports have extreme international coverage (e.g. car racing) but poor international successes of Slovenian sportsmen, whilst in some other Slovenian sportsmen achieve good results, however, they are less widespread internationally and receive less media attention (e.g. judo).

On the basis of this classification, it can be concluded that sports from the first three groups are most interesting for sponsors. These groups stand out significantly according to their sponsorship interest. The fourth group could be still classified as sufficiently interesting; however, it already significantly lags behind the first three groups. The fifth, by number the largest group, include sports that were not sufficiently interesting for sponsors in 2003.

Compared to previous findings (Bednarik et al., 1998), there have been some shifts in the interest of sponsorship in sport. An increase of interest in football and decrease in alpine skiing has been noticed. The latter is presumably the result of few unsuccessful recent seasons of Slovenian skiers, who did not achieve visible results at the major international events, such as World Cup, Olympic Games and World championships. Improvement of placement of basketball and football can also be connected with sports results of these two sports, particularly on the international level of senior national teams. The Slovenian football team has qualified to the 2000 European Championships and the 2002 World Cup, which caused football frenzy in Slovenia and an increase in interest for the national football team. In basketball, the continuous contact of the national team and club teams with the wide European elite caused the above-mentioned shift. The introduction of the Adriatic League has also influenced the interest for basketball, as it opens the promotion and media attention in the former Yugoslav area. Undoubtedly, the international distribution influences the interest for these sports. The fourth place is occupied by ski jumping, which did not achieve such high placement in the 1998 research. Presumably, the interviewed subjects did not recognise ski jumping as part of Nordic skiing (see: Bednarik et al. 1998); as a result, this increase is not seen as surprising. The largest decline in the top ten sports has been experienced by athletics and tennis. During the studied period, a decline of interest for tennis in comparison to other sports has been noticeable. Subsequently, this also resulted in a smaller number of people taking up tennis (Jurak et al., 2003; Strel, Kovač, & Jurak, 2007). In athletics, the research in 1998 is represented by the results of the golden period of Slovenian athletics (Olympic medal of Brigita Bukovec, medals from the European championships and World University Games), whereas the second research in 2003 was carried out prior to the biggest achievements of a new generation of athletes (Jolanda Čeplak' bronze medal at the 2004 Olympic Games in Athens and silver medal at the 2004 World Indoor Championships in Budapest, Primož Kozmos' gold medals at the 2007 World Championship and at the 2008 Olympic Games in Beijing). The biggest jump in placement in this five-year period is seen in volleyball, which climbed from thirteenth to sixth place. This can be attributed to the progressively better results of Slovenian teams and the global popularisation of this sport. Constant international results has caused handball, cycling and swimming to be placed in the top ten for sponsors most interesting sports in 2003, whereas car racing, ice hockey and kayak-canoeing have dropped out of the top ten sports.

The shift in the interest of companies for sponsoring sport can also be a result of other causes (e.g. changes in the sponsorship goals, changes in media attention, new products etc.) and not solely because of competitive results. An analysis of the goals of sponsors in sport reveals that these are most often connected with the improvement of public image of the company and the increase or maintaining of the reputation of the company and its trademarks in the social environment (Jurak, Bednarik, & Kovač, 2009).These findings have also been confirmed by other authors (Amis, Slack, & Berrett, 1999; Bednarik et al., 1998; Copeland, Frisby, & McCarville, 1996; Cornwell & Maignon, 1998; Irwin & Sutton; 1994; Meenaghan, 1991; Musante, Milne, & McDonald, 1999). The classification of sponsorship goals indicates the attitude of Slovenian companies, which do not consider sponsorship of sport primarily as means for increasing its market share, sales and profits, but more as a social vehicle for introducing the company name into the media or for creating new acquaintances with other sponsors/business partners at sports events, thus widening the network of their business connections. In the period of the last five years, changes have also occurred in the target goals of sponsors. Their attention is presently more directed to the social recognition of the company, its products and services.

Before global economic crises it was estimated that the income from sponsorship and TV rights represent a 59% share of the total income of Slovenian sports clubs and their associations (94.7 mio EUR; Bednarik, et al., 2008). According to the stagnation of sponsorship income of these sports organisations in past two years, some important issues, related to the commercialization of sport as impact of sponsorship interests have to be considered. One of these is undoubtedly the opportunity for reasonable de-professionalization of youth sport (in term of professional contracts of young players) and consequently reducing the negative effects of commercialization of youth sport.

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THE INFLUENCE OF FLEXIBILITY TRAINING PERFORMED AT THE FINAL PART OF PHYSICAL EDUCATION LESSONS

Sandra Kapus & Jernej Kapus

Abstract

The purpose of this study was to determine whether minimal amount of flexibility training with ballistics stretching improves flexibility in children. Subjects were 52 children (23 girls and 29 boys) between 9 to 10 years of age. The subjects were divided into two groups: experimental group (E) with 35 subjects and control group (C) with 17 subjects. After the initial testing, the E group was given the complex of flexibility–ballistics exercises for improving flexibility of the shoulder, low back and hip joint. These flexibility trainings lasted five minutes during the final parts of the physical education lessons.The subjects performed it three times per week for three months. During this period, the C group had usual lessons, without additional flexibility exercises. The identical testing protocol was used to evaluate pre- and post- training conditions. It included four anthropometric measurements and three measurements of flexibility (the shoulder-wrist test, the bend and reach test and the standing leg abduction test). As expected, the E group significantly increased range of motion in all three flexibility test with the training ($p<0.05$). There was significant improvement in flexibility of the hip joint at the C group during the experimental period ($p<0.05$). Furthermore, there were significant different training (experimental) effects between both groups on the flexibility of the low back ($p<0.05$). Considering the result of present study, it could be concluded that even minimal amount of ballistics exercises performed three times per week for three months has significant effects on the children's flexibility of the low back.

Introduction

Flexibility is believed to be an important element of fitness and health of the musculo-skeletal system (Corbin, & Noble, 1980). Considering this, stretching of human skeletal muscles to improve flexibility is a widespread practise. Its goals are mainly to reduce the chance of injury and to lessen the pain which can result from postural problems in daily life. Furthermore, for improving athletic performance optimum flexibility allows elimination of movement that is awkward and inefficient. Considering the hypothesis that only 50% of this motor ability is genetically determined (Pistotnik, 1999), it could be assumed that important gains in flexibility are possible in short time with appropriate training (Lucas &Koslow, 1984; Wallin, Ekblom, Grahn, &Nordenborg, 1985). Flexibility training is usually consisted of ballistic stretching and static stretching (Alter, 1996).

However, this important motor ability is often neglected in every day life. Indeed, Strel and co-workers (2001) concluded that in Slovenian region Zasavje the decline of flexibility of pupils in primary school is especially evident over the past twenty years. The teachers of physical education in primary school Šmartno pri Litiji (which is one of primary schools in mentioned region) are aware of this problem; therefore flexibility exercises are included in the physical education lessons. However, due to our experiences, pupils do not like very much such exercise. Therefore, the purpose of this study was to determine whether minimal amount of flexibility training with ballistics stretching improves flexibility in children.

Methods

Subjects

Subjects were 52 children (23 girls and 29 boys) between 9 to 10 years of age. They were the pupils of the fourth grade of primary school Šmartno pri Litiji. The subjects participated in the study after their parents had been informed of the associated risks and they had given written consent. The subjects were divided into two groups: experimental group (E) with 35 subjects and control group (C) with 17 subjects.

Procedure

The testing and training were performed during January and April 2007 in the gym of primary school Šmartno pri Litiji.

Training. After the initial testing, the E group was given the complex of flexibility–ballisticsexercises for improving flexibility of the shoulder, low back and hip joint. These flexibility trainings lasted five minutes during the final parts of the physical education lessons.The subjects performed it three times per week for three months. During this period, the C group had usual lessons, without additional flexibility exercises.

Testing protocol. The identical testing protocol was used to evaluate pre- and post-training conditions. It included four anthropometric measurements (height, weight, arm length, leg length) and three measurements of flexibility (the shoulder-wrist test, the bend and reach test and the standing leg abduction test). Prior testing – the subjects warmed up with some flexibility exercises.

The shoulder-wrist test (SW) was used to evaluate shoulder flexibility. In this test, the subjects stood in upright position against the wall with arms fully extended overhead. He grasped a yardstick with the hands in a shoulder width apart. In this starting position, he had to move a stick from the wall as far as possible. The horizontal distance from wall to yardstick and the arm length was measured. The shoulder flexibility was determined with the angle between the arms and wall (αSW). It was calculated by using the following equation:

$$\alpha SW = \arcsin \frac{D}{AL}$$

where D is distance from wall to yardstick and AL is arm length.

The bend and reach test (BR) was used to evaluate the flexibility of the low back. At BR – the subjects stood on a box and bended forward with arms extended as far as possibletowards toes. The flexibility of the low back was determined with the distance from the fingertips and toes.

The standing leg abduction test (SLA) was used to evaluate the flexibility of the hip joint. At this test, the subjects stood in an upright position. From this starting position, he had to slide his legs to the side as far as he could. The distance between the medial side of the feet and the length of the leg were measured. The flexibility of the hip joint was determined with the angle between legs (αSLA). It was calculated by using the following equation:

$$\alpha SLA = \left(\arcsin \frac{DL/2}{LL} \right) * 2$$

where DL is distance between legs and LL is the leg length.

Statistics

The results were presented as means and standard deviations (M, SD). The paired T test was used to compare the pre- and post-training data at both groups. The effects of different training protocols (physical education lessons with or without additional flexibility exercises) on the subjects' flexibility were analyzed using ANCOVA.

Results

During three months of the training period, the E group finished 19 (± 2) physical education lessons with additional flexibility exercises. When subjects of similar age were measured, Dolenec and Pistotnik (2001) obtained significant differences in flexibility between boys and girls. Considering this, the data were analysed according to gender in the present study. However, the effects of different training protocols did not differ between boys and girls. Therefore, the results are not separated according to gender in the following tables and figures.

Table 1 shows the anthropometric data measured at pre- and post-training testing for both groups. Regardless of group, there were significant differences in almost all anthropometric data between pre- and post-training measurement (p<0.05).

Table 1:The anthropometric data measured at pre- and post-training testing for the experimental (E) and the control (C) group.

Parameter	Group	Pre-training			Post-training		
Height (cm)	E	145,5	±	6,7	147,8	±	6,6 *
	C	144,1	±	6,4	145,9	±	6,2 *
Weight (kg)	E	40,5	±	9,0	41,7	±	9,2 *
	C	40,3	±	10,5	40,4	±	7,0
Arm length (cm)	E	64,3	±	3,4	64,2	±	3,7
	C	61,8	±	3,5	62,8	±	3,3 *
Leg length (cm)	E	79,7	±	4,0	80,8	±	4,0 *
	C	79,3	±	3,6	80,5	±	3,6 *

* notep<0.05 - significant differences between pre- and post-training testing (paired T test)

The results of the flexibility tests are presented in table 2. As expected, the E group significantly increased range of motion in all three flexibility tests with the training (p<0.05). In addition, there was significant improvement in flexibility of the hip joint at the C group during the experimental period (p<0.05).

Table 2: The data of the flexibility tests measured at pre- and post-training testing for the experimental (E) and the control (C) group.

Parameter	Group	Pre-training			Post-training		
αSW (°)	E	58,70	±	18,21	64,13	±	18,40 *
	C	49,81	±	13,65	53,40	±	16,30
BR (cm)	E	45,5	±	6,0	47,5	±	5,6 *
	C	46,6	±	5,1	46,0	±	4,9
αSLA (°)	E	123,70	±	13,83	134,80	±	16,78 *
	C	130,20	±	19,70	143,36	±	24,02 *

* notep<0.05 - significant differences between pre- and post-training testing (paired T test)

The comparisons of effects of different training protocols (physical education lessons with or without additional flexibility exercises) on the subjects' flexibility are presented in the following figures. Figure 2 shows that there were significantly different training (experimental) effects between both groups in BR (p<0.05).

Figure 1: The comparison of the effects of different training protocols (E group and C group) on the shoulder flexibility.

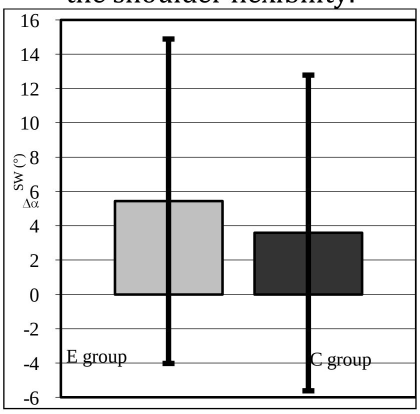


Figure 2: The comparison of the effects of different training protocols (E group and C group) on the flexibility of the low back (* note p ≤ 0,05 - significant differences between groups after the training (ANCOVA)).

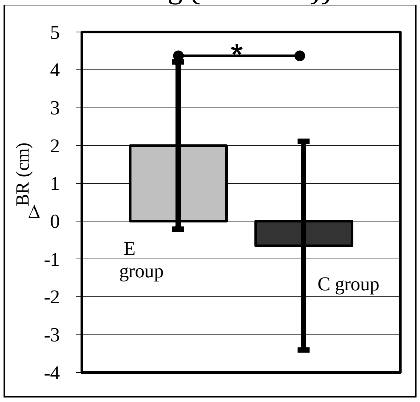
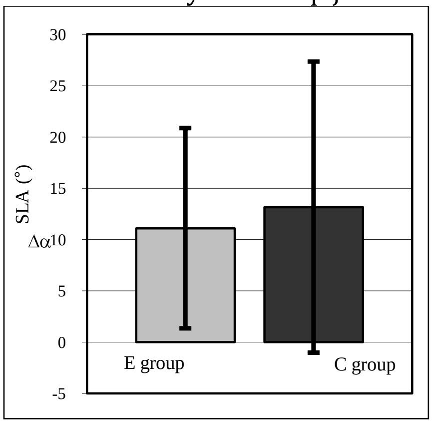


Figure 3: The comparison of the effects of different training protocols (E group and C group) on the flexibility of the hip joint.



Discussion

The purpose of this study was to determine whether minimal amount of flexibility training with ballistics stretching improves flexibility in children.The subjects were pupils of the fourth grade of primary school. Their anthropometric data (table 1) were in accordance with previous studies, which measured similar age subjects (Dolenec, Burnik, Smajič, &Pori, 2004; Jurak, Kovač, &Strel 2006).

The obtained results show that, even five minutes of ballistics exercises performed three times per week for three months had significant effects on the flexibility of the shoulder, low back and hip joint (Table 2). This flexibility training was performed only at E group during the final part of the usual physical education lessons. However, when comparing these training effects with results measured at C group, there was only one significant difference. Different effect was obtained only at BR (Figure 2). Unexpectedly, there were no significantly different training (experimental) effects between groups on flexibility measured in other two tests (Figure 1 and 3). It should be emphasise that, C group performed only usual physical education lessons without specific flexibilitytraining. A least three reasons could be suggested for such results:

It seemed that the five-minute durations of the training were too short to induce significantdifferences between groups.

Ideally, the goniometer should be used as equipment for measuring range of motion in selected joint. However, the presented study was based on equipments that are usually used during testing for Sports-educational chart (Strel et al. 1997). These measurements take place every year during physical education lessons in all Slovenian primary and secondary schools. It should be considered that measurements with meter sticks were only indirect methods for measuring flexibility with certain degree of error.

The subjects' activities were controlled only at physical education lessons. However, it could be presumed that they were physically active also out of these hours. Therefore they could be some other effects on subjects' flexibility independentlyfrom program at physical education lessons.

For further researches, it could be suggested to examine the effect of similar amount of flexibility training, however with static stretching. Despite, most of previous studies were unable to demonstratethe preferred method for improving flexibilitybetween both (Sady, Wortman, & Blake 1982; Lucas &Koslow, 1984), the static stretching has been suggested as method with less negative aspects in comparison with ballistic one (Hiti, 1994; Wallin, Ekblom, Grahn, &Nordenborg, 1985). Proprioceptive neuromuscular facilitation was obtained to be the most effective method for improving flexibility (Sady, Wortman, & Blake, 1982). However, these exercises are complicated and require an experienced therapist. Therefore, it is not appropriate to be used at physical education lessons (Pollock et al. 1998).

Conclusion

Considering the result of present study, it could be concluded that even minimal amount of ballistics exercises performed three times per week for three months has significant effects on the children's flexibility of the low back.

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MODEL OF PREPARATION OF THE NATIONAL PROGRAMME FOR SPORT 2011 – 2020

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Abstract

The last National programme for sport has been prepared for the 2000–2010 strategic period and as such it will run its course at the end of 2010. In line with directives of the Ministry of education and sport, before the end of validity of existing National programme for sport, »Project of preparation of the National programme for sport for 2011–2020« and the »Project of preparation of the amendments or preparation of the new Law on sport« have to be carried out. Slovenian Minister of education and sport, Igor Lukšić PhD, has named Marko Rajšter – general director of the Directorate for sport – as a project manager for preparation of these two documents. On the basis of recommendations from the Ministry of education and sport, Slovenian Olympic Committee – Association of Sports Unions and the Faculty of sport, the Minister has named a project team for realisation of both strategic documents. Documents should be finished and passed in the Slovenian National Assembly by the end of 2010. Methodological starting-point for preparation of the new National programme for sport for 2011–2020, which could become a fundamental strategic document for progress and development of Slovenian sport in the coming decade, was based on the methodology of strategic management, which recommends a series of steps in preparation of such documents. A project team has prepared a proposal for the new National programme for sport for 2011–2020, which will have to undergo a long path of changes and amendments until it will be passed in the Slovenian Parliament. When preparing the proposal, project team members have on the basis of available data and heterogeneous knowledge as well as familiarity with various segments of sport attempted to tackle sport in its entirety. A preliminary presentation of the proposal has been completed in front of all the committees of Slovenian Olympic Committee – Association of Sport Unions, which is the highest professional organisation from non-governmental sector in sport, in front of students of the Faculty of sport, which are potential users and creators of future image of sport, and also at 14 regional symposiums across the entire Slovenia. Responses of all types of public were critical but encouraging.

Introductory starting-point

The last National programme for sport (2000) has been prepared for the 2000 – 2010 strategic period and as such it will run its course at the end of 2010. In line with directives of the Ministry of education and sport, before the end of validity of existing National programme for sport (2000), »Project of preparation of the National programme for sport for 2011 – 2020« and the »Project of preparation of the amendments or preparation of the new Law on sport« have to be carried out. Slovenian Minister of education and sport, Igor Lukšić PhD, has named Marko Rajšter – general director of the Directorate for sport – as a project manager for preparation of these two documents. On the basis of recommendations from the Ministry of education and sport, Slovenian Olympic Committee – Association of Sports Unions and the Faculty of sport, the Minister has named a project team for realisation of both strategic documents. Documents should be finished and passed in the Slovenian National Assembly by the end of 2010.

Methodological starting-points

A proposal of the National programme for sport (NPS) for the next decade has been prepared within the project »*Network and support to non-governmental organisations in sport*«, which has been run by the Association for sport of children and youth in Slovenia and was partly financed from the European social fund. The project team, working on the large project, included several experts and scientists from the field of sport, management of sport and economy.

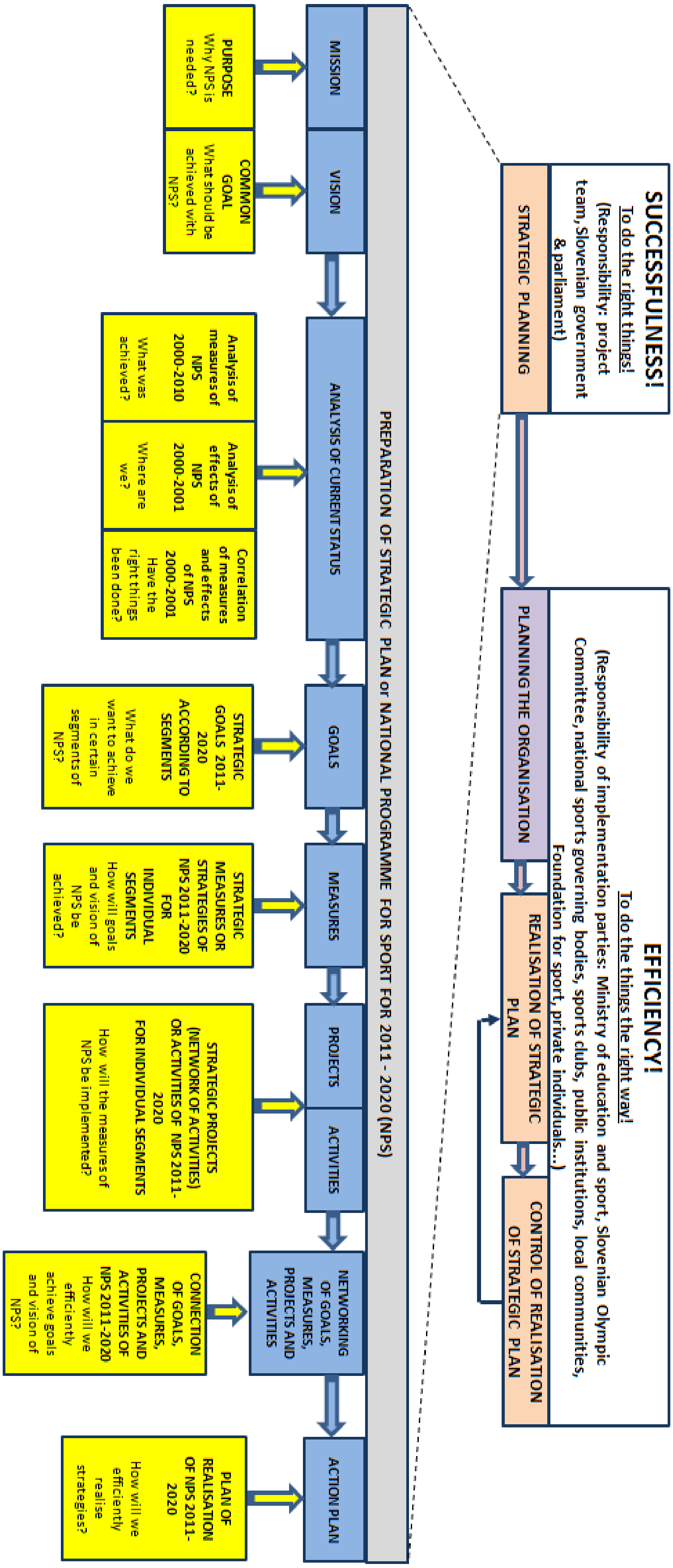
Methodological starting-point for preparation of the new NPS, which could become a fundamental strategic document for progress and development of Slovenian sport in the coming decade, was based on the methodology of strategic management (Žnidaršič Krajnc, 1996; Kolar, 2007; Pučko, 2003; 2008), which recommends a series of steps in preparation of such documents. The model of preparation of National programme for sport can be seen in Figure 1. The model in its top part presents the phases of strategic management or phases of preparation of National programme for sport for 2011 – 2020, preparation of the organisation for implementation of the National programme for sport for 2011 – 2020 and the control of implementation of National programme for sport for 2011 – 2020. Whereas the preparation of the strategic plan is connected with planning of successfulness (To do the right things!), the planning of organisation, implementation and control are connected with the efficiency (To do things in a right way!) of implementation of strategic goals and vision of the National programme for sport for 2011 – 2020. The successfulness of the National programme for sport for 2011 – 2020, which depends on establishing »right« strategic goals and measures, projects and activities, e.g. those that will increase successfulness of Slovenian sport and enable the implementation of strategic vision (common goal) and mission (purpose) of the National programme for sport for 2011 – 2020, will be a responsibility of the project team. The efficiency of the implementation of measures, projects and activities for accomplishing strategic goals will be a responsibility of all the acting parties in the process of implementation (organisation and realisation) of measures (strategies) and control of realisation of measures and achievement of the effects of measures (strategies). The lower part of the figure 1 shows a group of activities, which have to be carried out in the process of preparation of National programme for sport for 2011 – 2020 (NPS 2011 – 2020). Individual activities or steps in preparation of the NPS 2011 – 2020 follow consequently, as the realisation of one activity facilitates a sensible realisation of the next activity. Explanation is included for every step and activity as well as questions, which will have to be answered in the realisation of the activity.

Considering above-mentioned points, the strategic team has in its introductory starting-points of the preparation plan written that four strategic documents will need to be prepared in order to deal with the entire future development of sport. Documents are proposed to be prepared in the following order:

1. Analysis of the National programme for sport in Slovenia (2000),
2. National programme for sport for 2011 – 2020,
3. Action plan for the implementation of the National programme for sport in Slovenia for 2011 – 2020,
4. The novelty on the Law on sport or a new Law on sport (on the basis of passed NPS).

According to the project team members, only all four strategic documents together can present a logical unit, which will enablerational, successful and efficient realisation of progress and development of Slovenian sport in the next decade.

Figure 1: Model of preparation of the National programme for sport 2011 – 2020



Analysis of the National programme for sport in Slovenia (2000)

An analysis of the National programme for sport in Slovenia (NPS 2000) has been presented in an extensive scientific monograph, which on more than 350 pages presents an analysis of various aspects of sport between 2001 and 2008. The analysis consisted of a review of the entire internal setting of sport, which included those segments of sport that formed a part of NPS 2000. Strengths and weaknesses of implemented measures from the NPS 2000 were examined. Analysis also touched on the subject of some aspects of external setting of sport, namely those segments that in past already had and in future potentially could have important effects on the progress and development of Slovenian sport. Analysis of these aspects helped to understand the threats and opportunities of future development and progress of sport.

A method of whole analysis (evaluation) of sport in Slovenia has been used in order to examine the efficiency and successfulness of implementation of NPS 2000 for the period 2001 – 2008. Complete field of sport has been divided into substructures and each of the substructures of sport has been evaluated analytically. The field of sport has been divided into five substructures: organisational, financial, research & development, programme and materialistic (infrastructure) substructure. Within the individual substructures a finished analysis of individual contents of NPS 2000 has been carried out. The contents of NPS 2000 have been distributed according to their belonging to individual substructure of sport. Thus, within the entire analysis, in total 20 areas of sport have been reviewed and evaluated; namely, 17 segments (contents) of NPS 2000, which formed a part of internal setting of sport and three areas of external setting of sport (economic effects, taxation aspects and sport in educational system). In the segment of analysis of materialistic substructure, environmental as well as some other topics, related to construction of sports facilities, have been considered. The final chapters of the analysis included main findings from individual substructures and areas; furthermore, the evaluation of successfulness and efficiency of individual measures of NPS 200 has been presented. Additionally, an analysis of correlation of financial measures and selected effects, indicating the development and progress of Slovenian sport for the period 2001 – 2008, has been carried out and the evaluation of successfulness of fulfilment of the goals and purposes through NPS 2000 has been presented.

Numerous indicators (the number of medals at major competitions, the number of sportingly active adult population, number of sporting organisation, new training and competition sport facilities etc.) revealed that sport in Slovenia has in the last ten years experienced all-around progress and quality development. Important factors of contribution have been measures, implemented by the state and local governments, which were defined in the National programme for sport 2000. Other supporting factors were introduction of sport into various social areas (particularly educational), self-initiative of social organisation of sport, development of private sector in sport, media attention, interest of general public and Slovenian economy for private financing of sport. Main findings of the analysis are presented in Table 1.

In the last decade, organised sport in Slovenia was on a rise. In 2008, 7.439 sports organisations werefunctional, 82% (6.115) of them were sports clubs. The number of sports organisations (private and public) has throughout the entire observed period increased by 91% (3.544). Particular expansion has been noticed in private sector, both in the number of organisations and the income made. Despite this fact, the model of extra-curricular sport is still based on sports clubs.

Clubs are main protagonists of Slovenian competitive sport. In 2009, 87.520 athletes were registered (OKS-ZŠZ, 2009) as participants in competitive systems of national sports governing bodies up to the level of national champion (an estimate for 2000 was 15.000 athletes). In the same year, 4.520 athletes fulfilled criteria to become categorised (OKS-ZŠZ, 2007). The number of sports, the number and proportion of Slovenian local communities with categorised athletes, the number of elite athletes and the number of medals won at major competitions has been increasing throughout the ten-year period, indicating larger distribution of quality and elite sport. In last decade, the number of elite athletes has increased by 14.7% or 102 elite athletes. The number of medals won at major international competitions (Olympic Games, World and European championships) has been during the years 2000 and 2008 increasing by 8% per year. With five medals won at the 2008 Summer Olympic Games in Beijing, Slovenia placed second on the ranking list of medals won per capita (http://www.rtvslo.si/sport/preostali-sporti/slovenski-sport-svetovni-fenomen/217612); with three medals won Slovenia ranked third at the 2010 Winter Olympic Games in Vancouver (OKS-ZŠZ, 2010). Slovenia is one of the five European countries and by far the smallest country (France, Germany, Serbia and Spain), which in 2010 had teams qualified for Football World Cup as well as World Championships in basketball and handball.[1]

Table 1: Slovenian sport in numbers

Total expenditure for sport	597.521.712 € (1,93% of BDP)
Average annual expenditure of household for sport	496 €
Number of sports organisations	7.439
Number of sports clubs	6.115
Annual averages income of sports club	32.764 €
Resources from Yearly sport programme per person	49.28 €
Indoor sports facility (m^2 per person)	0.33
Outdoor sports facilities (m^2 per person)	3.15
Number of compulsory physical education lessons in education system	3 academic hours (45 minutes) in primary school and 1 to 3 in secondary school, 0 in higher education
Proportion of sportingly active adult population	64%
Number of children in sports programmes Golden Sun and Krpan	94.953 (approx. 70% of 6- to 9-year-old children and approx. 50% of 9- do 12-year-old children)
Proportion of swimmers among 12-year-old children	85.60%
Number of registered athletes in competitive systems of national sports governing bodies, competing for the title of national champion	87.520
Number of categorised athletes	4.520
Number of world-class athletes	52
Number of sports with categorised athletes	110
Number of local communities with categorised athletes	133
Number of children and youth, included in the project of National sports schools	7.016
Number of young athletes with scholarship	145
Number of suppliers of coaching education programmes and number of programmes	60 suppliers, 282 programmes
Number of researchers in sport	85
Average number of organised World and European championships per year	8

Such results were achieved with the help of various systemic measures. The level of expertise of working with children and youth has increased, particularly due to financial support for educated sports professionals, working with this sensitive part of population within the project of national sports schools. Among the important projects, enabling the athletes to acquire desired education, are also solutions in the field of balancing the academic and sport commitments of talented athletes (sports classes, scholarships, learning help and other types of modification of academic responsibilities) (Jurak et. al., 2005).

Various sports programmes for children (Golden Sun; Krpan; Learn to swim; Hoorah, free time) in the last ten years contributed to improvement of contents, workforce and materialistic resources of motor activity of pre-school and compulsory as well as free time physical education of pre-school and primary school children. Nevertheless, positive trends in organised free time sports activities of children did not manage to neutralise negative changes in lifestyle of children and youth. Consequently, increasing proportion of overweight and obese children, particularly between the ages of 8 and 13, has been noticed, as well as negative changes in functional indicators of aerobic endurance of children and youth (Strel et. al., 2009). Negative trends are still significantly smaller in comparison to other European countries.

Ensuring the infrastructure conditions for carrying out sports activity has been accomplished through intensive investments of local communities into a network of sports facilities, thus providing 0.33m^{2}of indoor sports facilities and 3.15m^{2}of outdoor sports facilities per capita. In contrast, an efficient catalogue of sports facilities, which would ensure adequate overview for efficient supplementing of network, is still required and lacking. In some local communities, sports facilities that were built require expensive maintenance, which will be hard to keep up due to limitations of local budgets. In general, construction of network of sports facilities was very dispersed across Slovenian regions; mostly multi-purpose sports halls were constructed. Less sports facilities per person have been noticed in larger towns, particularly Ljubljana and Maribor.

The network of sports facilities ensures access to sport for the majority of population; the fact has been confirmed also with international comparisons. Slovenes are in first place according to the use of natural sports facilities and one of the most sportingly active nations of European Union (Eurobarometer, 2010), as 64% of population is sportingly active and 33% of population practice sport on a regular basis(Sila et. al., 2010).

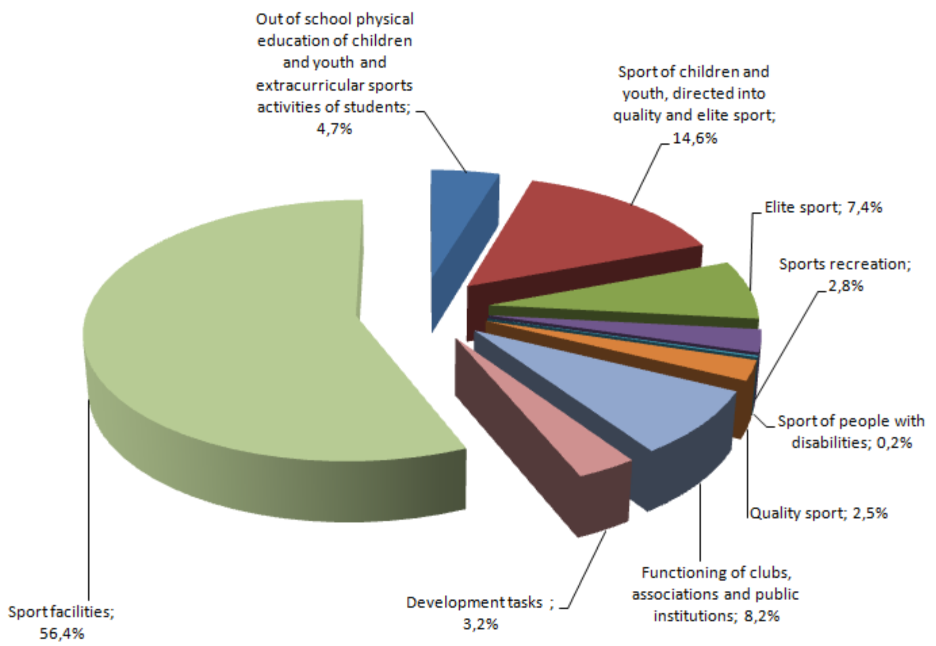
In the last decade a second developmental sports infrastructure has been set up. A system of education, training and promotion of professional workforce in sport has been formed. Training programmes of workforce in sport have been set up by competent providers (three providers of university and high education programmes; 282 training programmes and 60 providers). In the studied period, 1.130 professional people finished university or further education sports degree. In the same period, 9.679 professional people were trained in sport. Supporting the transfer of knowledge are sports and other organisations, which on an annual basis publish 70 scientific and professional items of literature from sport. Supporting the athletes with monitoring of their preparation are 9 laboratories of the Institute of sport at the Faculty of sport in Ljubljana and one laboratory at the University of Primorska. Despite reduced financing, scientific-research activity of sport is extensive and successful, although as a result of national strategy in the field of science it is more directed into publicising abroad and less in studying practical problems of sport at home. A National anti-doping commission has been set up in order to prevent doping and the activities of the commission have in ten-year period resulted in identifying the use of illegal substances and procedures in 18 athletes.

An analysis of financing of Slovenian sport revealed that the entire expenditure for sport in the last decade has been increasing on an absolute level; however, in relation to the GNP it has been decreasing due to major investments in transportation infrastructure. In 2001, expenditure for sport amounted to 433.9 million EUR (2.38% of GNP), whereas in 2007 it was 597.5 million EUR (1.93% GNP). The proportion of private and public expenditure has not been changing significantly throughout the years; in average public expenditure represents 84% and public expenditure 16% of total expenditure for sport. Proportion of public expenditure for sport is lower than in other EU countries. Expenditure of households represents almost half of total expenditure for sport. The largest proportion of money is spent on sports equipment (78.2% - sport clothing and shoes and outdoor sport equipment), whereas three times less money is spent on sports services (21.8% - sports courses, sports clubs membership fees, training fees, ski passes and tickets to sports events). Average Slovenian household spends 496 EUR per year for sport, which is comparable with EU-15 member countries. Expenditure of businesses for sport (mostly as sponsorships) in average represents 18.1% of total expenditure for sport.

The income of sports organisations has in the last decade risen from 158.9 million EUR to 300.3 million EUR. Despite significant increase of income in private sector, the income of sports clubs grew continuously. In 2008, the total income of sports clubs came to 200.4 million EUR; however, the income of an average club is stagnating as a result of growing number of clubs.

In 2008, 100.1 million EUR of public finances went to sport[8]in comparison to 63.4 million EUR in 2001. Local communities contributed 75.2% of this money and the state government 24.8% of total public expenditure for sport, signifying decentralised model of financing in sport, which can be compared to western European countries. Public finances have in the studied period reached almost 90% of planned expenditure in National programme for sport, although the realisation of individual contents of National programme for sport was very different. The best realisation has been noticed in the segment of construction of sports facilities. This category obtained the majority of public finances and its proportion within the total public expenditure has been increasing. In 2001, it represented 48.1 % and in 2008 56.4% of total public expenditure for sport (see Figure 2).

Figure 2: A structure of public finances in 2008 according to the categories of National programme for sport



However, some supporting mechanisms of Slovenian sport were not implementedin the last decade. Problems keep occurring in implementation of physical education throughout the entire vertical of educational system, implementation of health status of athletes, caring for the complete personal development of elite athletes, development and implementation of sport activity of children and youth with special needs and sport participation of disabled people, rationalisation of the use of public sports facilities and the lack of adequate training infrastructure for certain sports. It has also been noticed that some national governing bodies depend too heavily on public financing and that professional teams have continuous financial difficulties. Wrong decisions in 2006 on functioning and

[8] This includes finances for sport from local government, state government and Foundation of sport. Although sport is also financed from some other public sources (e.g. employment of athletes in state companies), data available was not adequate and have been neglected.

development of information system in sport resulted in shortage of information, which are essential in decision-making process. Additionally, balanced media coverage of different types of sport has not been achieved. Media report mainly on elite and quality sport and to a lesser extent fulfil its mission about the promotion of sport as an important factor of a healthy lifestyle. Non-governmental sports segment has warned about its reduced influence in decision-making process on public finances and the functioning of sport on a local level. In the area of taxation it has been noticed that it is not encouraging for the development of sport. All the above-mentioned arguments represent threats for the future progress and development of Slovenian sport.

A proposal of the National programme for sport of Republic of Slovenia for 2011 – 2020 and its action plan

Findings from the analysis of the previous decade represented a fundamental starting-point for planning and preparation of the proposal of the new NPS. In methodological sense, the new proposal follows the process of strategic planning, which happens after strategic analysis (see Figure 1). As such, NPS in its initial chapter includes definition of sport and the set of social roles of sport; this is followed by its mission, status (summary of analysis), vision, main goal and measures or strategies for achieving the goal.

Main mission of the NPS 2011 – 2020 is for the government to use the NPS for creation conditions for development of sport; in turn, sport to become an important factor of improvement of every individual and the entire society. National programme for sport defines public interest, which is carried out by acting parties and creators of Slovenian sport. Fulfilling of public interests will be achieved by:

1. Ensuring each individual a possibility for active participation in sport in a safe and healthy environment,
2. Providing all young people quality physical education lessons and out of school sports participation, which will enable acquisition of motor competency to the extent of sport becoming a part of their healthy lifestyle,
3. Providing everyone with interest and ability a chance to improve personal sports achievement and a possibility of public recognition of his or her importance,
4. Developing moral and ethical values of sport, respecting human dignity and safety of everyone involved in sport,
5. Creating encouraging environment for the development of all types of sports activity and for all parts of populations.

A vision,written in the proposal of the NPS 2011 – 2020 states that in the coming decade »*Sport will become more important part of culture of our nation and should become a necessary part of a healthy lifestyle and positive attitude towards life for every individual.*«

Main strategic goals, which were set in order to fulfil a vision and mission of NPS 2011 – 2020, are:

- To increase a proportion of sportingly active adult population in Slovenia by 5%,
- To increase a proportion of regularly active adult population in Slovenia by 5%,
- To increase a proportion of daily active children and youth by 20%,
- To increase a proportion of sportingly active population in expertly led programmes by 3%,
- To increase a number of athletes in competitive systems by 10%,
- To increase a number of elite athletes by 5%,
- To maintain the number of world class athletes.

Chapter »Measures« has been in the NPS proposal divided into six structures (sports programmes; sports facilities and natural facilities for sport; developmental activities in sport; functioning of sports organisations; tax benefits of sport; support for humanity in sport), consisting of 25 segments. Every segment (or structure, if it is a sole entity) includes: set strategic goals, which will support accomplishment of basic goals from NPS proposal, indicators, which can objectively measure reaching the strategic goals of the segment and measures, which should be realised in order to fulfil strategic goals of the individual segment. In addition, for each segment a proposal of action plan has been prepared, stating activities (or projects) needed to be realised for each measure, deadline and the amount of financial resources and the creators (both financial and organisational) for each activity. Chapter »Measures« is followed by chapters »Managing«, which in methodological sense represents a process of sensible organisation for efficient realisation of measures (strategies) of NPS, and »Financing«, which summarises and represents financial volume of NPS, relations between different structures in sport and time schedule for provision of public finances, needed for realisation of the NPS proposal. The proposal ends with priority tasks for the next decade.

Prepared NPS proposal for the coming period has been regarding to its contents set significantly wider than the previous National programme for sport. The significance of social roles of sport requires intertwining of sport with various social areas: health, education, business, environment, tourism, culture, finances, transportation etc. Development of sport cannot depend only on sports organisations and government as well as local bodies, which support sport. Therefore, the proposal defines the role and responsibility of individual creators for providing the conditions for development of sport in the entire social sphere. Proposal particularly emphasises solving of professional, organisational and managing tasks, which are closely related to sport. These tasks represent annual programme of sport (operational document), which will be every year financed from government and local budgets for sport and Foundation for sport. In part, where sport is intertwined with other social areas, the NPS proposal defines guidelines for appropriate placement of sport into strategies and policies of these areas and mutual work for common public good. Contents of the starting points of the NPS proposal follow the directives of the »*White book on sport*«, the European Council, European policies on different areas, which regulate sport and the international conventions from the field of sport, which have been ratified by Slovenia. It is worth mentioning two other important aspects of the NPS proposal. First, the NPS proposal defines sport as a basic right of all human beings: children, youth, adults, old age people as well as people with special needs. As such, the proposal is also intended for individuals who are residents of Slovenia and those who only reside temporarily. Second, the NPS proposal grants non-governmental part of society an important role in the field of sport and suggests that it should become an important decision-maker in the managing process of the NPS.

Instead of conclusion

A project team has prepared a proposal for the new NPS, which will have to undergo a long path of changes and amendments until it will be passed in the Slovenian Parliament. When preparing the proposal, project team members have on the basis of available data and heterogeneous knowledge as well as familiarity with various segments of sport attempted to tackle sport in its entirety. A preliminary presentation of the proposal has been completed in front of all the committees of Slovenian Olympic Committee – Association of Sport Unions, which is the highest professional organisation from non-governmental sector in sport, in front of students of the Faculty of sport, which are potential users and creators of future image of sport, and also at 14 regional symposiums across the entire Slovenia. Responses of all types of public were critical but encouraging. Nevertheless, it is important to realise that only cultured dialogue, which will be based on professionally and scientifically founded arguments will contribute to national strategy that could represent an added value to future successfulness of Slovenian sport.

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RELIABILITY AND VALIDITY OF A TEST BATTERY IN A SCHOLAR POPULATION

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Abstract

Many studies have examined the development of the motor skills during the evolutive age. So far, conditional tests have been mainly considered, while there is a lack of information about coordinative capabilities tests. The aim of this study was to assess the reliability and validity of a battery of motor tests commonly used to evaluate children and adolescent people. 478 subjects aged 11 to 14 yrs (M: 236; F: 242) performed six motor skills test: dynamic balance test on a square beam (DBT), 10-m dash sprint (DS), standing long jump (SLJ), throwing of the basketball ball to assess explosive strength of upper limbs (SBT), sit and reach flexibility test (SRC), handgrip (HG). Body height (BH) and weight (BW) were also measured. The reliability was studied with the test-retest method, calculating the Pearson's r correlation coefficient between trials of the same test, and the Cronbach's Alpha coefficient. To assess the structural validity, hierarchical cluster analysis and a factor analysis (with MCA and VARIMAX rotation) were performed with the SPSS Software. Four tests (DS, SLJ, SRC, SBT) showed a very good test-retest correlation ($r>0.90$). Good correlation was observed for the HG ($r=0.83$) and the DBT ($r=0.76$). Separate analysis were conducted on subsamples divided by gender and age (11-12 yrs and 13-14 yrs), obtaining results similar, for both the test-retest correlation and Cronbach's Alpha, to those observed in the aggregate sample. Hierarchical cluster analysis showed a first group of tests including HG, SBT together with BH and BW. The SLJ and DS tests were highly related each other and in a weaker way with the previous variables. Conversely, independence between the SRC and DBT and the other tests were observed. Factor analysis revealed three factors, explaining about 76% of the total variability. In the first factor (36% of var), anthropometric data, HG and DBT are highly saturated. In the second factor (27% var), the SLJ and DS are the most saturated variables. 13% of variability is explained by the third factor, correlated mostly to DBT and HG. The reliability of tests, assessed on a scholar population, showed good to very good levels. The structural validity analyses showed that the upper limb strength test is strictly related with BH and BW and then with the physical development of the boys. Strength tests involving a body displacement are instead less related to anthropometric characteristics. Coordinative tests as SRC and DBT are independent from both the strength tests and the physical development.

Introduction

Several authors emphasize the importance of motor evaluation in scholar populations (Barrow, 1979; Carbonaro, Madella, Manno, Merni, & Mussino, 1988; Kirkendall, Gruber, & Johnson, 1987). The EUROFIT project (Adam, Klissouras, Ravazzolo, Reson, & Tuxworth, 1988) and the project supported by the Italian Olympic Committee (Carbonaro et al., 1988) constitute two examples of test batteries carried out to evaluate the young scholars. The motor evaluation in the school have different goals as individuate the subjects with a poor motor performance and help the teachers to plan a better schedule about physical activities. Moreover, the scholastic evaluation can help the parents to select a sport that is more suitable to their sons' characteristics. Finally, the evaluation is a support for the schoolboys, teachers, the families to objectively verify the performance improvements after periods of planned physical activities. The teachers can set didactic goals based on the motor evaluation tests performed during the school year.

In the literature, conditional tests have been mainly considered (Babin, Katić, Ropac, & Bonacin, 2001; Cintas, Siegel, Furst, & Geber, 2003), while there is a lack of information about coordinative capabilities tests. Therefore, it is important to consider a test battery including also coordinative tests and flexibility assessments.

In Europe, the EUROFIT battery (Adam et al., 1988) is commonly used, whereas in Italy, besides the EUROFIT, it is also used the battery developed by Carbonaro and coworkers (1988). This battery emphasizes more the coordinative aspects. Furthermore, Carbonaro's test battery provided the national reference norms for the Italian sport population. Therefore, the reliability and validity of that battery have been analysed only on 11-14 years old subjects practising sport for at least two years.

The aim of this study was to assess the reliability and validity of a battery of motor tests commonly adapted to be used into a scholar context.

Methods

478 subjects aged 11 to 14 years (M:236; F:242) participated to the study. Their mean and SD weight and height are reported in table 1, in which the subjects are divide by age classes.

Table 1: Anthropometric characteristics of the subjects

		HEIGTH (cm)			WEIGTH (kg)	
GENDER	AGE	AVERAGE	S.D.	N	AVERAGE	S.D.
MALE	11-12	152.8	7.5	112	46.0	10.3
	13-14	160.6	8.6	124	52.0	9.6
FEMALE	11-12	153.5	6.6	127	44.7	8.7
	13-14	158.4	5.2	115	50.0	8.2

All the subjects performed a battery of six motor skills test:

1. Hand-grip (HG) for static strength: a calibrated hand dynamometer with adjustable grip (Takei scientific instruments) was used (Adam et al., 1988).
2. Basketball throw (SBT) for explosive strength of upper limbs: subjects had to throw a basketball ball as far as possible, from a sitting position on the floor and with two hands from the chest (cm.) (Carbonaro et al., 1988).
3. Standing long jump (SLJ) to assess explosive strength of lower limbs: the subjects attempted to jump as far as possible, with swinging of the arms and bending of the knees to provide forward drive, landing on both feet without falling backwards. A two foot take-off and landing jump was used and the longest distance jumped was recorded (cm.) (Adam et al., 1988).
4. 10-m dash run (DS): subjects run 10 meters at the maximum speed, after 15m used for the acceleration, and this time (accuracy: 1/100 seconds) was recorded with photocell survey (Capizzi, Dala, Facondini, Grandi, & Merni, 1979).
5. Dynamic balance test (DBT): participants had to walk backward on a square beam (side length: 70 cm; thickness: 4 cm; height 10 cm.) with two stance for each side. The trial finished when the subject returned to the start side. Starting with one foot on the beam, time (accuracy: 1/100 seconds) was recorded from the second foot take-off from the ground, and stopped at its foot-strike on the fifth side. A clockwise and counter-clockwise trial was performed (Carbonaro et al., 1988).
6. Sit & Reach (SR) for flexibility: participants sat on the ground with straight legs and had to reach forward as far as possible. A standard reach box was used, measurements in cm. (Adam et al., 1988).

All the tests were carried at school, during the physical education classes. The test battery was completed in two sessions of one hour each. In each session, the tests were preceded by a 10-min standardized warm-up. After the warm-up, the participants were divided into groups with four to six members. Each group was tested by one or two operators.

The same testing equipe, constituted by physical education teachers and researchers of the Faculty of Exercise Science of Bologna University, was involved in all the experimental sessions.

All the statistical analyses were performed with the Software SPSS 15.0. The reliability was studied with the test-retest method, calculating the Pearson's r correlation coefficient between trials of the same test (Kirkendall et al., 1987, Baumgartner, 1989). Furthermore, the Cronbach's Alpha coefficient was also computed. For some of the tests (SLJ, SBT) three trials were available and were considered for the reliability assessment, whereas for other tests (HG, DS, DBT) the reliability was evaluated using two trials. The SRC test was considered only for the validity analysis. To assess the structural validity, hierarchical cluster analysis and a factor analysis (with MCA and VARIMAX rotation) were performed. For the factor analysis, the composition of factors was verified separately for the age-classes and genders. Furthermore, an analysis of the proportion of explained variance by each factor carried out in the different genders and age classes.

Results

Table 2 shows the reliability coefficients, namely the Pearson's r coefficients obtained with the test-retest method. In the first raw (Total), data relative to the whole sample are reported. Conversely, in the following raws, the reported coefficients are those obtained by dividing the sample by genders and age classes. Considering the entire sample, high ($r > 0.8$) to excellent ($r > 0.9$) reliability was detected. Only the DBT showed lower values of the correlation coefficient, that were however higher than 0.75.

Considering the genders, the males at 13-14 years showed a lesser reliability in the DBT test ($r > 0.65$). Also the females in that age class showed a 0.7 correlation coefficient, in the HG test. Generally, the females showed a lower reliability compared to males in the HG test.

Table 2: Pearson's r correlation coefficients for the different considered tests

	HG	SLJ1-2	SLJ2-3	SLJ1-3	SBT1-2	SBT2-3	SBT1-3	DBT	DS
TOTAL	0.832	0.924	0.941	0.910	0.940	0.948	0.937	0.759	0.931
FEMALE	0.787	0.914	0.938	0.895	0.903	0.913	0.898	0.785	0.929
MALE	0.852	0.921	0.932	0.910	0.943	0.953	0.941	0.709	0.930
M11-12	0.741	0.885	0.893	0.912	0.946	0.925	0.932	0.734	0.914
M13-14	0.862	0.930	0.908	0.935	0.928	0.934	0.951	0.656	0.936
F11-12	0.758	0.879	0.858	0.927	0.907	0.892	0.912	0.803	0.926
F13-14	0.696	0.933	0.915	0.941	0.860	0.872	0.886	0.757	0.930

Table 3 displays the reliability coefficients computed as Cronbach's Alpha. This index confirms the elevated reliability of SLJ, SBT, and DS tests, already found with the Pearson's R. The HG resulted highly reliable for males, whereas its reliability was lower for females. The DBT showed a good reliability, however lesser than in other tests, especially 13-14 years old males.

Table 3: Cronbach's Alpha coefficients for the different considered tests

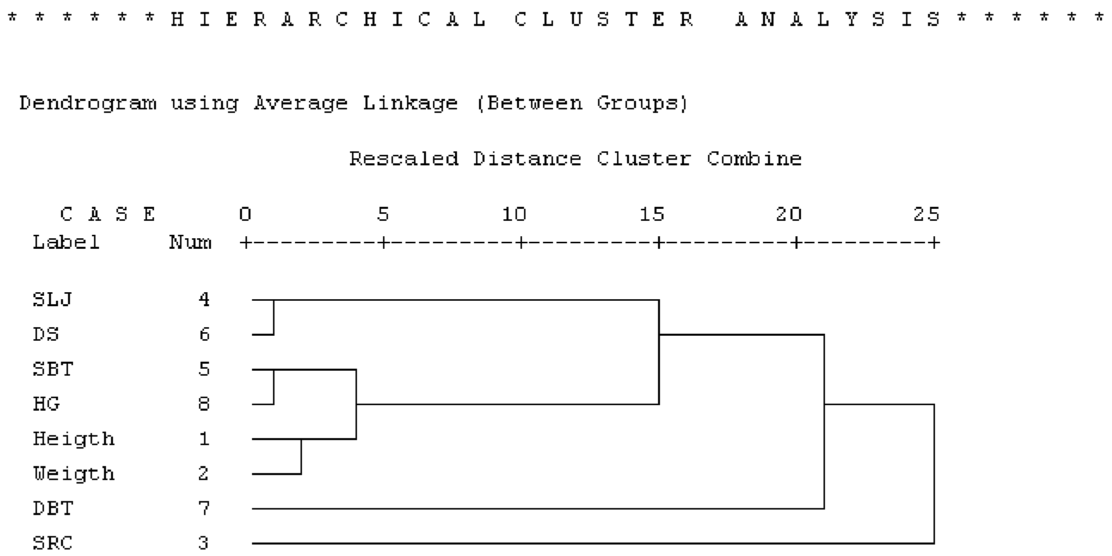
	HG	SLJ	SBT	DBT	DS
TOTAL	0.908	0.974	0.980	0.832	0.964
M11-12	0.849	0.963	0.977	0.847	0.953

M13-14	0.926	0.973	0.978	0.771	0.962
F11-12	0.862	0.959	0.965	0.887	0.961
F13-14	0.821	0.975	0.953	0.859	0.964

To study the structural validity of the test battery, two methods were used. The first one, more synthetic than the other, consisted in a hierarchical cluster analysis. The second method used a factor analysis.

In the hierarchical cluster analysis, the dendrogram was analysed, considering six tests and two anthropometric indices, in order to highlight which tests are the most related to the physical development, indicated with the body height and body weight. The dendrogram (Fig. 1) shows that the SLJ and DS are very linked each to the other. A similar connection can be observed for SBT and HG. These two tests are the most related with anthropometric parameters. The balance and flexibility tests are fairly different from the others.

Figure 1: Cluster analysis dendrogram, including all the test of the battery, body height and weight



The factor analyses performed on the entire sample, or on the different genders and age classes, show the same solutions, with three factors that are correlated to the same variables.

The first factor is saturated mainly with anthropometric indices, but also the HG and SBT tests are always highly related with it. The second factor is saturated mainly with DS and the SLJ. In some age classes, the SBT is saturated also with the second factor, although the correlation is less marked. The third is always highly saturated with the SRC test. In the two age classes, for males, the balance test is saturated also with the third factor. Conversely, in the analysis of the whole sample, and in females, the DBT test is saturated with both the second and the third factor. The percentage variance explained by the three factors is always higher than 70%. In the males of 13-14 years, the factors explain 80% of the total variance. The first factor explains, in the different considered analyses, 29 to 35% of total variability. The second factor explains 23 to 28% of the variance, whereas the third factor explains 13 to 17%.

Figure 2: Percentage of explained variance in the different factor analyses.

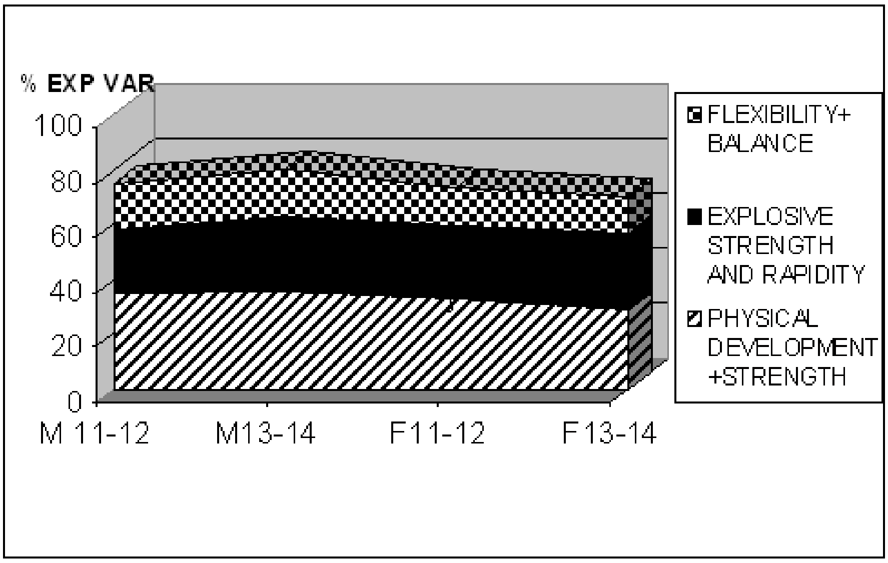


Figure 2 shows the trend of percentages of explained variance in the four analysed subgroups. It can be noted that in the 13-14 years age class, for males, there is the highest percentage of explained variance. Conversely, the females shows, compared to males, a lower percentage of explained variance in the third factor as the DBT is saturated also in the second factor. This factor, in females, shows a higher percentage of explained variance.

Discussion and conclusions

The two methods used to assess the reliability showed high to excellent reliability for the present battery of tests. The balance test used is that with the lower reliability, according to Carbonaro et al. (1988). A dynamic balance test was selected by Carbonaro et al. (1988) as it showed a better reliability compared to static tests proposed by Fleishman (1965), and Adam et al. (1988). To improve the reliability of a test, more trials can be performed. However, the balance test needs more time than other tests to be performed and so it is not suitable for assessment carried out in a scholar environment, where the time devoted to evaluation is limited. Eventually, a third trial can be performed only if the results of the first trials differ markedly. This test has not been carried out in the gym but in a quiet room, because the gym's noise can affect the variability of the performance. The lower reliability observed in the female group for the handgrip test can be explained with lack of self-confidence in maximum strength expressions. Also in this case, more trials could be used.

The validity assessment highlighted that the physical development (assessed through the body height and weight) is related mainly to maximum isometric strength tests and throwing performances. The explosive strength test (standing long jump) and rapid strength test (sprint) showed lower relationships with the physical development. This results are in agreement with those of Carbonaro et al. (1988), relative to a sport population of the same age range. In fact, those authors, in a factor analyses, found a composition of the first two factors and a percentage of variance explained that is very similar to that observed here. This factors are almost constant also analyzing separately different sports and different training volume classes (Carbonaro, Merni, & Madella, 2001).

The factor and cluster analyses confirmed that the flexibility and balance are abilities very different from strength and rapidity, but they constitute an important portion of the explained variability of the considered test battery. The different behavior of males and females concerning the balance can be explained considering the quick growth phase characterizing the males between 13 and 14 years that could create more evident problems in those subjects growing more rapidly.

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DRUG-TAKING AND SPORT ACTIVITIES AMONG 14 YEAR SCHOOL PUPILS IN SLOVENIA

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Abstract

Sport activities represent an important factor in preventing drug-taking. Most people begin taking drugs in their youth and become addicted easily. Therefore, it is important to offer young people a number of various healthy activities, among which sports activities undoubtedly belong to as well. The aim of this research was to establish whether there is a correlation between sport activity and drug-taking among 14-year-old pupils in Slovenia.We used a questionnaire of 38 variables on sport activities and drugs. The probability relations among the variables have been tested by the Hi-square.We have ascertained that there is some statistically significant correlation between sport activities and taking licit and illicit drugs. A statistically characteristic correlation has been occurred with drinking alcohol with male pupils and inhaling vapours with female pupils. We also observed significant correlation between organized sport as the type of sport and drug use.Our results indicated differences in alcohol use between participants who participate in organized sports.

Introduction

Undoubtedly, sport activities represent an important factor in preventing drug-taking. Most people begin taking drugs in their youth and become addicted easily. Therefore, it is important to offer young people a number of various healthy activities, among which sports activities undoubtedly belong to as well (Shapiro, 1994). Appropriate sport activities can most efficiently restrain drug-taking attempts, where on the other hand, wandering and strolling around with friends can only accelerate the progress of this bad habit. A healthy life style represents a very important aspect in education, which begins at home and continues in a kindergarten and school and finally extends in a form of self-education (Barnes, Hoffman, Welte, Farrell & Dintcheff, 2007). The problem of drug-taking among young people should not be solved as a sole problem, but rather in the scope of caring for young people in general.

Wichstrøm study provides a valuable contribution to the understanding of the drug-sport link. They focused their longitudinal analysis on organised sports, taking into account the parameters listed above, and adding two further parameters. First, the timing of the drug-sport link: for example, alcohol intoxication and sports participation were negatively correlated at baseline, but sports participation at baseline was positively correlated with alcohol intoxication measured seven years later. Secondly, the drug-sport link can mediate gateway effects: for example, initial sports participation reduced later tobacco use via lower levels of cannabis initiation (Wichstrøm & Wichstrøm, 2009). Of course, further research is needed to better understand the timing of the drug-sport relationship and the gateway effects favoured or impeded by sports participation. Socialisation into sport may teach adolescents to use various kinds of substances to cope with everyday life. For example, in a sample of university sport students 36% had used cannabis to enhance academic performance (Lorente, Peretti-Watel, & Grelot, 2005). Sporting activity and drug use may be impelled by similar motives or values. Both activities may reveal similar impulses for sensation-seeking, the search for a thrill, vertigo or 'flow' (Edgework, 1990). This hypothesis is especially relevant to the relationship between sliding sports practice and alcohol and cannabis use (Cherpitel, Meyers, & Perrine, 1998; Peretti-Watel, Guagliardo, Verger, Pruvost, Mignon & Obadia, 2003). Outings and other peer-oriented activities were strongly correlated with cannabis use. Occasional use was more common among respondents who participated in many different outdoor activities. Regular use was associated with a more selective lifestyle, focusing on music-oriented outgoings and time spent at a friend's home in the evening (Peretti-Watel, Guagliardo, Verger, Pruvost, Mignon & Obadia, 2004).

The purpose of the present study was to find whether there is a correlation between sport activity and drug-taking among 14-year-old pupils in Slovenia.

Methods

Sample of subjects

The sample of subjects studied here includes 14-year-old pupils – 326 male and 354 female pupils. The study includes pupils from 9 different primary schools in Slovenia.

Sample of variables

This research is based on a self-constructed questionnaire of 38 questions on sport and drugs, adapted for 14-year-old pupils. The questionnaire includes questions about socio-demographic information, sport activities, type of sport activity, frequency of participation in sport activities, legal drug use, illegal drug use, relationship with parents, etc.

Procedures

Data has been processed by the SPSS software (Statistical Package for the Social Sciences. The probability relations among the variables have been tested by the Hi-square at a significance level less than 5 % (P=0.05).

Results

This research indicates that most male pupils (37.4%) spend their spare time practicing sport or meeting friends. A little over one half of female pupils in the first place spends their spare time meeting friends and in the second place practices sport.

5.3% male and 12.6% female students smoke. A little over one half of the pupils questioned never tried smoking. The majority of male pupils had their first cigarette at the age of 13, female at the age of 12. The majority of those who smoke, smoke on special occasions only and the time they smoke range from 1 to 6 months to two and more years. With a little less than one half, some of their friends smoke.

There is a little over one half of the questioned children's parents who do not smoke and 12.3% where both parents smoke.

The results of this research show that 98,4% male and 94,5% female 14-year-old pupils tried alcohol. They mostly drink alcohol once a month or less frequently and first tried it between the age of 10 and 13. The main reason they have first tried alcohol is curiosity and it is the children's parents who offered alcohol to majority of pupils questioned. The majority of questioned pupils state they can have fun without alcohol.

18.6% male and 26.3% female pupils tried drugs. The prevailing types of drug-taking are vapor inhaling, pills (e.g. sedatives) and cannabis (marijuana, hashish). The majority of pupils tried drugs at the age of 13. Those who have tried drugs, say they first tried it for the same reason as cigarettes and alcohol – curiosity. The majority of pupils say they are familiar how drugs are harmful.

The answer to the question »What is in your opinion the most important reason young people start taking drugs?« almost one half answered it was the curiosity. The second most frequent answer was a desire to be accepted or approved by the coevals. The other answers were curiosity and attempt to overcome emotional distress, depression, and anxiety.

Half of the pupils questioned are of the opinion that sport activities are those that would turn young people away from taking drugs next would be the promotion of parties with no drugs and alcohol.

We have ascertained that is no statistically significant correlation between sport activities and taking licit and illicit drugs. However, a statistically characteristic correlation has been ascertained between sport activities and attempts to drink beer and wine with male pupils, and inhaling vapours with female pupils. All the questions were related to attempts and not regular usage of licit and illicit drugs.

Discussion

Adolescence is the time when children push their parents away while their friends are becoming more and more important. Despite that, it is encouraging that so many young people devote their spare time to sport. In our study we find sport involvement to be associated with less alcohol use among male pupils and less inhaling vapors among female pupils. These findings are inconsistent with a research made by Sallis and colleagues, where no consistent association between physical activity and alcohol consumption exists (Sallis, Prochaska, & Taylor, 2000). Results of our study were also inconsistent with work that reported that physical activity and excessive alcohol use were unrelated (Schuit, van Loon, Tijhuis, & Ocke, 2002), work by Kueffer and colleagues (2005) that indicated that athletes had significantly higher rates of alcohol use that non athletes and with work by Miller and colleagues (2003), which reported increased levels of alcohol use and binge drinking among male athletes when compared with nonathletes.

In our study, although the correlations between type of sport and drug use are significant. Our results indicated differences in alcohol use between participants who participate in organized sports. This finding is consistent with some studies that found substantially less alcohol use among youth who participated in organized sports (Ferron, Narring, & Cauderay Michaud, 1999; Hellandsjo Bu, Watten, Foxcroft, Ingebrigtsen & Relling, 2002).

We used the questionnaire focused on 14-year-old pupils who still visit the primary school. According to their age, quite a large number of primary school pupils smoke drink alcohol or takes drugs. The number will probably increase when these children get to a secondary school. In order to move into a positive direction, we need to be more active within the families, schools and local communities. Parents are those who raise their children from the start and pass their behavior patterns on to them. Whether parents smoke or not, does not however influence the frequency of male and female pupils sport activity. The majority is of the opinion that sport and smoking do not go together The primary reason why children start smoking is curiosity. Children want to know how a person feels when smoking. At the same time, they want to be liked, or do not want to be an exception among others. The coeval pressure is high in this period and it can influence the »smoking« habits of adolescents. With over one half of male and female pupils, none of their friends they spend time with smoke.

If parents are sport active and have their children involved in sports as well, children will accept sport as part of their everyday life and spare time. Parents are also responsible to openly talk to and inform children about the drug-taking problem. Permissive attitude towards smoking and alcohol in a family, where in addition some of the parents smoke and drink too much alcohol, more likely causes children to start smoking or take any other drugs. Experts recommend parents to start talking about smoking, drinking alcohol and taking drugs to their children when they are 5 or 6 years old, since many children have their first cigarette and an alcohol drink very early. By then, they should be appropriately familiarized with drugs being unacceptable and harmful. Parents should tell their children how to turn down a cigarette and alcohol if offered and yet remain a “hero” (Stergar, 2004). They should talk about commercials, publicity, the “true” messages, and wrong beliefs about drugs among young people (relaxation, body weight control, less harmful light cigarettes, mature appearance, better digestion…). Their educational attempts will certainly be more successful if their behavior will support what they are saying (Ivelja, 2004).

Fight against drugs continues and is seeking new methods that would enable a more healthy way of life among young people. Schools are nowadays participating in various projects with which young people are being motivated to promote sport and not drugs.

Joining in this fight are also medical and other institutions pertaining to preventive and curative treatments. PE teachers should get involved more as well. In cooperation with parents, they could well use sport to restrain drug-taking and build upon a relationship towards sport activities. We are of the opinion that young people will be turned away from smoking by means of planning a qualitative way of life. People who are adequately occupied most likely fulfill their needs by taking part in appropriate activities and this way does not feel the need for any kind of substitutes.

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STUDENTS CAMPS AS MODEL OF EDUCATION OF HEALTHY LIFESTYLE

Dušan Mitić, Aleksandar Ivanovski & Goran Prebeg

Abstract

Most of the time is dedicating to studies, exploring the literature, researches and exams. Preoccupation with the education and some exam obligations are not leaving a lot of time for students to do some sports recreational activities which can reduce stress, enlarge good mood and expand working capacity. Main goal of student's camps is to promote healthy way of living where physical activity has dominant role. Attendance of the camps will be filled with large numbers of sports recreational programs in which students will have opportunity to overview their abilities and easer decide their real activity in their lives afterwards. Beside, the program has the role to make better communication, to increase religious and national tolerance, to increase humanity towards disabled, weak and old people. Educational and creative workshops are the basic ways of implementing day and evening programs. A concept of student's camps is shown in scheme 1, and is based to focus the energy of students in direction of active participation of creating and designing all programs with help of fully trained animators and instructors. Public evidence and active participation in creating a program are movers of activities and method to direct the energy of participants. Main target is that with expand number of activities we do the repositioning and stabilization of physical activities in one systematic regular exercising and to raise physical and mental abilities. Through health care and education they will get basic information about nutrition, first aid, different diseases addiction (drug, alcohol...). Project is based on cooperation of Ministry of education, youth and sport, and health, as government representative and Sports for All associations, Student parliament as non government representative. Faculty of sport and physical education and Association of experts in recreation, Student polyclinic with help of tourist agency would take care of direct realization of the project.

Introduction

Most of the time is dedicating to studies, exploring the literature, researches and exams. Preoccupation with the education and some exam obligations are not leaving a lot of time for students to do some sports recreational activities which can reduce stress, enlarge good mood and expand working capacity.

Main goal of student's camps is to promote healthy way of living where physical activity has dominant role. Attendance of the camps will be filled with large numbers of sports recreational programs in which students will have opportunity to overview their abilities and easer decide their real activity in their lives afterwards. Beside, the program has the role to make better communication, to increase religious and national tolerance, to increase humanity towards disabled, weak and old people. Educational and creative workshops are the basic ways of implementing day and evening programs. A concept of student's camps is shown in scheme 1, and is based to focus the energy of students in direction of active participation of creating and designing all programs with help of fully trained animators and instructors. Public evidence and active participation in creating a program are movers of activities and method to direct the energy of participants. Main target is that with expand number of activities we do the repositioning and stabilization of physical activities in one systematic regular exercising and to raise physical and mental abilities. Through health care and education they will get basic information about nutrition, first aid, different diseases addiction (drug, alcohol...). Project is based on cooperation of Ministry of education, youth and sport, and health, as government representative and Sports for All associations, Student parliament as non government representative. Faculty of sport and physical education and Association of experts in recreation, Student polyclinic with help of tourist agency would take care of direct realization of the project.

Period of leaving during the studies is always bringing some specific things in our lives. Biologically this is the period where ends the development of one person. Psychologically this is the period of young adolescents who are still searching the personal identity and place in the society. Their interests for travelling, humour and sports recreational activities (Pantic, 1981) are exposed and represents the generator of their behaviour. The same time students are studying professions that have chosen. Expectations from parents and surrounding are always present. Studies, lectures, exams and preparations for exams are different from previous way of education. There is no pressure of constant questioning, but exams are present and they must be prepared. Instead of simple reading a book, now they have to make research and use adequate methodology of learning. Lectures are not obligatory but the evidence of participations at the classes exists. Same time exercises are obligatory and each individual has possibility to choose which activities will take and what to do with his free time. The freedom of choice can create the conditions for person to develop himself or get in the trap of hedonism, enjoying and parties. Students are less taking physical activities. Preoccupation with the education and some exam obligations are not leaving a lot of time for students to do some sports recreational activities which can reduce stress, enlarge good mood and expand working capacity. Sport has chosen the most talented, students from the other hand the state has cut physical education in schools from 1998.

The project STUDENTS CAMPS AS A MODEL OF EDUCATIOIN OF HEALTHY LIFESTYLE has for the main goal to gathered large number of students during the summer and winter holiday. It has been planned for camps to last 7 days each. Camps are not created for young sportiest, either to sport professionals, but they can take part too. It is important to mention that is planed large numbers of recreational activities and modification of sports events but with rules that motivate students for participation. Participation is very important thing comparing to sports events where wining is the most important fact. Friendship and creative doing are dominant things together with different activities are ways to learn new things and get nice habits. Comparing to University sports games which gathered the best sportiest of the world at University level, STUDENTS CAMPS AS A MODEL OF EDUCATIOIN OF HEALTHY LIFESTYLE are created for all the students that have desire and energy to meet their generations and build healthy way of living.

Previous expirience

Model of sports recreational competitions (SPRET) in primary schools as theoretical possibility was promoted at congress at Avala 1994 (Mitic, 1994). The congress was organized by Association for sports recreation of Yugoslavia. At FISCOMMUNICATIONS 1995, in Nis this program was analyzed from the point of better communication between the classes in school that were involved in the program. Modification of this version was published "Nastava i Obrazovanje"no. 1, 1997, pg.68-79. At international scientific congress, December 1997, in Novi Sad, were exposed experiences of this program (SPRET) in primary school "ALEKSA ŠANTIĆ" from Kaluđerica.

The idea of such modelling of sports recreational competitions of students was years of experience of authors and several generations of students who were doing the program with students of high schools under the command of Professor Živanović.

The necessity of movement in process of searching personal place and personality with the students, is the base for the concept of participations in activities where we get the points in imaginary system of competitions.

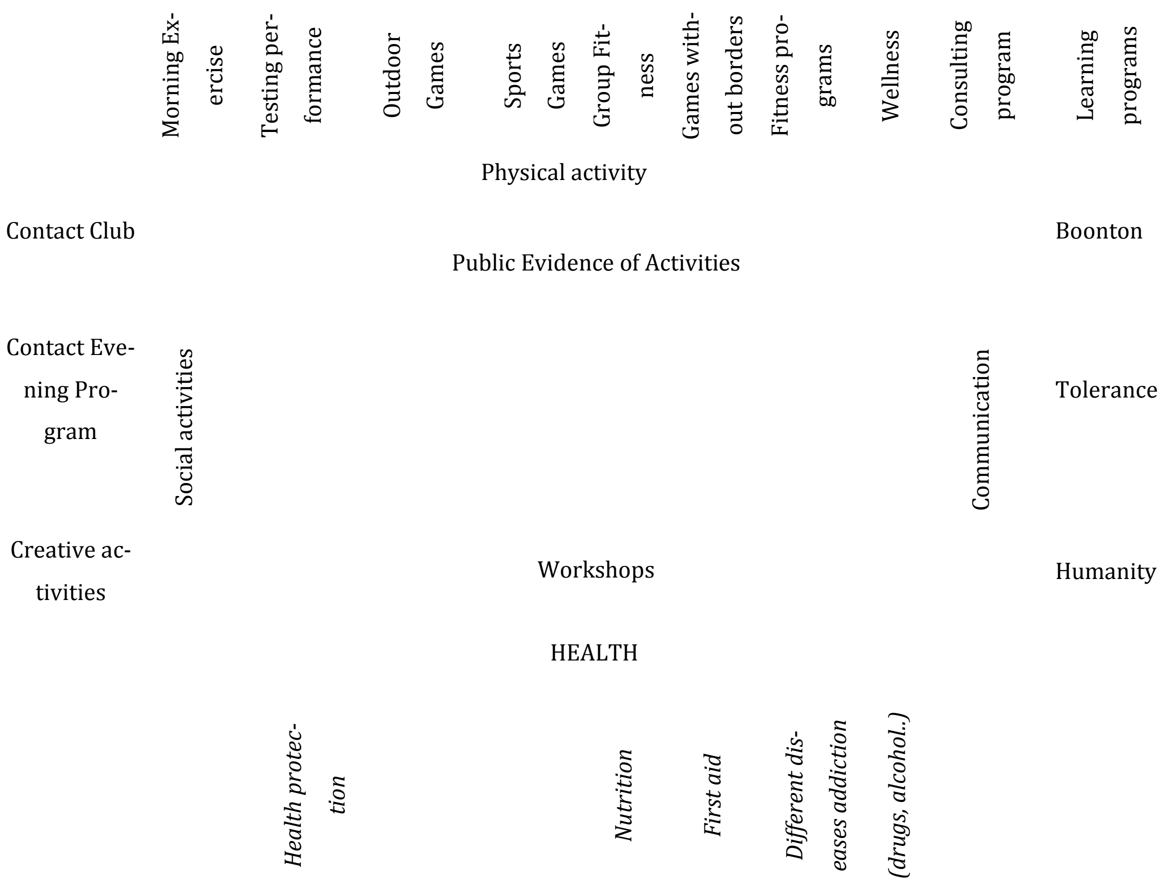
The next check of the model of public evidence was successfully done on ten winter festivals of recreation for children. Association Sport for all Belgrade established this manifestation for the children age 10 to 14. State system has taken only 15 % children talented for sports, so the rest of them joined the recreation festivals. Festival was created as group competition (each team 10 persons), where each individual had personal public evidence. Festival is based on participation in offered activities where each activity brings points for individual and group score. Every participant that gets over 50% points wins the diploma “master of snow hills”, if person gets over 75% points at festival wins diploma a „snow AS”, and if the person gets 100% points diploma is called “champion 100%”. Groups can be organized from school, municipality, different organizations, best students, employee’s children, humanitarian organizations and etc.

Seminar for training animators that is obligatory for the students from department of recreation at Faculty of sport and physical education in Belgrade is polygon for more than 30 years where we do testing and valorisation of sports recreational programs, different social games and contact evening programs. The positive answer of students has encouraged us to develop the concept in direction of general student population.

Concept

Main goal of student’s camps is to promote healthy way of living where physical activity has dominant role. Attendance of the camps will be filled with large numbers of sports recreational programs in which students will have opportunity to overview their abilities and easer decide their real activity in their lives afterwards.

Scheme 1: students camps of healthy lifestyle in Serbia



A concept of student’s camps is shown in scheme 1. Educational and creative workshops are the basic ways of implementing day and evening programs. A concept of student’s camps is based to focus the energy of students in direction of active participation of creating and designing all programs with help of fully trained animators and instructors. Public evidence and active participation in creating a program are movers of activities and method to direct the energy of participants. Each individual creative contribution represents one part of chain in building of communications inside small groups and developing positive atmosphere. Individual contribution to the program influences the growth of a feeling of self confidence. This is the way of developing feeling of group functioning, creates feeling of connection with the group, program and place. On the basis of large number of participants in creation of programs, the impression is that the program belongs to them which is not far away from the truth. The successful way of leading such a group can be seen only if the group has the feeling of creativity and can't be seen that someone more experienced is helping. The direction of energy of participation is based on total system of public evidence and they open new possibilities that provoke students and motivate them for team work. The program has the role to make better communication, to increase religious and national tolerance, to increase humanity towards disabled, weak and old people. The other segment expected effects of the program ishigher sense of care about healthy life. They are based on more knowledge about nutrition, protection at work, dangerous sickness of today's life as aids and etc.

Training

It is planed that the realization of camps is done by the students who already have previous experiences and have passed similar camps with younger or older people. At audition will be selected the best and they will have special training. Program of training is adequate for developing skills and abilities necessary for this project. After the training the selection will be made for the ones who will be working at camps. The most of them will be instructors and animators for all kind workshops and activities. The next phase is international camps, so trained persons will have to know foreign languages. From all candidates a high level of psycho-physical preparationsis expected, so they can move and keep others with positive energy. The concept of animators training is based on the scheme and experience of Belgrade school for animators (www.bsa.dif.bg.ac.rs) that works successfully since 2002.

Realization

It is planned for the camps to last during winter and summer holidays. Program of camps depends from the space and technical conditions of specific destination. Program can be modified concerning specific places as the sea, lake, pool, sports fields, ski tracks etc. The most important thing is that location of object is dislocated from crowded places so the group can have certain discretion. Beside the sports fields mentioned, it is necessary to have classrooms for the social activities and logistic equipment as microphone, computers, projector etc. This all is necessary because of public evidence, handbook, flayers etc.

Program

When we speak about physical activities, every day start with morning exercise, which has for main target to wake up the body, and create a health habit of regular morning exercising.

Afterwards starts activities on the open place such as "orientation as fun game", "treasure hunting", "excuse me please" etc. School of alpine and Nordic skiing, games at snow, ice skating, make the day activities. Camp is opportunity to try some new activities and get new experience in motor movement so they can easily to continue with some of them back home. Testing the student's physical conditions with the battery of Eurofit tests represents base for their health monitoring and recommendation about their fitness in future.

All physical activities in combination with contact club, evening programs, educational and creative workshops lead toward the successful camp. Each person posses some creativity, at the camp everyone has own chance to show it and will be encourage for that. At the camp will be functioning workshops about communication and health. It will be shown how to behave (basic bon ton), how to communicate to everyone (disabled people, different religions, nationalities, and race ...), how to expand our views, and when we think about health, new diseases, how to cope with diseases of our nearest people, how to give first aid, how to avoid negative trends (alcohol, drugs…). Education will finish with workshop about the nutrition.

Social games and activities are in function of improving communication. Contact club games give possibility for creative contribution of individuals and open space for group working and team building. Evening contact programs are new challenge and opportunity to participate in creation of good evening and depend from individual participations. It is a rule that we always remember event where we took active place. The quantities of direct involvements as result give the feeling of connection to group and program and enlarge the pleasure of attendance.

Partners

Project is based on cooperation of Ministry of education, youth and sport, and health, as government representative and Sports for All associations, Student parliament as non government representative. Faculty of sport and physical education and Association of experts in recreation, Student polyclinic with help of tourist agency would take care of direct realization of the project.

Conclusion

STUDENTS CAMPS AS A MODEL OF EDUCATIOIN OF HEALTHY LIFESTYLE, event that promotes healthy way of living and gathers people of active way of living towards themselves and surrounding. When we are talking about exercises and health, at first place we put keeping the present situation with our good health and wish to prolong the „youth“ as synonym of good functioning organism and life`s joy.

We need to give quality to life. Not to use artificial ways of prolonging life when we start losing control.

Camp is opportunity to make control of psycho-physical status. From the camp we can’t expect a large fitness improvement but it is opportunity to check present health status through battery of tests. Also to accumulate positive energy that is made, when on the one place you have people with the same ideas. Camp is supposed to be place to promote new accomplishments, new ways of working out, actual technical innovations, new contacts and personal experience.

Through the lectures, workshops, discussions, exchange of opinion and ideas, each individual is becoming more reach. The size of one nation, when we are talking about recreation, we do not measure by the medals won in competitions, but with a number of participants in recreational activities. It always depends from the level of education for the same activities. Education is based on tradition of society, family, personal experience, and educational system, propaganda that makes organization because of society need. Main target is that with expand number of activities we do the repositioning and stabilization of physical activities in one systematic regular exercising and to raise physical and mental abilities.

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PHYSICAL EXERCISE MOTIVATION DETERMINANTS OF FEMALE STUDENTS AT THE UNIVERSITY EDUCONS

Milan Nešić, Franja Fratrić & Dragan Ilić

Abstract

The desire of most people today is directed towards health, vitality, quality and long life. Results of some studies show that people who exercise regularly, with properly organized and individual physical activity, are less prone to various kinds of diseases of today, primarily cardiovascular and psychosomatic. Physical activity and sport, in the process of educating the youth should be an important factor in building, maintaining and improving the bio-psycho-social components of the student population.Noting the relevant issues for further functioning and development of university sport in Serbia, where special attention is drawn towards determinism in creating conditions for meeting the needs and interests of students for physical activity and health promotion, has been identified the need for establishing the basic parameters for the proper organization and direction of university sport. In this context, it highlights the position of the female student population for who are linked very negative indicators of their involvement in physical and sports activities, both at the University and in everyday life. Empirical research conducted at the University EDUCONS was aimed at determination of motivational drivers of studentsfor inclusion in the potential programs of physical exercise at the University. In a sample of 170 students, using a modified Campbell motivation questionnaire (Campbell et al, 2001) was detected the structure of motivation for physical training at the University, through the nine motives, in the manifest and latent space.

Introduction

Consideration of various aspects of modern tendencies in sport cannot be viewed comprehensively, if we do not pay attention to the most important achievements of the ancient Greek philosophical mind. They are very important for stressing the desire to preserve the Olympic spirit in sport and to prevent deformation of its original principles, among which one should mention the following: fostering authentic features games, establishing harmony of body and spirit, as well as the preservation of aesthetic and moral principles in sport. Thus, even today, in the modern phrase "university sport" is established the old Platonic idea of “kalokagathia”, which indicates the need for establishing a balanced and harmonious unity of man's physical and mental abilities.

However, in practice it eventually gave way to create ideology of sport and sport events, where dominates a preponderance of politics, show business, profit factors, entertainment, etc. (Radoš, Nešić, 2010).

In new era, in which another life values came to the scene, our universities must stay those areas where the most important factors in the formation of a complete humanperson are: acquiring scientific knowledge, aesthetic, moral and cultural values, given the relevant care and physical exercise and sports. The phrase "university sports" but, by itself, indicates (in the ontological and axiological sense) the need to foster the harmonious unity between man's physical and mental abilities.

In this context, observed topic is focused on the academic area of Serbia, which (under the auspices of the former state of Yugoslavia) was one of the most developed areas of higher education and identified by activity and value of university sport. However, since the year 1998 and then passing the Law on Universities, sports activities among the student population almost died down. Few sports sections and associations, whose work was not interrupted, were more an expression of the individual efforts of activist-enthusiasts, but designed and purposeful part of the system of higher education. Because of this insistence on the creation of an evaluative “kalokagathia” spirit and revitalization of university sport, is an important need of our time, as important dimensions in building a versatile individual and humanistic social relations (friendship, cooperation, fair play, perseverance, integrity). After all, International University Sports Federation (FISU) builds its philosophy on that statement as well.

Research background

National Strategy for sport development in the Republic of Serbia as a priority strategic objective has defined: ''.... strengthening school and university sport and the establishment of functional system of a school and university sports competitions''. However, there is still no clear and time-determined conception of the development of sports fields, which results in spontaneous and chaotic existence of some form of sport at the university. The current success of university sport competitions are more a result of other sports organizations, rather than organized sports life within any university. Students, among others, do not have facilities for practice and competition at universities, clearly and professionally formatted system of sporting activities appropriate to their interests and needs (Nešić, 2003), and in particular the issue of inability to use public sports facilitiesin their community. The above facts are the occasion for stains and needs to recognize the importance of optimal strategy for the development of university sport, both in the Republic of Serbia and the region of Vojvodina, as well as on individual universities as basic ''micro" units where students physical exercise should exhibit certain characteristics (Fratrić & Ilić, 2010).

Noting the relevant issues of further functioning and development of university sport, where special attention should be directed towards creating conditions for meeting the needs and interests of the student population for physical activity and health promotion, it is necessary to establish basic parameters for its proper organization and direction. In this context it is necessary it is important to emphasize the position of female student population, for who are linked very negative indicators of their involvement in physical and sportsactivities.

Determination of their motivational determinants (Mitić, 1992) for inclusion in programs of physical exercise, both at university and in leisure time (Campbell & Willis, 1992) as a first step in defining possible directions for improving the social and personal position in this part of the student population.

Methods

Research that was conducted in an extensive research project at the University EDUCONS as transverse study, using Survey method, was aimed, inter alia, at the detection of female students' motivation dispositions for involvement in physical exercise activities at the University.

The subject sample consisted of 170 female students from the University EDUCONS from Sremska Kamenica, and as a research instrument was used Campbell motivation questionnaire (Campbell et al., 2001), which was modified for this purpose and adapted to the needs and goals of the research. Original questionnaire, which includes 13 motifs for the exercise, this time, is condensed to a total of 9 social motives that are most commonly used as drivers for engaging in physical activity.

Respondents were asked ''How important would be for you during sport activities at the University... '': 1) Maintaining or improving health, 2) Socializing and meeting new friends, 3) Good look, 4) Relaxing and forgetting the everyday worries, 5) Entertainment and leisure, 6) Reduction in body weight, 7) A sense of alertness and mood, 8) Being in fashion; to improve in front the others, and 9) To improve in front of yourself. Responses were given on a five-point 'Likert-type' scale, where the value 1 (one) expressed the importance of the lowest motives, and the value of 5 (five) is determined by the highest level of significance of each motif.

Results were analyzed using descriptive and of comparative statistics. Manifest area of motivation is dealt with scaling technology, while the latent space of motivation was detected using statistical procedures - factor analysis.

Results and discussion

Of the nine monitored motives for involvement of female students in activities of physical training at the University highest positioned in the value system of respondents was the motive marked as improvement (maintenance) of health, what confirms the results of the vast majority ofpreviousresearch conducted on similar samples. The next value group, whose average scalar positions were between 3 and 4, consisted of five motifs, tentatively designated as friendship, desire for a better look, relaxation, fun and well-being (Table 1). Two motives, which average scalar values were ranged between 2 and 3, were the need to maintain optimal body weight and to prove to you (achievement motive). As the lowest ranked motive was tentatively identified as "being in fashion" and was the only one which had an average scalar value less than two.

Table 1: Descriptivestatistical parameters

Motive	Mean	Std. Dev.	Std. Error	Min	Max	N
Health	4,69	,707	,054	1	5	170
Socializing	3,87	1,058	,081	1	5	170
Look	3,84	,946	,073	1	5	170
Relaxation	3,68	,940	,072	1	5	170
Entertainment	3,38	1,020	,078	1	5	170
The mood	3,09	1,191	,091	1	5	170
Weight Loss	2,75	1,124	,086	1	5	170
Achievement	2,57	1,318	,101	1	5	170
Being in trend	1,95	1,022	,078	1	5	170

Based on the intercorrelation of observed variables was formed the initial correlation matrix (Table 2); based on the correlation matrix is defined hierarchical structure of nine initial vectors in the given area of motivation (Table 3). The characteristic roots (Egenvalue values) higher than one were recorded only in the first four vectors, which are entered in the further procedure and of which later were formed the four factors of motivation.

Table 2: The initialcorrelation matrix for determination the latent structure of motivation

Motive	Health	Socializing	Look	Relaxation	Entertain-ment	Weight Loss	The mood	Being in trend	Achieve-ment
Health	**1**	,017	-,104	-,144	,016	-,053	-,129	-,105	-,195
Socializing	,017	**1**	-,016	-,072	-,075	-,166	-,343	,037	-,299
Look	-,104	-,016	**1**	-,047	-,119	,101	-,145	,022	-,057
Relaxation	-,144	-,072	-,047	**1**	,035	-,031	-,075	-,098	-,184
Entertainment	,016	-,075	-,119	,035	**1**	-,130	-,086	-,026	-,051
Weight Loss	-,053	-,166	,101	-,031	-,130	**1**	-,094	-,233	-,112
The mood	-,129	-,343	-,145	-,075	-,086	-,094	**1**	-,108	,164
Being in trend	-,105	,037	,022	-,098	-,026	-,233	-,108	**1**	,115
Achievement	-,195	-,299	-,057	-,184	-,051	-,112	,164	,115	**1**

Table 3: The values of the nine initial vector of latentstructure

The initial vectors	Egenvalue (characteristic root)	% Variance explained
1.	1,618	17,977
2.	1,359	15,101
3.	1,252	13,911
4.	1,146	12,735
5.	,969	10,771
6.	,828	9,196
7.	,800	8,891
8.	,702	7,804
9.	,325	3,613

The numerical values of factor scores, obtained by orthogonal and slope projection of the main components of the four extracted factors were very similar, indicating a very stable structure of the latent motivation space in the subjects included in this study (Tables 4 and 5). With Varimax procedure were obtained slope solutions which have formed highly interpretable matrix with four factors in the area of motivation (Table 5).

Table 4: The initial matrix structure of the extracted factors of motivation (unrotated orthogonal projection of the main components, with the communality values determined for each variable)

Motive	Factor 1	Factor 2	Factor 3	Factor 4
Health	,243	-,300	-,297	-,678
Socializing	,741	,217	,001	-,120
Look	,170	,027	,684	,145
Relaxation	,137	-,218	-,247	,791
Entertainment	,052	,012	-,598	,163
Mood	-,059	-,627	,495	,028
Weight loss	-,726	-,068	-,145	-,038
Achievement	,085	,770	,088	,009
Being in trend	-,641	,418	,119	-,081

The first factor, which explained most of the total variability, is saturated with three dominant motives, tentatively designated as “Socializing”, “Weight loss ” (taking care of body weight) and “Being in trend” (prove it to others). Starting from the logical content of these three motifs, as well as their basic semantics, the first hierarchical factor in the observed latent motivational space, is defined as “Social desirability”. This shows that the three motifs, in fact, are the main drivers of female students to exercise physical activity at the university. This result is consistent with general trends of young people, especially women, that through sporting activities are realized primarily the needs of social interaction with the environment.

Table 5: Rotated structure matrix of extracted motivation factors (Varimax method of slope projection of the main components)

Motive	Factor 1	Factor 2	Factor 3	Factor 4
Health	,243	-,300	-,297	-,678
Socializing	,741	,217	,001	-,120
Look	,170	,027	,684	,145
Relaxation	,137	-,218	-,247	,791
Entertainment	,052	,012	-,598	,163
Mood	-,059	-,627	,495	,028
Weight loss	-,726	-,068	-,145	-,038
Achievement	,085	,770	,088	,009
Being in trend	-,641	,418	,119	-,081

The most significant projection on the second extracted factor had two motives in the applied research questionnaire defined as "a feeling of comfort and moods (conditional, mood motif) and “Being in trend and prove to the others” (conditional, achievement motif). Analyzing the content and semantic message of these formulations the second hierarchical factor can be defined as the “Prestige”. He points to the importance of sports facilities in the life of young people, given that this age is rich in various types of competition, comparison, searching for “my place” in society, through the proper implementation creates a feeling of comfort, satisfaction, and creates energy for daily life and working activities.

The third factor was mostly saturated with two motifs, in the questionnaire formulated as a “Good appearance” and “Fun and entertainment”'. Starting from the social messages that contain specified themes, this factor can be characterized as a lifestyle. Motifs that form this factor can be viewed in the light of modern living environment of young people. Good look, care for the “good” figure, cared for the body, as well as current fashion trends, is increasingly attracting the youth. Sports activities are one of the “tools” that are offered to young people, especially via media. In this context, they see a different form of entertainment, both directly through sports, and through the effects of physical exercise (good looks) in other types of entertainment activities that young people exercise in their free time.

The fourth factor, which is the smallest quantity described variability in the observed area of motivation, was formed by two reasons that are in the research questionnaire formulated as: "maintain and improve health" (health motivation), or "relaxing and forgetting the everyday worries" (tentatively, the motive relaxation). As the first motive has explicitly pointed out the importance of protecting the general physical health, and the second implicitly the need to protect the physical health of people, hence as the logical name of the fourth factor is: Caring for mental and physical health.

In order to check whether the applied factor model achieved the maximum “parsimonia” in explaining the motivation latent space, were calculated the intercorrelations among the four defined factors. For all four factors were obtained high coefficients of determination (Table 6), indicating that each has a high predictive value in explaining the motivation of the complete space. In other words, using a questionnaire and a significantly smaller number of motives offered would very reliable detect the intensity and level of attitude towards the basic driving forces for participation in physical exercise or playing sports at the university.

Unlike the coefficient of determination, coefficient of simple linear and partial correlation (Table 6) had very low values, where they were numerically quite close. Such low values of correlation coefficients indicate the absence of significant correlation between the extracted factors, which clearly indicates that there was an almost ideal “parsimonia”. Based on these data it can be, with a lot of confidence, say that in the latent motivational structure of subjects covered in the survey, there are four relatively stable factors that reveal the basic reasons for participating in physical exercise at the University. They could me marked as: (1) factor of social desirability, (2) the prestige factor, (3) the tendency to separate lifestyle and (4) concern for the psycho-physical health.

Table 6: Correlation matrix of factors extracted (determination coefficient)

Components	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	-,981	,184	,023	,058
Factor 2	,151	,910	-,333	-,195
Factor 3	,087	,336	,937	,040
Factor 4	,085	,156	-,106	,978

Conclusion

The research results have generally shown that in the latent motivation area of students of the University EDUCONS there are four factors that indicate possible trends in opting for practicing sporting activities within the University. Given that this is a population that is not very ''sport'' or about 82% of respondents are not engaged in sports activities, i.e. do not exercise regularly, the perceived motivational tendencies might be a good sign in the creation of physiognomy of exercise activities in the development plans of the University EDUCONS. This is supported by the fact that their positive opinion about the usefulness of physical exercise was given at 94% rate, and 62.4% of them answered that they would clearly be actively involved in organized sports activities if they were organized at the University. Approximately 35% of respondents in this indicator were undecided, and they can be considered as potential participants in sports programs. Only 2.4% of the respondents clearly stated that they would not perform any form of physical exercise.

From the above said is possible to create direction for sports and recreational programs at the University EDUCONS. First of all, they should be aimed at satisfying the need for social contacts and socializing students. Sports activities at the University should enable faster social cohesion and learning among the student population as a centre of their social interactions. The first factor (social desirability) is a good sign for this.

Since it is mainly the younger population (70% aged 19-27 years) the nature and forms of sports activities within the university should have a sufficient dose of' "attraction" to attract young people to engage in them, follows that the factor "Prestige" has the significant importance for sports programs policy creators at the University EDUCONS. In this context it could be considered a third extracted factor (Lifestyle).

Of course, always important health physical exercise component in this case could be the result of an increasing accentuation of a healthy lifestyle. Particularly in young people this trend in recent years is strongly present. On this occasion is noticed that among the respondents, first of all, think of the impact of sports activities through preventive-compensate aspect of physical exercise on the neuro-emotional stress, given that in this age do not appear prominent and massive form of other health problems. Therefore, exercising at the University may represent the activity of health-preventive character, and in this regard it must be treated. Or, to create a physical exercise programs aimed at this goal. At this points the fourth factor in the latent space of motivation (Care for mental and physical health).

Therefore, the results can be considered an adequate contribution to the general thesis determined that in the education of youth, physical activity in general, and particularly sports, must represent significant determinants of building, maintaining and improving their bio-psycho-social capacity. Sports in universities should reflect its original profile, which is reflected through dimensioning of the three main areas of effectiveness: 1) by contributing to the creation of an all-round personality of each individual, 2) through the development and expansion of recreational values of the student population, particularly through the active encouragement of friendship, cooperation , fair play, perseverance, integrity, etc.. and 3) the development of team spirit, where it must be borne in mind the fact that, in this case, we speak about future academic citizens of a society, who will soon be found at key positions (in politics, economy, culture, education, manufacturing, business, etc..), for what they need to take responsibility on themselves in the modern environment that is burdened with all possible kinds of "games and competitions". In this context it should be profiled the concept of physical exercise for students, as long-term project that will contribute to improving the quality of life and work at the University EDUCONS.

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PREDICTION OF SUCCESSFULNESS OF YOUNG TENNIS PLAYERS

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Abstract

The purpose of this study was to assess the possibilities for predicting playing successfulness of young tennis players in competitive tennis, thereby, using machine learning methods applied to the players` motor abilities and morphological tests results. The analysis included altogether 883 male and female tennis players, aged between 8 and 16 years old, who underwent regular testing by the National Tennis Association and were positioned on its ranking list between the years 1993 and 2008. Several machine learning methods were used to predict competitive performance. Two machine learning methods for the identification of the most promising predictors were included. Additionally, we tested suitability of correlation analysis for selection of the most promising predictors. Predictions of competitive performance of tennis players proved to be a highly complex issue, because the accuracy of predicted models in our study, based on morphological and motor factors, was relatively poor for practical use.

Introduction

Tennis is one of the most popular sports in the world, both in terms of its widespread competition system and how much attention the media pay to it, as well as in terms of large numbers of people of both sexes and all ages that participate in it. As is the case in all sports today, tennis is no exception when it comes to the fact that it is the top players who steer the development of the sport as well as of the training and diagnostic technologies used. The absolute competitive performance of a tennis player is indicated by the position on the ATP ranking list. This position is the cumulative result of numerous factors, procedures and activities. The factors playing an important role in the development of any young tennis player include those involved in the initial selection procedure, in planning and in organization, as well as how the subsequent training and its supervision is performed. In particular, supervision over the effects of training in various areas of the tennis player's bio-psycho-social status is important. It can, to a large extent, influence the efficiency of the training system as a whole, and even more, also that of the absolute competitive performance of the player. In this context, tests pertaining to main anthropometrical characteristics and motor abilities are indispensable. They help us in in-depth understanding of relations between the bio-functional potentials and the player's actual competitive performance. Regarding this kind of analyses in kinesiology, classical statistical approaches and subjective estimates by experts were most commonly used. In our opinion, some state-of-the-art data analysis methods from the artificial intelligence field can assist us in searching for more reliable and objective evaluation means to address these questions. We believe this way we can make an important contribution to taking more efficient decisions in the course of development of young players.

Machine learning is an artificial intelligence field which deals with discovering knowledge in data by data analysis and by the automatic generation of knowledge databases for expert systems, for the construction of numeric and qualitative models using classification and regression analyses, etc. In recent years, we have witnessed a rapid increase in the volume of data in digital form. Machine learning is becoming an important tool for transforming these data into useful information, since manual processing of such a vast quantity of data has become impossible. The increased recognition of machine learning is also reflected in a rising number of commercial systems within the sectors of industry, medicine, economics, banking, etc. The basic principle of machine learning is the automatic modeling of data. Learned models attempt to interpret the data, from which the models were constructed. They can assist in making decisions when it comes to studying the modeled process in the future (predictions, diagnosis, control, verification, simulations, etc.).

Predictions of competitive performance can be made using either classification or regression methods. Both approaches have in common that out of a multitude of independent variables they can construct a model, whose output is an observed variable (Hand, Mannila, & Smyth, 2001). In prediction an independent variable is known as an attribute and observed variable is known as a class attribute or just a class. We are using these two notations when we talk in the context of prediction. There are two types of classes: discrete or continuous. The output of the classification model is a discrete class, whereas the output of the regression model is a continuous class. Classification and regression can employ various methods based on different approaches, which is why there are differences in how well different methods perform with regard to different issues. It is possible to improve the reliability of individual methods by selecting only the most promising attributes (Kohavi & John, 1997; Kononenko & Kukar, 2007). In doing so, those attributes which do not influence the class are eliminated, and therefore, mostly exert a negative effect on the performance of the learned model. Individual attribute may be eliminated manually or by using various automatic methods which prove more or less efficient regarding diverse issues.

The aim of this study was to assess the possibilities for making predictions of performance in competitive tennis by employing classification machine learning methods on the basis of motor and morphological tests of young tennis players. The efficiency of predicting competitive performance was studied with regard to two age groups (under 12 years and between 12 and 16 years) in male and female categories. Our final aim was to identify those attributes which proved as the most useful in making predictions. For this purpose we used two methods for attribute selection. Additionally, we were interested in correlation between all tests (attributes) with each other, and between all tests and ranking (class), that might also be useful for selection of the most promising attributes.

Methods

Subjects

The sample of subjects included those Slovene tennis players who were positioned on the ranking list of the Slovene Tennis Association in individual periods and who also underwent morphological and motor measurements in these individual periods. Measurement data was collected for 511 male tennis players and 372 female tennis players, i.e. 883 individual tennis players in total. The data collection procedures met international ethical standards and were consistent with Helsinki Declaration. The selected subjects were divided into three physical age groups. The entire sample of measurements was then divided into age categories for analysis of the predictability of competitive performance:

- Age category U12/U12: for subjects in the age group under 12 years on the basis of measurements performed in the period under 12 years of age, consisting of 170 male tennis players (age 12.14±1.02 years, body height 153.53±7.95 cm, body weight 42.85±7.58 kg) and 157 female tennis players (11.85±.75 years, 155.74±8.16 cm, 44.02±8.33 kg).
- Age category 12-16/12-16: for subjects in the age group between 12 and 16 years on the basis of measurements performed in the period between 12 and 16 years of age, consisting of 341 male tennis players (14.88±1.20 years, 170.35±10.08 cm, 58.43±11.49 kg) and 215 female tennis players (14.80±1.19 years, 166.65±6.18 cm, 55.93±7.46 kg).

Data collection

A test battery contained tests of anthropometrical characteristics and motor abilities, whose usefulness in predicting competitive performance in tennis was already identified. Results of these tests were used as attributes. Tests of motor abilities provide us with an insight into the general and tennis-specific abilities of players. With the selected tests, we covered all key areas of the player's motor and functional abilities (strength, speed, agility, flexibility, balance, coordination, endurance). All measurements were conducted annually in the laboratories of the Faculty of Sport in Ljubljana between 1993 and 2008. Table 1 presents the composition of this test battery.

Table 1: Applied morphological and motor tests.

Abbreviation	Measure and Test	Ability/Dimension
M-1	Body height	Morphology
M-2	Body weight	Morphology
M-3	Body mass index	Morphology
M-4	Fat tissue percentage	Morphology
M-5	Muscle tissue percentage	Morphology
M-6	Bone tissue percentage	Morphology
P-1	Sargent test	Explosive power - lower ext.
P-2	Medicine ball throw (2 kg)	Explosive power - upper ext.
P-3	Four-jumps test	Explosive power - lower ext.
P-4	Sit-ups	Muscular endurance - trunk
S-1	20-metre sprint	Sprint acceleration
A-1	9 x 6-metre sprint test	Agility
S-3	Foot tapping	Alternative movements' frequency - lower ext.
S-4	Hand tapping	Alternative movements' frequency - upper ext.
F-1	Forward bend	Passive flexibility - lower ext.
F-2	Sprain with a stick	Passive flexibility - upper ext.
F-3	Launge	Active flexibility - lower ext.
A-2	Fan	Agility
A-3	Hexagon test	Agility
C-2	Obstacle course backwards	Coordination - whole body
C-3	Racquet ball handling	Coordination - tennis-specific
B-1	Balance beam turn-arounds	Dynamic balance
E-1	2400-metre run	Endurance

The position on the ranking list of Slovene Tennis Association for an individual year was used as the primary criterion for estimating competitive performance. This ranking list takes into account results achieved in that competition year. The position on the Tennis Association ranking list is determined on the basis of a coefficient which represents the total number of points won by individual player, divided by the number of tournaments played.

Data processing

In analyzing the predictions of competitive performance with classification algorithms, it was necessary to discretize the sample data, since classification algorithms do not work with continuous classes. Class was determined by the position on the ranking list of Slovene Tennis Association, and was divided into two parts, i.e. the top ten players, and others. The reason for this was our aim to separate top players from the rest, as only top players can succeed on the international level. Classification was performed by means of several methods: the naive Bayes classification method, decision tree, the C4.5 algorithm, the k-nearest neighbor, support vector machine (SVM), and logistic regression. These methods use considerably different approaches (with the exception of the decision tree and the C4.5 algorithm, since the C4.5 algorithm is a variation of the decision tree). Each of these methods is able to predict discrete classes. The simplest method is the k-nearest neighbor method, whereas the most complex one is SVM (Kononenko & Kukar, 2007). The evaluation of the performance of classifiers was conducted with classification accuracy, and surface under the ROC (receiver operating characteristic) curve, using the k-fold cross validation method "k equals 10".

The naive Bayes classifier is a simple probabilistic classifier based on applying the Bayes theorem with assumptions of conditional independence of values of different attributes with regard to the given class. In spite of this, it performs much better than might be expected when it comes to a number of complex actual issues (Zhang, 2004). The decision tree is a tree-like structure, the leaves of which represent classifications, whereas its nodes are conjunctions of attributes which lead to classifications. Interpretations of such structures are simple, which is one of the reasons for the decision trees to be used in practice quite commonly. C4.5 is an algorithm used to generate a decision tree, which was developed by Quinlan (1993). The k-nearest neighbor is an algorithm for classification based on closest training examples in the attribute space. Classification of a new case is done on the basis of k-nearest neighbor votes (the neighbor being assigned to a certain class) by selecting the class which receives the majority of votes. SVM is one of the most successful classification methods. Unlike the majority of machine learning algorithms, which aim for minimization of the number of attributes, the SVM method uses as many attributes as possible, out of which the method itself selects a suitable combination which leads to the needed information. Logistic regression is a method which generates a linear model on the basis of a transformed predictor variable. The transformed variable is approximated by using the linear function in the same way as with linear regression (Witten & Frank, 2005).

The possibility of automatically identifying the most promising attributes was tested using both the ReliefF method and the wrapper approach. ReliefF (Robnik-Šikonja & Kononenko, 2003) works independently from the learning algorithm and assumes neither apriori nor conditional independence of attributes. Consequently, it works efficiently also when dependent attributes are involved. The wrapper approach (Kohavi & John, 1997) conducts a search in a space of attributes with one of the search algorithms and adds or removes one or several attributes in each iteration. Each iteration also includes a test on selected attributes of the learning algorithm and calculations of the learning performance.

Correlation analysis was carried out between all tests and between all attributes and class. Pearson's correlation coefficient was used. We wanted to test whether there are a lot of dependent attributes, which might affect the performance of learned models. High correlation coefficient between attribute and class would indicate attribute with potentially high predictive power. Additionally, descriptive statistics were calculated for all attributes.

Results

Both the naive Bayes method with ReliefF and logistic regression with the wrapper approach, proved to be the most accurate in predicting competitive performance in U12/U12 and in 12-16/12-16. In these two cases other methods produced somewhat less accurate results.

Comparing the prediction in U12/U12 and in 12-16/12-16 regarding gender there were no larger deviations, except for female in U12/U12 for naive Bayes with ReliefF the classification accuracy was 0.73 (Table 2). The naive Bayes with ReliefF was on average better method then the logistic regression with wrapper approach, but results of both of them differed by 0.06 at most.

As regards the classification methods by selecting only the most promising attributes, the performance of the logistic regression method was influenced to the largest extent. In U12/U12 and in 12-16/12-16, the wrapper approach on average improved accuracy by 0.08, whereas the ReliefF method improved accuracy by 0.07 (Figure 1). All other methods improved in accuracy by ≤ 0.04. The difference in improvement of the accuracy between the wrapper approach and the ReliefF methods was on average 0.02 for individual classification methods in U12/U12 and in 12-16/12-16.

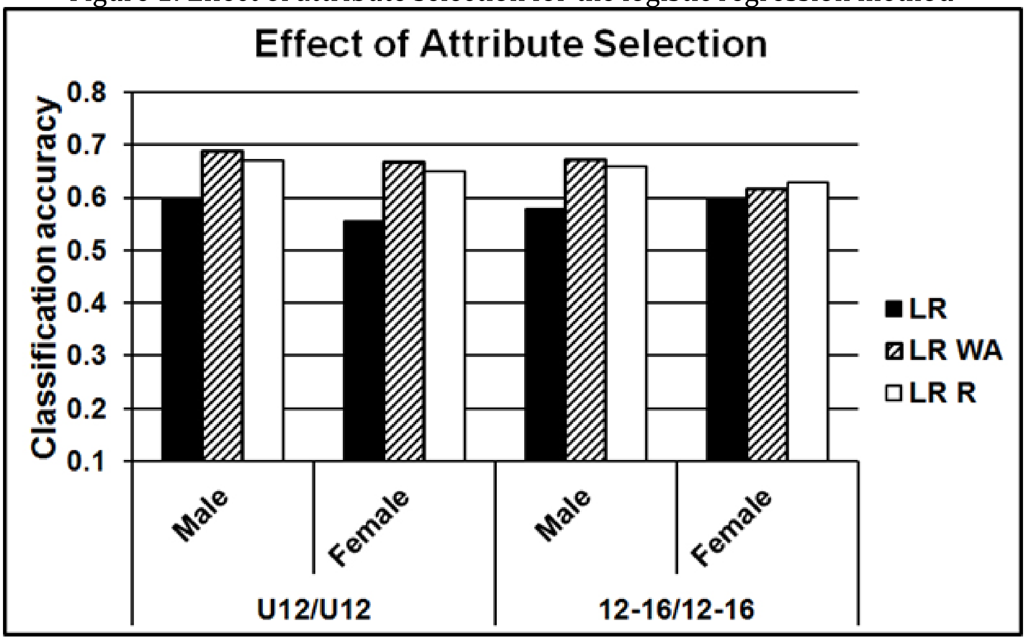
C-3 and A-2 were the most commonly selected attributes by means of the logistic regression method in combination with the wrapper approach for predicting competitive performance in U12/U12 and in 12-16/12-16, whereas the ReliefF method selected C-3 and A-1 most commonly.

Regarding morphological dimensions high positive correlation coefficient ($r \geq 0.8$) was observed between M-3 and M-2; and high negative correlation coefficients ($r \leq -0.8$) were observed between M-2 and M-6, as well as between M-3 and M-6. This applies to both age categories for males and females. Only one correlation coefficient, between A-1 and A-2, regarding motor tests stood out with $r \geq 0.55$ for all groups except for 12-16 females. Among correlation coefficients between attributes and class C-3 correlation coefficient was the highest (r around 0.40 for all groups), while all other correlation coefficients were low ($r \leq 0.35$ and $r \geq -0.35$).

Table 2: Classification accuracies of all models for studied samples of tennis players. (NB – naive Bayes, DT – decision tree, C4.5 – C4.5 algorithm, kNN – k-nearest neighbor, SVM – support vector machine, LR – logistic regression, WA – wrapper approach, R - ReliefF).

	U12/U12		12-16/12-16	
Method	Male	Female	Male	Female
NB	0.67	0.66	0.67	0.62
NB WA	0.62	0.70	0.68	0.61
NB R	0.67	0.73	0.66	0.67
DT	0.59	0.62	0.65	0.56
DT WA	0.63	0.65	0.51	0.62
DT R	0.66	0.63	0.53	0.66
C4.5	0.58	0.62	0.60	0.58
C4.5 WA	0.66	0.63	0.59	0.64
C4.5 R	0.65	0.61	0.60	0.66
kNN	0.64	0.58	0.55	0.61
kNN WA	0.53	0.63	0.62	0.55
kNN R	0.62	0.56	0.55	0.63
SVM	0.57	0.64	0.61	0.55
SVM WA	0.65	0.61	0.55	0.54
SVM R	0.60	0.59	0.60	0.58
LR	0.60	0.56	0.58	0.60
LR WA	0.69	0.67	0.67	0.62
LR R	0.67	0.65	0.66	0.63

Figure 1: Effect of attribute selection for the logistic regression method



Descriptive statistics of attributes for all groups are presented in Table 3.

Table 3: Descriptive statistics of motor abilities and morphological tests.

	male						female					
	U12			12-16			U12			12-16		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
M-1	170	153.5	8.0	341	170.4	10.1	157	155.7	8.2	215	166.7	6.2
M-2	157	42.9	7.6	296	58.4	11.5	157	44.0	8.3	215	55.9	7.5
M-3	157	18.0	2.0	296	20.1	2.1	157	18.0	2.2	215	20.1	2.1
M-4	157	19.4	6.9	296	14.9	3.8	157	21.1	6.1	215	21.6	5.1
M-5	157	40.2	4.4	296	42.2	3.3	157	41.7	3.4	215	44.8	3.6
M-6	157	29.6	3.1	296	25.6	3.0	157	27.8	3.1	215	24.0	2.6
P-1	142	41.6	10.1	200	49.8	9.4	140	41.8	9.4	171	43.7	8.2
P-2	169	755.5	137.0	316	1110.7	303.8	157	659.4	130.8	215	838.1	156.8
P-3	170	724.3	64.2	302	888.3	92.2	157	709.2	65.0	211	765.3	101.9
P-4	168	48.5	8.3	279	58.1	8.9	157	46.2	7.1	215	52.7	8.7
S-1	169	3.8	0.2	314	3.5	0.3	156	3.8	0.2	215	3.7	0.3
A-1	170	19.3	2.2	294	16.4	2.4	157	19.2	2.4	214	17.6	2.1
S-3	170	28.2	2.9	299	30.8	3.2	157	28.4	2.4	215	31.2	3.7
S-4	161	39.7	4.1	273	47.2	4.8	148	40.8	4.4	195	46.8	4.1
F-1	170	44.4	6.7	318	48.4	7.6	156	48.8	5.4	215	53.2	5.8
F-2	170	65.8	18.0	316	74.9	19.3	157	63.1	14.1	215	64.8	17.3
F-3	170	153.4	12.5	318	167.3	15.0	157	158.0	11.8	215	169.4	13.5
A-2	170	16.3	1.6	312	14.1	1.7	157	16.7	1.7	215	15.4	1.3
A-3	170	11.1	1.3	316	10.1	1.4	157	10.8	1.7	215	9.9	1.3
C-2	168	11.4	2.1	292	9.5	1.7	157	11.8	2.0	215	10.7	2.1
C-3	169	38.6	9.8	300	56.0	12.6	157	34.6	10.0	215	47.9	11.2
B-1	169	21.0	9.0	298	25.7	13.8	157	22.9	8.2	215	26.9	14.2
E-1	100	663.1	59.3	177	598.4	57.1	85	698.6	65.2	114	635.9	123.5

Discussion

Regarding classification analysis, a classification accuracy value above 0.60 was considered a satisfactorily accurate result. With a well selected sample, classification accuracy around 0.50 can be achieved with a random classifier (Kononenko & Kukar, 2007) alone, which makes models with classification accuracy under 0.60 unsuitable for the issues in question. The most accurate classification models are the naive Bayes method with ReliefF and the logistic regression with the wrapper approach. Their classification accuracies differ by 0.06 at most (Table 2), which is a negligibly small difference. These two methods are therefore equally suitable for predicting competitive performance of the young tennis players. While the SVM method is usually considered to be one of the most reliable ones when it comes to complex actual issues (Caruana & Niculescu-Mizil, 2006; Kononenko & Kukar, 2007). However in our case, contrary to expectations, the SVM models produced the least accurate results (similar also the k-nearest neighbor models). A conclusion to be drawn from this is that the machine learning methods tested (the naive Bayes and the logistic regression) was the most suitable for predicting competitive performance in U12/U12 and 12-16/12-16 for males and females. However, they can be hardly considered as suitable for the use in practice. We speculate that for practical purposes classification accuracy should be above 0.80.

Similar findings to these were reported by Filipčič (1996), who compared the uniformity of estimates made by means of regression analyses in the fields of motor, morphological and functional dimensions of tennis players aged between 12 and 14, with estimates of potential performance made using expert modeling. The correlation coefficient between both estimates is 0.72. According to the author, a rather low correlation between estimates made by means of both procedures can be attributed to the fact that the estimates by the expert system do not reflect current relations between criterion and prediction variables, but is aiming to predict relations that will arise in future.

High (positive and negative) correlations coefficients between morphological dimensions in our study were expected, because they are directly or indirectly calculated from each other. Correlation coefficient above 0.55 between A-1 (9 x 6-metre sprint test) and A-2 (Fan) is also expected, whereas they are based on a very similar functional mechanism. Both tests involve agility. Agility can be defined as the motor ability to carry out acceleration/deceleration types of locomotor movements effectively, including changes in direction. All of these are based on neuromuscular power, quickness of reaction/response and feet coordination. Previous studies (Filipčič, 1996; Filipčič & Filipčič, 2005; Šerjak, 2000; Unierzyski, 1994) established that agility tests elucidate competitive performance at a statistically significant level.

Additionally to the machine learning methods, we also observed Pearson correalation values between the attributes and the class in order to compare results of selection of two conceptually different approaches. The highest correlation coefficient was found for C-3 (Racquet ball handling), which was also selected as one of the most promising attriute by automatic methods (ReliefF and wrapper approach). On the other hand, automatic methods selected also A-1 and A-2 as one of the most promising attributes, however correlation coefficient between these two and ranking variable was very weak ($-0.3 \leq r \leq 0.3$) for all tested groups. Based on these findings we can conclude that correlation is not appropriate for selection of the most promising test. It is also limited with its linearity while problem of prediction of competitive performance is likely to be nonlinear.

In the future, it would make sense to carry out measurements and data collection in a more organized manner, as it was observed in certain cases that a large number of values were missing. Understandably, this depends on the availability of financial resources, however, along with further developments the situation is expected to improve. Regarding predictions of competitive performance, a future study including a larger number of factors which influence the competitive performance of tennis players would most likely produce even better results. It would also be interesting to observe improvements with regard to predictions of players' competitive performance for several years in advance.

In this study, predictions of competitive performance of tennis players turned out to be a highly complex issue, as the accuracy of predicted models, based on morphological and motor factors, was relatively poor for practical use. Reasons for this lie in the fact that the competitive performance was predicted only on the basis of estimates of potential performance in the fields of morphological, motor, and functional dimensions, and in doing so the players' personality traits, mental and competitive abilities, technical and tactical competencies, and experience were not taken into account. Therefore, our future goal should be to use measurement procedures to cover all fundamental dimensions of athletes' bio-psycho-social status to the largest extent possible, as well as to take into account dynamic correlation procedures, which are present among them.

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THERMOVISIONAL DETECTION OF VIRAL MUSCLE INFECTION IN ATHLETES

Goran Roglić, Franja Fratrić, Milan Nešić & Dragan Ilić

Abstract

Infrared thermography, or thermovision, is increasingly applicable in sport. Thermic forms, thermic imprints, temperature distribution and isotherms, change of temperature degree, are all terms that will be met in sport more and more. Thermovisional method is fast, efficient, and with technology development it is becoming more and more available. In this paper thermovisional method has been used to detect viral infection of head and neck muscles (MYOSITIS). Thermovisional method in this complicated case was important for differential diagnosis. Infection looked as if it was caused by teeth, but that was wrong diagnosis. The infection has been monitored during the application of physical therapy and thermovisional method has given an objective insight into the recovering process of the athlete.

Introduction

Body temperature has been determined by temperature production generated by metabolic processes and mechanisms that enable thermoregulation. The skin is crucial as a barrier between environment and the inside of the body. Normal temperature is between 36,2 and 37.8 degrees Celsius. In normal conditions inner body temperature is several degrees higher than on the surface of the skin. Temperature begins to fall at tissue depth 2.5 cm making temperature dissipation gradient. Peripheral tissues, like muscles, fat, skin, are able to function in a wider temperature range (of 20-40 degrees Celsius) than inner organs which require less temperature variation and more stable temperature. Changes in skin temperature affect the blood circulation, affect warmth receptors in the skin and hypothalamus. The warmth is lost by the following mechanisms, 60% through IR (Infra Red) radiation, 25% through evaporation, 12% through air circulation, and 3% through conducting.

We are going to give a brief summary on the application of thermovision in sport. Clark, Mullan and Pugh (1977) registered changes in the skin temperature in their work in 1977. Infrared thermography has also been used for visualization of the skin temperature in two resting athletes as well as running at outside temperature of 20 degrees Celsius and in a chamber at 11 degrees Celsius. Temperature distribution has been recorded on the film and analyzed. Parallel to it, there has also been used a method for measuring temperature by using the thermocouple. The conclusion was that in running average body temperature above the muscles is significantly different from the average temperature while resting. Both measuring method gave the results within 1-5 degrees Celsius. Veghte, Adams and Bernaeur (1979) measured temperature changes during the training sessions. This study examined dynamic skin temperature changes connected to vascular changes that go with running and other exercises. They noticed the rise in temperature (with maximal rise of 1.7 degrees Celsius) with the increase of training difficulty of 20, 50 and 80%. They also noted significant rise in the skin leg temperature that is exercised comparing it to the one that was resting. Torii, Yamasaki, Sasaki and Nakayama (1992) did the studies where temperature rise and drop was processed in different sports, like running, swimming, cycling. The initial temperature drop in cycling was examined in ten healthy men. The examination was done with difficulty of 50-150 W in a chamber with 10 to 40 degrees Celsius and relative air humidity of 45-55%. Temperature was thermographically measured and thermocouple was used. The temperature drop during the exercise did not depend on the season of the year although the sweating was greater at 40 degrees than at 30 degrees Celsius. They concluded that temperature drop was not caused by sweating, but by vasoconstriction, that was probably caused by non-thermical factors. In the last years, technology of thermovisional sensor production developed so much that they do not differ from standard mobile phones. This allows new application of thermovisional method and opens new possibilities of application in sport. Looking from that perspective, we have a more up-to-date thermovision, more flexible, fast, more efficient, with enormous possibilities of data processing, at the site of measuring, real-time, with data usable real-time. The first papers on the application of thermovision in assisting sports injuries were published about thirty years ago, by Keyl and Lenhart (1975), where temperature changes of injuries were thermovisionally pictured. They concluded that injuries can be recognised like a local hyperthermia, if injury is not deep in the tissue. In combination with anamnesis, infrared thermography played an important role in diagnosis and regular treatment during therapy. They examined 82 patients with distortions, ruptures and knee injuries. In all cases there was an increase in temperature in the region of injury. Other processes like phlebitis, furunculosis and tumors were also registered.

Methods

Thermovisional measuring was done on an athlete aged 20, height 179, weight 65 kg. She is a kick boxer, chosen after having complained on headaches and jaw aches during and after training sessions.

The athlete was in a thermostated room for about twenty minutes, in order to lower the skin temperature comparing to the temperature of the environment. After that thermovisional camera was used to record pictures. Pictures of the head were made. Frontal part of the head and side thermovisional pictures of left and right part of the face. The air humidity was 45% and air temperature was 28 ºC. Anamnesis of the athlete pointed to the fact that there was infection, but it was impossible to determine focus. It was necessary to determine the cause of infection and locate it accurately in order to start the therapy. The athlete had constant headaches and high temperature.

During thermovisional measuring care was attentively taken to avoid that the athlete touches her face during taking pictures. In case that there was a hand touch, it would leave thermal imprint for ten minutes which would give a false picture. The camera used was the latest generation of thermovisional camera Mobir M3.

Camera M3 is currently one of the top portable thermovisional cameras. Basic functions of the thermal camera:

- All pictures are represented in LCD in black/white or palette of 256 colours,
- Real-time picture can be frozen and recorded on Flash memory,
- Real-time picture can be made 2x bigger
- recorded and frozen picture can be processed in the camera itself
- recorded pictures are transmitted into the computer via USB 1.1 interface and processed with the programme for post-analysis of the thermal picture (Post Processing Analysis Software).

Performances of the picture:

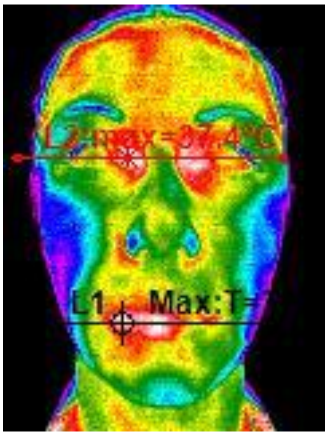
- Detector: FPA (Focal Plane Array) with non-cooled microbolometer
- Spectral range: 8-14 μm
- Thermal sensitivity ≤ 120mK, 30°C

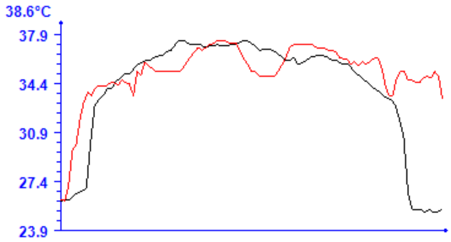
Measuring characteristics:

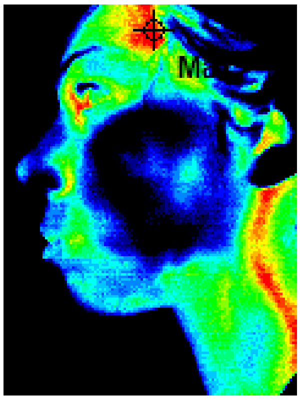
- Temperature range: -20°C - +250°C, Resolution: 0.1°C
- Measuring modes: Auto hot-spot trace, spot, area, line .

Results and discussion

In Pictures 1-6 there are thermal pictures of the head and neck region. Pay attention to the areas of cheeks, they are cooler, because behind the tissue there is an oral cave filled with the air that is ventilated and of the environmental temperature.







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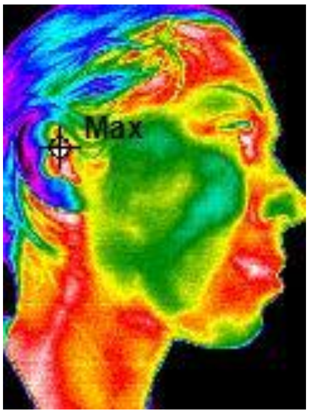

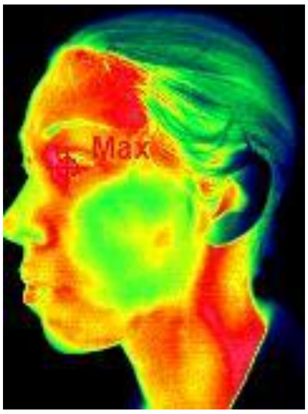

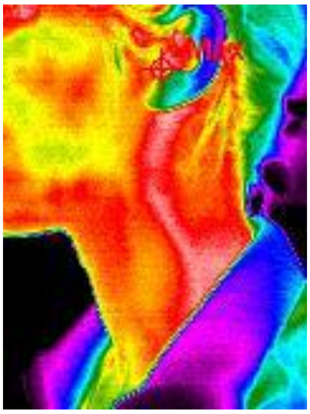

4 5 6

In pictures 1-4 the focus of the infection is clearly shown. The muscle warmth that are under infection shows the area that is affected (in picture 1 the white areas, and in picture 3 the red ones). We are also interested in temperature asymmetry that is noticed when comparing the left and right part of the face, looking from the front. It shows where the infection is localised and what is its volume. Maximal temperature of 38.6 ºC was recorded at the moment of measuring. It is interesting to say that the body temperature, measured with classical thermometer showed normal value. One more conclusion can be drawn, and that is, regarding that fact, infection detected in the early phase when it did not spread through the whole body. Thermal picture showed the same results as the clinical picture of the athlete.

In picture 1 there is a graph of thermal distribution along the lines L1 and L2 (the black and the red line), and respectively, there are graphs from which significant temperature difference and injury asymmetry were observed. On line L1 temperature difference of symmetrical points on the face 1.1 ºC, and on line L2 1.3ºC. Moreover, it shows the direction of the infection that is spread in the right part of the face and where the focus of the infection is. The infection was treated as a viral infection regarding the fact that it was not an isolated pathological bacterial flora of the nose and throat. It was sanated completely in 7 days.

Conclusion

Thermovisional examination localized the focus of the viral infection. Viral infection of the nose (rhinitis) spread to the sinuses (frontal part that is a bit above the eye and etmoidal – inside and a bit under the eye). Those two sinuses open into the nasal cavity. The infection from the nasal cavity spread into the throat, and lymph nodes that drain it are placed along carotidal artery and jugular vein that are in the warmest part of the neck, which can be seen in pictures 3,4,5 and 6.

Thermovisional recording of the face (frontal, left and right profile), showed the volume of the infection and it was immediately localised. Thermal picture, distribution of temperature gradient and clinical picture of the athlete were completely the same. Thermal pictures clearly show the asymmetry of the infection, as well as localisationn of the infection on the right part of the face. With appropriate treatment for viral infection, this infection was successfully sanated in seven days.

In this case thermovisional method showed significant for early detection of viral infection that was localised in the area of head and neck. It is crucial that an athlete is withdrawn from hard training for a while and that there are no physical challenges that can cause worsening of the viral infection and additional complications with bacterial infection.

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THE PERCEPTION OF SPORT AMONG PUPILS OF CLUJ NAPOCA, PILOT PROJECT

Antonio Saccone

Abstract

What does the youth think about sport? How the pupils perceive a complex phenomenon as sport? In our global society, sport can be considered a multi-faceted phenomenon:the aim of this research is to show the perception of sport among pupils of high school of Cluj Napoca, in particular the potential of sport as tool to be used in social development policies. The research is quantitative, the form measures six concepts: competition, education, fun, health, socialization and participation. Each concept has eight items, divided in nine batteries, related to game, regular season, training, “champion” (X2), value of sport (X2), physical education and being spectator of sport events. The form includes a part related to sport idols. The respondents are divided in two groups: athletes and non-athletes. 422 pupils of last year of nine high schools of Cluj Napoca – selected through sampling cluster procedure – filled the form. Health is the main aspect of sport. Education, competition and socialization are important. Participation and fun are less considered. “To play well for the team” is a meaningful element during the game. The skills improvement is the main aspect of training. Thinking at the regular season, to participate to the championship is crucial. Physical education in school is “useful to develop body and mind”. While spectators of sport events, the pupils are focused on technical and tactical plans. “The champion” is a “winner”, the healthy lifestyle is the main benefit of participating in sport. The sport idols are “national sport heroes”, “global sport icons” or “number one” in their discipline. The results show a good awareness of the social value of sport among youth. The consideration of health, education and socialization are relevant elements: the pupils, both engaged and not-engaged in sport, consider health as main benefit of sport.

Introduction

We live in a complex society and sport can surely be considered as complex social phenomenon. Different organizations use sport as a tool to achieve a deeply heterogeneous gamma of goals: some are interested in competing, others consider the health benefits, some place more emphasis on the aggregative value and others are attracted by the economic market. The goal of this research is to understand if sport can be used as tool of development: one useful to promote education, socialization, healthy-lifestyle, active citizenship or if it is just a competitive phenomenon. The target group is represented by the youth: the pupils of high schools from the city of Cluj Napoca.

The European Union and the United Nations recognize the sport as tool of development in several official publications, related to health (both public and individual), education (both formal and non-formal), social inclusion, advocacy, partnership building, sustainable development, intercultural dialogue, active citizenship and social cohesion (European Commission, 2007; United Nations, 2003 – 2005; UNICEF, 2004; http://www.undp.org/partners/foundations/sport/; www.sportanddev.org, http://www.un.org/themes/sport/). Moreover the active role of sport is acknowledged also by the United Nations as tool to achieve the Millennium Developing Goals (United Nations Inter-Agency Task Force on Sport and Development, 2003; International Conference for Sport and Development, 2003; 2nd Magglingen Conference 2005).

A recent research run in Serbia (Saccone, 2009) shows that the Junior volleyball players of Belgrade consider education and socialization as very important elements of sport. Health, competition and participation are relevant as well, fun is relatively important. Males respondents are more interested in competition and fun, females contrariwise underline more education and socialization. An healthy lifestyle is the most important benefits of participating in sports. During training it is very important to improve skills and communication. "To play well for the team" is the main quality of the "champion" and it is also the most important aspect during the game. Important goals during the regular season are those of participating in the championship and getting a good position in the final ranking. The main sport-idols of the Junior volleyball players from Belgrade are Serbs and males. Biancalana (2004) evidences that the youngsters consider sport as important activity because it's healthy: almost every pupil knows at least one football players and one cyclist, the main part of pupils knows at least one swimmer and one basketball player. The basic rules of football, basket and volleyball are well known by the pupils. An Italian research (Borgogni & Digennaro, 2010) shows that to emulate the sport idols is the main reason to practice sport.

At European level, recent statistics shows that "to improve health" is the main reason to be engaged in sport. "to improve fitness", "to relax" and "to have fun" are relevant as well. One respondent every four mention also "to improve physical performance", "to improve physical appearance", "to control weight" and "to be with friends". Among the youngsters, the most frequent answer is "to have fun", followed by "to improve health" and "to improve fitness" "To improve physical performance" and "and "to be with friends" result to appeal more youngsters respondents than other age groups. Men are more motivated by fun, competition and company of friends. To control weight, to improve health and the physical appearance are most likely mentioned by women (Eurobarometer, 2010). 22% of youngsters are member of associations: among these, the 49% are part of sport associations (European Commission, 2009). Among the European Union citizens, 40% say to play sport at least once a week. Men are most involved in sport than women: this evidence is evident in all age groups, but it is stronger in the 15-24 age group (Eurobarometer, 2010).

Method

The research is based on quantitative methods. The form is composed by two sections. The first one is for the athletes, so the pupils engaged in sport on regular basis: it includes five batteries of items related to game, regular season, training, "champion" and the value of sport (the question is "why would you suggest to practice sport?"). The second section is for the pupils not active in sport on regular basis: it includes four batteries of items related to physical education in school, to be spectator in sport events, the concept of "champion" and the value of sport (the question is "why would you start to practice sport?"). Each section includes 24 items, each items is related to a concept. Each concept is measured by 8 items, four for each section. The form measures six concepts of sport:

- "Competition": it takes into consideration scores and rankings.
- "Education" is focused on three main elements: to learn how to practice a sport, improving skills and technique; the physical education; to acquire new knowledge through non-formal education.
- "Fun" means leisure dimension: to play, to have fun, to enjoy friends.
- "Health" measures how important are physical exercise, wellness of body and healthy lifestyle.
- "Socialization" is related to the aggregative dimension of sport: to make new friends, to share experience and feelings, to increase social skills, to improve social life.
- "Participation" in sport is a form of active citizenship: through the respect of rules, referees, competitors, losers and winners, the athletes develop civic skills.

The respondents are asked to select their section, then to choose three items for each battery: the first choice gets ten points, the second five, the third one. As consequence, each concept and each items can be measured by a mark: from zero (not important at all) to ten (very important). The final part of the form is related to sport idols: each respondent could mention three sport idols, independently of sport, age, nationality, gender.

The target group of the research is composed by the pupils of high schools of Cluj Napoca. The respondents have been selected through sampling cluster procedure. The website of the Municipality of Cluj-Napoca includes a list of 41 high schools. From this list, 9 schools have been randomly selected. In each of the nine schools, two class-groups have been chosen and all the pupils of these classes have filled the form. It looks a sufficiently large universe for academic and scientific purposes and, at the same time, it is within reach, according to the time-line and budget-line of the project.

The results are obtained by statistical analysis: descriptive statistics, analysis of frequencies and independent t-test. The results are presented in five paragraphs. The first paragraph provides with an overview about the concepts. The second one is dedicated to pupils engaged in sport: it includes the perception of game, regular season, training, “champion”. The third is dedicated to the pupils not-engaged in sport: it shows the perception of physical education, the value of sport and the most important aspects of sport events from spectator’s point of view. The fourth part analyzes in detail each concept. The last part is related to the sport idols.

Due to practical and legal issues, I had to leave the forms in the secretariats of the schools and to come back to get the form filled afterward. The schools gave the form to the pupils: for this reason, I couldn't assist while the forms were filled and I couldn't provide the pupils with accurate information in case of misunderstandings. As consequences, I have had a considerably number of missing answers or mistakes in the forms.

422 students filled the form: 197 males, 191 females and 34 didn't indicate the gender. 113 students (26,8%) are regularly engaged in sport activity, 307 contrariwise are not engaged in sport activity (72,7%). Among athletes, 61 are males and 41 are females (10 didn't indicate the gender). 12 respondents declared to practice two sports. The most popular sports are football and volleyball, with 26 students each, then basket (13), handball (11), tennis (9), swimming (5) and other 24 sport (35).

Results

The concepts, overview

The youth from Cluj Napoca considers health as the main aspect of sport. Education, competition and socialization are important as well. Participation and fun are less considered. The only relevant difference between gender groups is linked with fun, which is considered more by males respondents**.**

The opinion of the respondents non engaged in sport activity on regular basis is similar to the global group. Among pupils regularly engaged in sport activity the perception changes: health is still the main element of sport, followed by competition and socialization; education is lightly more relevant than participation and fun. Looking at gender differences, the sportsmen have the tendency to pay greater attention to competition and fun. The sportswomen contrariwise pay more attention to socialization and participation.

Table1: Concepts, overview

	GLOBAL		MALES		FEMALES	
Concept	*mean*	*sd*	*mean*	*sd*	*mean*	*sd*
Competition	5.392	2.971	5.478	2.987	5.225	3.027
Education	5.706	2.697	5.676	2.735	5.780	2.699
Fun	4.716	2.773	5.095	2.748	4.401	2.737
Health	6.424	2.591	6.126	2.774	6.577	2.370
Socialization	5.196	2.913	5.374	2.911	5.015	2.858
Participation	4.865	2.548	4.725	2.526	4.993	2.530

Pupils regularly engaged in sport

THE GAME: During the game, the most important thing is to play well for the team and for the team-mates. The final score and to have fun are important as well. Males respondents consider more relevant the competition than females respondents. “To respect referees, rules and competitors” is less considered.

Table 2: Concepts, engagement in sport, gender

		GLOBAL		MALES		FEMALES	
Concept	*athlete*	*mean*	*sd*	*mean*	*sd*	*mean*	*sd*
Competition	yes	5.550	2.864	5.862	2.472	4.992	3.085
	no	5.326	3.019	5.269	3.109	5.303	3.019
Education	yes	5.190	2.864	5.213	2.814	5.021	3.076
	no	5.917	2.602	5.922	2.675	6.023	2.534
Fun	yes	4.825	2.909	5.331	2.945	4.310	2.685
	no	4.672	2.723	4.978	2.652	4.433	2.767
Health	yes	6.239	2.446	6.218	2.398	6.116	2.464
	no	6.499	2.650	6.078	2.965	6.723	2.329
Socialization	yes	5.500	2.582	5.456	2.657	5.674	2.556
	no	5.054	3.052	5.326	3.068	4.756	2.941
Participation	yes	4.998	2.467	4.833	2.725	5.317	1.191
	no	4.808	2.586	4.667	2.425	4.877	2.698

Table 3: During the game, how important is

cod - item	*mean*	*sd*
1.1 - to win (competition)		
overall	5.31	3.892
males	5.49	3.969
females	4.69	3.947
1.2 - to have fun (fun)		
overall	5.28	3.777
males	5.06	3.716
females	5.50	3.723
1.3 - to play well for the team (socialization)		
overall	6.32	3.593
males	6.40	3.616
females	6.56	3.404
1.4 – to respect rules. referees and competitors(participation)		
overall	4.70	3.436
males	4.52	3.377
females	4.86	3.662

REGULAR SEASON: The most important aspect during the regular season is to participate in the championship: this opinion is shared by both gender groups. “To have fun” and “to get a good positioning in the final ranking” are relevant as well, especially considering only males respondents. Females respondents are particularly satisfied with being part of a group.

Table 4: Thinking at the regular season, how important is

cod - item	*mean*	*sd*
2.1 - to participate to the championship (participation)		
overall	7.15	3.438
males	6.95	3.205
females	7.39	3.600
2.2 – to get a good positioning in the final ranking (competition)		
overall	5.74	3.758
males	6.06	3.944
females	5.50	3.556
2.3 – To be part of a group – team-mates. club... (socialization)		
overall	5.39	3.682
males	4.31	3.341
females	6.93	3.452
2.4 – to enjoy. to have good time (fun)		
overall	5.79	3.652
males	6.30	3.636
females	5.31	3.683
2.5 - to do physical activity on regular basis (health)		
overall	4.58	3.608
males	4.57	3.727
females	3.95	3.320
2.6 – to improve your skills (education)		
overall	4.51	3.548
males	4.80	3.563
females	3.44	3.614

TRAINING: It is an educational moment: the most important aspect is the skills improvement, especially among sportsmen. “To do physical activity” is the second most important item. “To enjoy friends” is more relevant for males than females. “To communicate with the group and with the coach” is more considered by females.

Table 5: During the training, how important is

cod - item	*mean*	*sd*
3.1 - to do physical activity (health)		
overall	6.00	3.775
males	5.97	3.724
females	6.00	3.849
3.2 – to enjoy friends. to have good time (fun)		
overall	4.71	3.530
males	4.97	3.674
females	4.30	3.253
3.3 – to improve your technique (education)		
overall	6.72	3.544
males	6.96	3.400
females	6.26	3.958
3.4 - to communicate with the group and with the coach (participation)		
overall	3.69	3.096
males	3.27	3.875
females	4.54	3.388

CHAMPION: For the “champion” is very important “to win a lot of competitions and games” (especially among males) and it is very important to “play well for the team and top help the team-mates” (especially among females). Fair play and technical excellence are more relevant for females, the physical performances contrariwise is more important for males.

Table 6: Think at the "champion". How important is for a "champion"

cod - item	*mean*	*sd*
4.1 - to win a lot of competitions and games (competition)		
overall	6.62	3.684
males	6.89	3.521
females	5.72	3.900
4.2 - to respect referees. rules and competitors (participation)		
overall	5.11	3.814
males	4.88	4.082
females	5.64	3.451
4.3 - to play for the team and to help team-mates (socialization)		
overall	5.78	3.644
males	5.63	3.799
females	6.73	3.680
4.4 – to train and to have a good physical (health)		
overall	4.52	3.424
males	4.93	3.208
females	4.06	3.783
4.5 – to be technically the best (education)		
overall	4.45	3.425
males	4.18	3.323
females	5.36	3.954

VALUE OF SPORT: The pupils from Cluj Napoca would suggest to start to practising sport "To have a healthy lifestyle": the opinion is really polarized, especially considering females respondents. "To have fun" and "to learn how to practice a sport" results to appeal more males respondents. "To get new friends" and "to have success on the field" results to appeal more females respondents.

Table 7: Think at one of your friends who doesn't practice any sport. You would suggest to do sport

cod - item	*mean*	*sd*
5.1 – to get new friends (socialization)		
overall	4.06	3.347
males	3.50	3.218
females	4.63	3.432
5.2 – to have a healthy lifestyle (health)		
overall	8.11	3.224
males	7.84	3.505
females	8.27	3.034
5.3 – to have fun (fun)		
overall	4.97	3.692
males	5.58	3.737
females	3.91	3.449
5.4 – to have success on the field (competition)		
overall	3.17	3.871
males	3.08	2.906
females	3.63	3.249
5.5 – to learn how to practice a sport (education)		
overall	4.28	2.833
males	4.46	2.924
females	3.81	2.562

Pupils not regularily engaged in sport

PHYSICAL EDUCATION: The main aspect of physical education in school is that it “is useful to develop body and mind”: the opinion is strongly polarized. Moreover physical education “completes the lessons, teaching values like discipline, respect and tolerance”, “it is useful to develop competitive spirit”, “it makes school more attractive” and it “allows to do physical activity on regular basis”.

Table 8: Physical education in school

cod - item	*mean*	*sd*
6.1 – it is useful to develop body and mind (education)		
overall	7.61	3.519
males	7.91	3.392
females	7.60	3.492
6.2 – completes the lessons. teaching values like discipline. respect and tolerance (participation)		
overall	5.47	3.228
males	5.25	3.119
females	5.19	3.285
6.3 – it is funny and it makes school more attractive (fun)		
overall	5.33	3.209
males	5.55	3.343
females	5.39	3.332
6.4 – allows to do physical activity on regular basis (health)		
overall	5.02	3.730
males	4.89	3.790
females	4.62	3.476
6.5 – strengths friendship and cohesion of class-group (socialization)		
overall	3.86	3.171
females	3.88	3.391
6.6 – is useful to develop competitive spirit (competition)		
overall	5.52	3.446
males	4.14	3.324
females	4.96	3.572

SPORT EVENT: While spectators of sport events, the pupils of Cluj Napoca are focused on technical and tactical plans. Both gender groups consider important also fair play. Males are more focused on spectacular dimension, females contrariwise pay greater attention to physical performances. The males enjoys more than females to follow sport with group of friends.

Table 9: Think at a game / sport event that you have recently watched (live or tv). What have you appreciated the most

cod - item	*mean*	*sd*
7.1 – Spectacular dimension (fun)		
overall	5.86	3.675
males	6.07	3.718
females	5.41	3.730
7.2 – technical and tactical plans (education)		
overall	5.96	3.639
males	5.81	3.751
females	6.14	3.563
7.3 – fair play (participation)		
overall	5.48	3.662
males	5.53	3.574
females	5.67	3.649
7.4 – agonism and your idol/team to win (competition)		
overall	5.02	3.644

males	4.91	3.554
females	5.20	3.672
7.5 – physical performance of athletes (health)		
overall	4.68	3.597
males	3.92	3.367
females	5.27	3.712
7.6 – friends with whom I watched the game (socialization)		
overall	4.37	3.831
males	4.92	3.977
females	3.54	3.695

CHAMPION: The “champion” is a winner: social skills and physical conditions are important as well. Looking at gender differences, “to be technically the best” is more important for females than males. The statistical evidences are influenced by the respondents who didn't indicate the gender.

Table 10: Think at the “champion”. How important is for a “champion”

cod - item	*mean*	*sd*
8.1 – to win a lot of competitions and games (competition)		
overall	6.44	3.866
males	6.22	3.927
females	6.18	*3.923*
8.2 – to play for the team. to help team-mates (education)		
overall	6.38	3.562
males	6.69	3.553
females	6.30	3.508
8.3 – to train and to have a good physical (health)		
overall	5.04	3.525
males	5.19	3.801
females	5.02	3.250
8.4 – to play in enthusiastic and spectacular way (fun)		
overall	4.32	3.585
males	4.21	3.496
females	4.93	3.863
8.5 – to respect rules. referees and competitors(participation)		
overall	4.97	3.569
males	5.26	3.566
females	4.55	3.519
8.6 – to be technically the best (education)		
overall	4.86	3.561
males	4.49	3.210
females	5.07	3.972

VALUE OF SPORT: “To do physical activity on regular basis” is a good reason to start to practice sport on regular basis: the opinion is strongly polarized. Also “to have success on the field” is a relevant element. Males would most likely start to have fun than females. Females contrariwise are more attracted by participating in championship and being part of group.

Table 11: Why would you start to practice sport on regular basis?

cod - item	*mean*	*sd*
9.1 – to get new friends (socialization)		
overall	3.88	3.141
males	4.03	3.208
females	3.32	2.847
9.2 – to have healthy lifestyle (health)		

overall	8.39	2.966
males	8.12	3.252
females	8.59	2.776
9.3 – to have success on the field (competition)		
overall	5.33	3.682
males	5.33	3.684
females	5.64	3.734
9.4 – to participate to the championship. to co-work with team/club(participation)		
overall	3.85	2.890
males	3.31	2.619
females	4.37	3.059
9.5 – to learn how to practice a sport (education)		
overall	4.24	3.185
males	4.34	3.525
females	4.26	3.942
9.6 – to have fun (fun)		
overall	3.79	3.175
males	4.80	3.243
females	2.98	2.844

Concepts under magnifying lense

COMPETITION: It is considered as quite important element of sport by the pupils of Cluj Napoca, especially by males respondents and by athletes. The “winning champion”, “to get a good positioning in the final ranking of the championship” and “to win” during the game are the most important issues. Finally “to have success on the field” is considered as attractive element in order to start to practice sport.

EDUCATION: It is the second most important aspect of sport. The peak of education is represented by the physical education in school, considered as complementary activity in the educational path of pupils. Also the trainings are strongly connected with the skills improvement. Finally, while spectators of sport events, the pupils pay great attention to the technical and tactical plans of the event.

FUN: The leisure dimension is the less considered by the pupils of Cluj Napoca, especially considering only females respondents. Among sportsmen, fun dimension is the fourth most important concept associated to sport. The most relevant item of this concept is the physical education, which makes school more attractive. Moreover “to enjoy the team-mates” during the training and to assist to spectacular sports events are considered as relevant issues.

HEALTH: It is the most important aspect of sport. It is universally recognized as the main benefits of sport activity, with very few differences according to the gender and by pupils engaged in sport and not-engaged in sport. The present research confirms the tendencies evidenced by the previous researches about this topic.

SOCIALIZATION: It is considered as relatively important aspect of sport. Among sportswomen, it is the second most important concept. The most important aspect of socialization is related to the “champion”, who plays for the team and helps the team-mates, and the game, where is very important “to play well for the team”.

PARTICIPATION: To participate to the championship is the main example of social participation in sport. The physical education in school is acknowledged as a tool to teach respect, tolerance, discipline and self-esteem. The “fair play” is also considered as important element while watching sport events.

Sport idols

Despite the fact that when she was competing, the respondents weren't even born, the most popular sport idol is Nadia Comanenci. The other great Romanian sport idol Gheorghe Hagi is second. The majority of athletes inside the top15 are Romanian (8): the nationality is often a common element between pupils and idols. The sixth place of Gabriela Szabo is interesting because she was born in Cluj district and she has Hungarian nationality: in Cluj Napoca there is a quite big Hungarian minority. The “international” sport idols can be considered as top-athletes in their disciplines and “global celebrities”.

Table 12: Sport idols, top 15

ranking. name	country	sport	votes	percentage
1. Nadia Comanenci	Romania	gymnastics	110	8.7 %
2. Gheorghe Hagi	Romania	football	75	5.9%
3. Rafael Nadal	Spain	tennis	48	3.8%
4. Cristiano Ronaldo	Portugal	football	46	3.6%
5. Roger Federer	Switzerland	tennis	39	3.1%
6. David Beckham	United Kingdom	football	32	2.4%
7. Gabriela Szabo	Romania	athletics	31	2.3%
8. Adrian Mutu	Romania	football	28	2.2%
9. Maria Sharapova	Russia	tennis	25	2.0%
10. Gheorghe Muresan	Romania	basketball	23	1.8%
11. Ilie Nastase	Romania	tennis	23	1.8%
12. Micheal Jordan	USA	basketball	22	1.7%
13. Cristian Chivu	Romania	football	17	3.2%
14. Micheal Shumake r	Germany	formula1	17	3.2%
15. Marius Urzica	Romania	gymnastics	15	1.2%
other names – 283			566	44.9%
missing			152	12.0%
TOTAL			1269	100%

Table 13: Sport idols, gender

ranking.gender	idols	percentage
1. males	870	68.5%
2. females	247	19.5%
missing	152	12.0%
TOTAL	1269	100%

Table 14: Sport idols, top10

ranking.sport	idols	percentage
1. football	412	35.5%
2. tennis	187	14.1%
3. gymnastics	134	10.5%
4. basketball	90	7.1 %
5. athletics	46	3.6 %
6. handball	42	3.3 %
7. boxing	29	2.3 %
8. formula1	22	1.7 %
9. ice skating	22	1.7%
10. swimming	22	1.7 %
other sports 34	119	9.5 %
missing	152	12.0%
TOTAL	1269	100%

Although the universe is composed by approximately the same number of males and females and despite the fact that the most popular sport idol is female, the big majority of idols are males. As predictable, the majority of idols are football players: one every three (the proportion is respected also among the top-15). Second place for tennis which has also four idols in the top 10. The third sport is gymnastics: this good performance is connected mainly to Nadia Comanenci and Marius Urzica (both in the top-15). Basket, athletics, boxing, formula1, ice skating and swimming are mostly related to top-athletes: respectively Gheorghe Muresan and Micheal Jordan, Gabriela Szabo, Lucian Bute (14), Micheal Schumaker, Evgeny Plushenko (12) and Michael Phelps (12). Handball is the exception: it is the sixth most mentioned sport but among the top15 there are not handball player. Volleyball is the most practised sport but it is not not among top-10 sports and there are not volleyball players among the top15.

Conclusions

The pupils regularly engaged in sport represents the 26.8% of the respondents, the pupils not engaged in sport activity are 72.7%. The most popular sports are football and volleyball, then basket and handball.

The main aspect of sport perceived by the pupils of Cluj Napoca is health. The pupils engaged in sport would suggest to practice sport "to have an healty lifestyle", the pupils not engaged in sport would start to practice sport for the same reason. Education, competition and socialization are important as well. Participation and fun are less considered. Males respondents considers fun more important than females. The pupils engaged in sport, besides health, consider also competition and socialization as very important. Sportsmen have the tendency to pay greater attention to competition and fun, sportswomen contrariwise pay more attention to socialization and participation.

The pupils engaged in sport consider "to play well for the team" as main aspect of the game: males consider very relevant also the score. The most important aspect during the regular season is participating to the championship; the training is perceived as educational moment. The pupils not engaged in sport, consider physical education "useful to develop body and mind": moreover it "teaches values as respect, tolerance and discipline" and "it makes school more attractive". While spectators, the pupils consider the technical and tactical plans as the most important aspect of the sport events.

The "champion" is universally perceived as a winner: the main sport idols are "national sport heroes", "global sport icons" or "number one" in their discipline. Almost one every two idols is football or tennis player. The big majority of sport idols are females.

Final considerations

Although we live in a complex and global society and in spite of the fact that sport includes several problematic aspects, the results of the analysis show a good awareness of the healthy value of sport among youth from Cluj Napoca. Health is considered as the main benefit: this element is very encouraging in the perspective to spread sport activity in the society. The good performance of concepts like education and socialization describes sport as healthy activity not just for body: involvement in sport can produce benefits on physical, intellectual and social plans.

The debate on the perception of sport and the potential of "sport and development" is very important and it deserves growing and growing attention, especially in crisis time: in fact, sport can play a relevant role in several future social challenges without necessarily requiring huge amounts of resources. For example it is proved that regular sport activity reduces the risk of several diseases: to increase the participation in sport means to reduce costs of public health and simultaneously to increase the level of wellness of citizens. Moreover, sport can act as a bridge to gather together the future generations of European citizens, it can be an effective tool to improve youth leadership and it provides citizens with new possibility of social participation and social inclusion.

The facilitations of debate and the positive to cooperation among different stakeholders seem to be two key-elements in reaching these goals. For these reasons, the intent of this research is to be element of inspiration for further investigations at grass-root level. Above all and according to the results, the aim of this research is to inspire future concrete projects and actions at grass-root level, in order to fully use sport to its full potential as tool of development. The NGO, the GO, the Academic Institutions and the private sector should be aware of the good predisposition of the youth evidenced by this research.

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YOUNG ATHLETES AND LATERAL CHOICES IN DIFFERENT SPORTS

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Abstract

Humans prefer to use a limb rather than the other, and not always the same for different tasks. Furthermore, people show a variable functional asymmetry: somebody is markedly right- or left-sided when performing different tasks, while others show various degrees of mixed laterality (Greenwood, 2007). Aim of this study is to investigate the lateral choices among young athletes practicing different sports. 390 young athletes (M: 234; F156) practicing sport in Emilia-Romagna and Abruzzo, Italy, aged 11-14 were divided in eight sport groups: Soccer, Athletics, Volleyball, Basketball, Other Team Sports (OTS: Rugby, Handball, Water Polo), Individual Sports (IS: Triathlon, Gymnastics, Swimming, Roller Skating, Rowing), Combat Sports (CS: Judo, Karate, Wrestling), Sport requiring a lateral choice (SLC: Fencing, Tennis). Different tasks were used (performance test) to assess lateral choices: 11 tasks for the hand, 4 for the foot, 5 for twist rotation. Lateral choices were assessed following two criteria: first, noting the side used by the subjects in writing, throwing or kicking a ball; second, computing an index, taking into account the number of right and left performances for all the tasks. In this case subjects choosing the right or left side in all the tasks (or all except one) were considered right or left sided; the other subjects were considered and named “inconsistent”. Writing, throwing and kicking sidedness data were then reported for each sport or sport groups such as frequency and percentage of subjects right, left or inconsistent in hand, foot and twist choices among these sport categories. Lefthanders in writing and throwing are highly represented in SLC (15% of the sample and 11% respectively) and volleyball (11%); in kicking, OTS is the highest represented category with left choices (29%), followed by basketball and soccer (23%). Hand, foot and twist sidedness are then described for each considered sport or sport group. Lefthanders are highly represented in volleyball and SLC (8%), inconsistent in OTS (22%). Left footed are mostly represented in SLC (30%), CS and soccer (21%); inconsistent in soccer (26%), IS and volleyball (23%). Left twisters are numerous in SLC (33%) and athletics (18%); inconsistent in OTS (76%) and IS (75%). Left-handed and left-footed are highly represented in SLC, CS and soccer. This could be due to selection factors and training tactical and strategic choices, according with Groius et al.(2000). Inconsistents are prevalent in OTS for the hand, in soccer for the foot and in all the sports involving twist direction.

Introduction

Laterality is the attitude of individuals to use their left or the right side in movements involving the use of one side of the whole body. Researches on laterality have been devoted for many years to different topics. Some authors deal with aspects linking the structure and the functions of the nervous system. As for other apparates, in the nervous system a higher development of a hemibody compared to the other can be observed, and functional and structural asimmetries have been reported. Typically, the hemispheres of the brain are asymmetrical with respect to their structure and function. For examples, right-handers own a left cerebral hemisphere with structural properties that are related with the better performance of the right vs. the left hand in many motor tasks (Teixeira, 2008). Then, atypical lateralization refers to relative symmetry, and a lesser asymmetry between the hemispheres is related to neurobehavioral problems (Toga & Thompson, 2003). It is still under debate if the phenomenon of laterality is mainly determined by genetic characteristics or environmental influences (Bishop, 1990; Bryden et al. 1997; Llaurens et al. 2009; Porac & Coren, 1981). Anyway, environmental influences affect the laterality of populations due to cultural and social features (Fagard & Dahmen, 2003), and this is true also for children (Janßen, 2000). Furthermore, left-handedness results to be a risk factor for injury in sport (Coren, 1989; Craft et al 1972; Emery, 2003; Gofin et al., 2004; Sahin et al., 2009; Wright et al., 1996).

In this field of study, it is problematic to compare the results of different researches as many methods to gather the data are used (Bishop, 1990; Bourassa et al., 1996). To assess laterality, some authors use questionnaires or observation (preference tests), whereas others ask their subjects to execute motor tasks (performance tests) (Doyen & Carlier, 2002; Dragovic & Hammond, 2007).

A lesser body of research analysed the links between laterality, motor performances and sport. The starting point in many studies is the observation that, in some sports (fencing, tennis, cricket, baseball etc.), there are more left-handers than right-handers, especially between high-level athletes or teams. Conversely, this trend is not observed in other ballistic sports (Brooks et al., 2003; Groius et al., 2000; Raymond et al., 2006). This allows to state that left-handers have some advantages compared to right-handers. Various hypotheses have been proposed to explain this. Are left-handers advantaged due to genetic characteristics? It is evident that manual laterality and also other kinds of laterality are, at least in part, genetically determined (Bryden et al., 1997; Grouios et al., 2000; Harris, 2010). Or are they favourite due to reasons related to environmental factors? (Loffing et al., 2010). Anyway, it is evident that left-handers have some advantages on a tactical and strategic perspective (Brooks et al., 2003; Hageman, 2009; Loffing et al., 2009) and that there is no reason to invoke any additional neurological advantage (Wood & Aggleton, 1989). Aggleton & Wood (1990) showed that in sports that do not offer a strategic advantage to a left-hander, the frequency of left-handed players at the top level is not higher than that found in the general population (no difference for snooker and bowling, and lower proportion in darts and golf). Moreover, left-handedness frequencies in interactive sports (like fencing, tennis, baseball, cricket) appear to be very high, when compared to non-interactive sports (gymnastics, swimming) and to the general population (Grouios et al., 2000; Raymond et al., 2006).

As in some sports the left-handers show to have some edges, the coaches are interested to select them because they can perform better than right-handers, or because they have potentialities to do so with training. Furthermore, coaches need often to direct the lateral choices of their pupils. In these cases, it can be supposed that the number of sportsmen that are directed to use their left side is affected not only by the characteristics of the sport, but also by the experience of the coach.

The purpose of this study is to analyse the phenomenon of laterality in a youth sport context. Preference-based tests were specifically used in order to verify:

1. The responses in the upper limb, lower limb, ocular and rotation laterality, and the relative gender differences.
2. The different lateral responses in young sportsmen in sport and everyday movements.
3. The laterality differences between young sportsmen practising sports with different lateral engagement.

Methods

383 young athletes (M: 230; F153) were involved. The participants were from North-centre Italy (200) and South-centre Italy (183).

For all the age classes, there were more male than female participants. For both the genders, the most represented age class was that of 12 years. 4% of participants practised Track and Field. Volleyball, soccer and basketball were represented, respectively, by 16%, 10% e 7% of the subjects, whereas the remaining 43% was represented by individual sports, of which the most numerous group was constituted by the “other sports” category.

The participants and their parents gave their written informed consent to participation and all the operators involved were preemptively instructed on the procedures to be used, in order to achieve a uniform and exact assessment of the different trials. The assessments were based on a questionnaire used to evaluate the youth sport practice, and on the performance in a battery of tests requiring a lateral choice. All the participants compiled the questionnaire, allowing to classify them according to the practised sport and training characteristics. The following parameters were recorded: training sessions per week (average: 2-3 sessions per week), training hours per session (average: 2 hours per session); training months per year (7 to 12 months per year). All the subjects practised the chosen sport for at least two years (to a maximum of height years) at the time the experimental sessions were carried out.

Figure 1: Distribution of participants, divided into age and gender subgroups

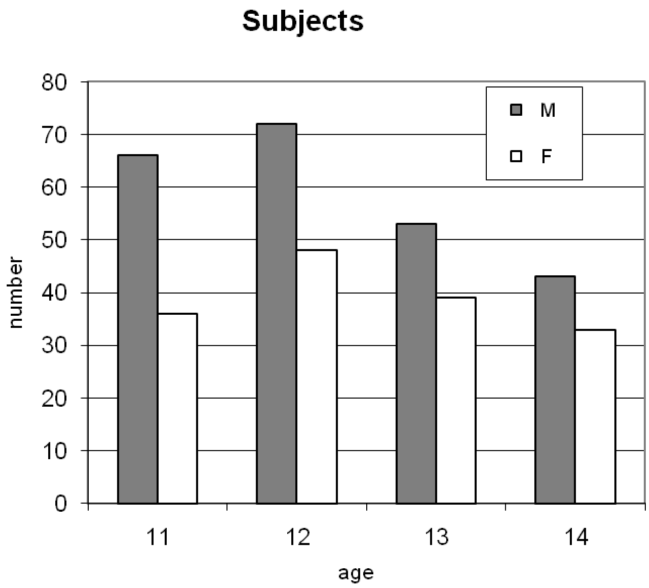

Table 1: Distribution of the subjects divided by practised sport

Sport	Gender		Total
	Males	Females	
Track and Field	44	47	91
Volleyball	23	37	60
Soccer	38	1	39
Basketball	27	1	28
Karate	13	8	21
Tennis	12	9	21
Roller skating	2	14	16
Swimming	11	7	18
Gymnastics	2	15	17
Triathlon	10	4	14
Rowing	11	3	14
Others (Judo, Wrestling, Fencing, Handball, Waterpolo, Rugby)	37	7	44

Assessment of lateral choices

The laterality tests consisted in miming sport or everyday gestures, according to the instructions provided by the operator. Eleven, four, five, and one items were selected to assess the lateral choices concerning the upper limb, the lower limb, the rotation and the visual laterality, respectively. The subject positioned himself opposite to the operator, in a seated or standing position, and he/she was asked to choice a limb (right or left) or a rotation sense, in a spontaneous and instinctive way.

The 21 items constituting the battery were:

- Throw a ball with one hand
- Drive a spike
- Wash your teeth with a toothbrush
- Comb your hair
- Make a paper ball with one hand
- Take a glass to drink
- Blow your nose
- Cut with a knife
- Mix the sugar in a cup 1 (the hand that mixed was recorded)
- Write your name (the writing hand was considered)
- Handgrip (push on a dynamometer)

- Mix the sugar in a cup 2 (the rotation sense of the teaspoon was considered)
- Drink from a low fountain from one side
- Turn towards a friend calling you from behind
- Turn around a chair
- Turning sense in an equilibrium test performed walking on a square
- Hop on one leg (the takingoff foot was considered)
- Kick a ball (the kicking foot was considered)
- Takeoff to jump with one foot (the takingoff foot was considered)
- Standup (from seated position) with a foot only
- Look through a tube

Laterality was assessed following two criteria: first, noting the side used by the subjects in all the tasks (such as writing, throwing or kicking a ball); second, computing the number of right and left choices for all the task groups (upper limb, lower limb, rotation side). The subjects choosing the right or left side (clockwise or anti-clockwise) in all the tasks (or all except one) were considered right- or left- sided. The other subjects were considered and named "inconsistents". Writing, throwing and kicking sidedness data were then reported for each sport or sport groups as well as frequency and percentage of subjects right, left or inconsistent in hand, foot and rotation choices among these sport categories.

Statistical analysis

The SPSS 15 Software was used to compute percentage values. Contingency tables were constructed including laterality, gender and sport as variables. The gender differences were analysed with Chi-Square tests, with significance set at alpha=0.05.

Results

Table 2 displays the left response percentages of the 21 considered items. For each group, the data have been ordered starting with the items with the lowest percentage of left-handed or anticlockwise rotation sense.

For the manual dominance, the item showing the lowest percentage of lefthanders was "throw a ball" (7.1%), and this is particularly evident in females (5.9%). The writing hand showed a slight higher percentage of left-handers. This value corresponded to that of the "drive a spike" and "brush your teeth" items (7.9%). Other everyday movements showed higher left-handers percentages, up to 10% in the “blow your nose” and “take a glass” tests. The “make a paper ball” item can be considered to be the least affected by environmental influences, since it presented the highest observed percentage of left-handers (11.7%). This is also the only item showing significant differences between males and females. Left-handed boys showed higher percentages than girls, the percentage values of which in this item were similar to those of the “writing hand”.

Concerning footedness, “kicking a ball” is the item showing the lowest percentage of left-footed (M 17.7% ; F 11.8%). However, this poportion was higher than all the items relative to the upper limb. Higher percentages of left-footed can be observed in items requiring the subject to stand up from the seated position (M 32.7; F 43.4%) and to hop on one foot (M 27%; F 42.8), showing significant gender differences. The highest proportion of left-footed was in the “take off to jump” test (about 43%).

Table 2: Proportion of left choices in the considered items

Kind of laterality	Item	% overall	% Males	% Females	Sig
HAND	Throw a ball	7.1	8.0	5.9	ns
	Drive a spike	7.9	7.5	8.6	ns
	Write your name	7.9	8.3	7.2	ns
	Wash your teeth	7.9	9.7	5.3	ns
	Cut with a knife	8.6	9.8	6.7	ns
	Hand-grip	8.8	9.3	8.1	ns
	Comb your hair	9.0	10.2	7.2	ns
	Mix the sugar 1	9.8	9.8	9.9	ns
	Blow your nose	10.1	11.1	8.6	ns
	Take the glass	10.1	11.5	7.9	ns
	Make a paper ball	11.7	14.2	7.9	<0.05
FOOT	Kick a ball	15.3	17.7	11.8	ns
	Hop on one leg	33.3	27.0	42.8	<0.01
	Stand-up	37.0	32.7	43.4	<0.05
	Take-off	43.0	42.0	44.4	ns
ROTATION	Mix the sugar 2	25.1	26.5	23.0	ns
	Turn towards a friend	42.1	41.2	43.4	ns
	Turn around a chair	49.6	48.4	51.3	ns
	Equilibrium test	51.6	56.2	44.7	<0.05
	Drink from a fountain	57.0	56.8	57.2	ns
EYE	Look through a tube	21.7	20.8	23.0	ns

Concerning the rotation items, the lowest percentage of subjects twisting left (anticlockwise) can be noted in the “mix the sugar” test (M 26.5 ; F 23%). Instead a higher percentage of anticlockwise cases was observed in the “turn around a chair” item (M48.4% ; F51.3%). An even greater percentage of left-twisting subjects was seen in the turning sense of the equilibrium test (M 56.2%; F 44.7%), the only rotation item showing gender differences ($p<0.05$). The “drink from a fountain” item is, among all the considered items of this group, that showing the highest proportion of anticlockwise, both in males and females (about 57%).

The eyedness task showed a left preference of 21.7%, markedly higher than those relative to upper limb, but lower than anticlockwise rotations. The “kick a ball” item is the only footedness task showing left- oriented choices lower than the ocular task.

In the analysis of laterality in different sport groups, track and field, soccer, volleyball and basketball have been singularly considered as in Table 1. On the contrary, sports including a smaller number of subjects and presenting affinities regarding the strategies in the lateral choice, have been grouped into a unique category, as indicated below:

- Other team sports (Rugby, Handball, Waterpolo)
- Combat sport (Judo, Wrestling, Karate)
- Other individual sports (Triathlon, Rowing, Gymnastics, Swimming, Roller skating)
- Racket sport (Tennis, Fencing)

Table 3 shows comparison among sports or sport groups, related to the left-side preferences observed in three items: "write your name", "throw a ball" and "kick a ball". These three items were selected because writing is the item most frequently considered in literature, while the others are of great interest in the field of sport.

Volleyball and basketball showed percentages of left-handed writers higher than 10%, while soccer and "other team sports" presented the lowest percentages of left-handers.

Regarding left-handedness, Racket Sports are particularly represented also in throwing (11.1%). After this sport group there are the Volleyball and Other Team Sports, while Basketball presented significantly lower percentages compared to writing. Other Team Sports showed a percentage of left-handers twofold in the throwing task compared to the writing task. Conversely, in the Combat Sport group the left-handers percentage in throwing was half (from 6.1% to 3%) compared to writing.

The highest number of subjects kicking with their left foot was observed in Other Team Sports (28.6%), Basketball, and Soccer (23%). Other Team Sports and Volleyball showed a lower proportion (10-11%). Therefore, in kicking, left-footed subjects were more numerous than the respective proportion noted for the upper limb, in writing and throwing tasks, in all the sports and sport groups observed.

Table 3: Left-sided responses in sports or sport groups. Percentages of left choices are reported for the three considered items (writing, throwing and kicking)

SPORT	ITEM (% left-sided)		
	Write your name	Throw a ball	Kick a ball
TRACK AND FIELD	6.6	8	14.9
SOCCER	5.1	5.1	23.1
VOLLEYBALL	11.1	9.5	11.1
BASKET	10	6.7	23.3
OTHER TEAM SPORTS	4.8	9.5	28.6
COMBAT SPORT	6.1	3	12.1
OTHER INDIVIDUAL SPORTS	8.8	7.5	10
RACKET SPORTS	14.8	11.1	18.5

The last section of the study concerns a classification of subjects into three categories: strongly left- and right-oriented subjects and "inconsistent", as indicated in the methods.

In table 4, the percentages of subjects classified strongly left- and right-sided are reported for the hand, foot and rotation categories and for the considered sport categories.

The highest percentages of strong left-handers were observed in Volleyball and Racket Sports. Inconsistents were numerous in Other Team Sports and Racket Sport. These two sport groups showed almost one third of the subject with a tendency to use the left upper limb (29.6%).

Regarding the foot preferences, strong left-footedness was prevalent in Racket Sports (29.6%), followed by Combat Sports (21.2%) and Soccer (20.5 %). Even in the Other Sports left-footedness was relevant, being 17.5 the minimum percentage (in Voleyball). Foot preference in inconsistent subjects presented a proportions of left-footed over 20% in

Soccer, Other Individual Sports, Volleyball and Track and Field. It is worth noting the low percentage of inconsistent subjects in the Racket Sport group (7.4%) and, furthermore, the great proportion of strongly left-footed subjects.

Table 4: Sport or sport group responses in hand, foot and rotation motor tasks. For each task, data concerning strongly left-sided or inconsistent subjects are reported.

SPORT	HAND (%)		FOOT (%)		ROTATION (%)	
	Left	Incon-sistent	Left	Incon-sistent	Left	Incon-sistent
TRACK AND FIELD	3.4	8.0	19.5	20.7	18.4	50.6
SOCCER	5.1	5.1	20.5	25.6	12.8	64.1
VOLLEYBALL	7.9	7.9	17.5	22.2	7.9	63.5
BASKET	6.7	10.0	20.0	13.3	13.3	53.3
OTHER TEAM SPORTS	0.0	28.6	19.0	19.0	14.3	76.2
COMBAT SPORT	3.0	12.1	21.2	15.2	12.1	69.7
OTHER INDIVIDUAL SPORTS	3.8	10.0	18.8	22.5	13.8	75.0
RACKET SPORTS	7.4	22.2	29.6	7.4	33.3	40.7

Concerning the anti-clockwise choices, these were preferred in the Racket Sports (33.3%) and were similar to those described for footedness. The other considered sports showed percentages from a minum of 7.9% in Volleyball to a maximum of 18.4% in Track and Fields. In twisting movements, inconsistent subjects were very numerous in comparison to inconsistents in hand and foot tasks, and to the other left- and right-oriented groups in twisting movements.

Discussion and conclusions

The aim of this work was to analyse the lateral choices in a sample of young athletes aged 11-14, practicing sport for at least two years. The observed percentages, regardless of the practised sport, showed that left-handers are proportionally less than those observed in the categories of foot and rotation movements. Left-handers proportion in the different manual items showed a range of variation smaller than that for foot and rotation items (4.6%). About the gender differences, the left-handed males are more than females in ten tasks out of eleven, in agreement with Lambert (2009), although only in one item, “make a paper ball”, significant gender differences were found. Probably, this item is the most generic of the battery and it is also the less conditioned by the environment.

Some differences observed in the left-handers responses among the different items can be explained considering the required precision or strength involved in the movement. Carbonaro et al. (1988) identified, with a multiple correspondence analysis, a “precision” factor, explaining the 34.5% of total variability, while a “strength” factor explained the 5.7% of lateral choices variability. The most discriminated items along the first factor were “mix the sugar”, “write your name”, and “blowing your nose”. Concerning the strength component, the most important items were “hand grip”, “drive a spike”, and “throw a ball”, the last being discriminated also for the precision factor.

In the present data, it can be noted that the items requiring high strength showed a higher proportion of left-handers than those requiring above all precision, such as “mix the sugar” and “blow your nose”. In the considered sample, the proportion of left-writers is lower than that of the left-sided for all the other items, probably because that item is the most influenced by the environment (Gabbard & Misaki, 1996).

In lower-limb items, the percentage of left-footed was quite heterogeneous (15.3 to 43 %). This is due to the different characteristics of the tests. The wider proportion of left-footed compared to right-footed was already recognized by Gabbard (1996), stating that “in those individuals who do not possess a strong biological propensity for right-side control, the probability of mixed-sidedness would be greater for the feet than for the hands”. Among the various considered items, kicking is a bi-pedal function, requiring a support and a kicking foot, namely it involves both strength and precision, differently from other tasks requiring mainly strength. Furthermore, the hopping item does not require a clear support or non-preferred foot function (Gabbard, 1996; Greenwood et al., 2007). The hopping and standing-up items, also according to Carbonaro (1988), are those that more than others involve a strength expression. The four items, therefore, present different peculiarities and this explains the different percentage of left-responders. The kicking test shows, compared to the others, a lower left-footed percentage (15.3% vs. 33-43%). This is in line with the results of Greenwood (2007). Canan (2008) reports that the motor control of fine movements is similar for upper and lower limbs. A different trend for males and females can be observed for the other three items. The females show values of left choice always higher than 40%, whereas, in the males, similar percentage can be seen only for the "take-off to jump" item. The gender differences are significant for the hopping and standing-up items. This leads to suppose that a high percentage of females feels the left lower limb as the strongest one.

In the sense of rotation, the different items show proportions that are even more variable than in for the foot laterality. The "mixing sense" is the item with the lowest proportion of left responses, whereas the "drink from a mountain" item presents the highest proportions of left choices.

In three items out of five, the clockwise rotation sense is the most frequent. In mixing, the clockwise sense is fairly predominant (75%). 81% of the subjects choosing the right hand to mix the sugar, rotate in clockwise sense. Similarly, 81% of those preferring the left hand, rotate in anticlockwise sense. Therefore, 19% of subjects show a rotation sense that is opposite with respect to the selected hand.

The other items involve rotations of the head or of the whole body, stimulating, in a different fashion for each item, the vestibular and visual apparatus. In these cases, left rotations are more than in mixing, with values of about 50%. The item showing the highest percentage of clockwise rotations is that involving the movement of the head only ("Turn towards a friend calling you from behind").

The only item concerning the ocular laterality, "look through a tube", showed 21.7% of left preferences. In the literature, a proportion of about 30% is reported when the required task consists in looking through a telescope leaned on a support, whereas this proportion is lower if the subjects is asked to look through a tube kept in the hand (Bourassa et al., 1996).

Comparisons amongst different sports and sport groups concerned, firstly, the "write", "throw", and "kick", items. The writing hand is with no doubt the most conditioned by the environment and it is subject to socio-cultural influences. In some sports (track and field and team sports), the writing item shows a left-handed percentage that are lower compared to throwing. Other sports (racket sports, combat sport, basketball) show an opposite trend, i.e. in those cases there are more left-handers in throwing than in writing. This leads to postulate the existence of a a social influence in sports in which throwing with the left-hand is advantageous.

The social influence, already present in everyday movements, can lead in a sport context to favor the left side for technical and strategic reasons in those sports involving a direct or indirect opposition (Alexandris, & Barkoukis, 2000; Grouios et al., 2000). Probably, in other individual sports, the pupil selects the right side for imitation, and the coach supports this choice because the technique is easier to handle with, being similar to that of the majority of athletes.

Concerning the lower limb, the proportion of preferences for the left side is higher than in the upper limb, in agreement with the literature (Gabbard & Misaki 1996). In fact, the left foot in kicking is preferred in a percentage, that is more than twofold compared to combat sports, soccer, track and field, basketball and racket sports. Volleyball and individual sports show instead similar laterality values in the three items. In the first group of sports, it could be useful to use the left foot due to technical or tactical chances. In this case, an influence of coaches can be hypothesized, according to Nonis (2006), stating that lower limb preference is task dependent.

Considering the three laterality indices individuated (strongly left- and right sided and inconsistent), racket sports show a percentage of left responses higher than other sports, although there are differences between the upper and the lower limb. In fact, for the upper limb the percentage of inconsistents is higher, whereas in the second the percentage of strongly left-sided subjects is the predominant one. Other sports are affected by specificities of the technique and the tactic. Soccer shows very high percentages of strongly left-sided and inconsistents for the lower limb. A similar behaviour can be seen for track and field and volleyball. Other team sports show high proportions of inconsistents for both the upper and lower limb. These results can be interpreted separately for each sport, considering the specific gestures performed with lower and upper limbs and the rotations, taking into account the eventual advantage of left rotations. The present results seem to confirm what reported in the literature about the advantages of left-handers. In fact, Loffing (2010) observed that right-handed players tend to use always the same tactic behaviour when they are opposed to left-handers, confirming that probably left-handers can be advantaged by this behaviour.In team sports, there is also the need to play on the left or right side of the field, using mainly one of the two sides, or being capable to use both the sides indifferently. For that reason, coaches aim to individuate left-handed or left-footed players, or direct inconsistent players to use the left side.

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STATIC AND DYNAMIC BALANCE IN YOUNG CLASSICAL FEMALE BALLET DANCERS

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Abstract

The goal of this study was to test static and dynamic balance in young well trained classical female ballet dancers with the aim to gather preliminary reference data about balance in female ballet dancers. Furthermore, we compared their results to the norms we have for the other groups of subjects. Twenty-seven female collegiate female ballet dancers volunteered for the study. Each subject performed six different balance tasks – still stance in: (i) parallel stance, (ii) single leg stance, (iii) closed eyes single leg stance, (iv) 2nd position on toes; and (v) active balancing on a tilt-board in parallel stance – frontal plane, and (vi) single-leg stance – sagital plane. Static balance tests were analyzed using a force plate, while dynamic balance was quantified using an electronic tilt board. All the repetitions (three repetitions of each task) were carried out in a random order, which in combination with rest intervals, minimized the potential learning and fatigue effects. Results showed an almost linear trend in the increase of all the body sway related parameters from parallel stance, over single leg stance to the closed eyes single leg stance; values for each being about a twofold. Majority of the parameters showed above-average values of the dancers` stability. Second position on toes showed comparable values to those from single leg stance with open eyes. The relative effects of increasing the task intensity were much less than known for normal subjects. In this context, also the dependence on visual feedback turned out to be less expressed. We hypothesize about the sport-, task-, and environment-specific balance adaptations. This, however, could be important information for practical implementation of balance exercise into balance training routine as well as a guide for the future research on the field.

Introduction

Balance is the ability to maintain the centre of gravity of the body while minimizing postural sway. It is a state of bodily equilibrium characterized by complete stillness, void of opposing forces on all sides. Adequate postural control is essential for normal daily activity and requires the integration of visual, proprioceptive and vestibular information. The degree to which individuals rely on those information sources depends on task difficulty, cognitive load (Pincus & Goldberger, 1994), motor skill (Lipsitz & Goldberger, 1992; Pincus, 1991) and pathology (Borg, Finell, Hakala, & Herrala, 2007; Kantz, 1999). Posturography is becoming increasingly important, both for diagnostic and monitoring purposes and for the evaluation of interventions (Peng et al., 1994; Thurner, Mittermaier, & Ehrenberger, 2002). Irregular pattern of the body sway, proven not to be simply a noise product, has become a prominent theme in fundamental studies of the postural control underlying mechanisms (Goldberger et al., 2000; Goldberger, Peng, & Lipsitz, 2002; Ladislao, Rabini, Ghetti, & Fioretti, 2008; Richman & Moorman, 2000). Aiming to this goal, various methodological approaches have been used, ranging from average scalar parameters such as mean sway path, sway area, sway velocity, or mean frequency (Sarabon, Rosker, Loefler, & Kern, 2010; Vette, Masani, Sin, & Popovic, 2010); to more complex analyses of recurrence, detrended fluctuation, sample entropy, diffusion coefficients, and Lyapunov exponents (Goldberger et al., 2000; Melzer, Benjuya, & Kaplanski, 2004; Priplata et al., 2002; Richman & Moorman, 2000; Stins, Michielsen, Roerdink, & Beek, 2009).

Classical ballet dancers are highly trained to be precise in their motor control. In their study, Lepelley and co-workers (Lepelley, Thullier, Koral, & Lestienne, 2006) have reported about practice specific adaptations showing less muscle co-contractions in single leg kicking activities. Moreover, Thullier and Moufti (Thullier & Moufti, 2004), showed better precision of open kinetic chain movements with one leg while still standing on the other leg in ballet dancers as compared to gymnasts.

Staying balanced is not a matter of staying rigidly in one spot. Balance is found by continually shifting the body to make subtle adjustments. Motor tasks in which a subject is asked to sustain a static position are examining so called static balance. On the other hand, dynamic balance can be basically tested by two types of tasks (a) standing as still as possible on an unstable surface or (b) standing on a stable surface but actively voluntarily shifting the centre of mass above the support base. Moreover, when testing considering balance underlying sensory-motor mechanisms we need to be aware of the complex sensory integration involving skin mechanoreceptors, proprioceptors, vestibular system and vision. The latter plays a major role and can also be specifically adapted to training history.

Ballet dancers exhibit high level of expertise in movement control and balance. Although individuals with a predisposition for better movement and balance, and its background neuromuscular control may likely be drawn to dancing, it is also very likely that the training dancers receive contributes to their skilled balance skill. Several studies have indicated better balance control in dancers than in control participants (Crotts, Thompson, Nahom, Ryan, & Newton, 1996; Golomer, Dupui, Séréni, & Monod, 1999). However, the significant differences have primarily been reported for highly demanding balance tasks, which are not predominantly represented in everyday life (Hugel, Cadopi, Kohler, & Perrin, 1999).

The goal of this study was to test static and dynamic balance in young well trained classical female ballet dancers with the aim to gatherpreliminary reference data about static and dynamic balance in young female ballet dancers. We hypothesized that female ballet dancers will show significantly better results in balance tests, especially when static balance is considered. In the discussion we illuminate the balance results from this study with those from our previous studies on the non-trained young healthy subjects, soccer players and cyclists.

Methods

Sample

Twenty-seven female collegiate classical female ballet dancers (age 15.2 ± 1.1 years, body height 164.9 ± 5.5 cm, body weight 51.0 ± 6.2 kg) volunteered for this study. The protocol was consistent with the Helsinki Declaration and Ovied Convention and was approved by the National Ethical Committee. Before the enrollment, the dancers and their parents were thoroughly informed about the aim, measurement protocol, benefits, and potential risks of the study. Since all the dancers were less than 18 years old on the dates of the measurements, the document of informed consent was undersigned by their parents.

Measurement protocol

The measurements were carried out during three consecutive days. In order to avoid external disturbance factors, the entire procedure was carried out in a separate room at the ballet school. This way concentration was maximized. First, each subject was exposed to a 15-minute standardized warm-up including locomotion activities, stretching, activation, and finally, balance exercises. After a short rest, a subject performed six different balance tasks – four static balance tasks (still stance in: parallel stance (PS), single leg stance (SL_{OE}), closed eyes single leg stance (SL_{CE}), and ballet specific 2nd position on toes stance (PS_{2ND})) and two dynamic balance tasks (active balancing on a tilt-board in parallel stance (TB_{PS}) – frontal plane and single-leg stance (TB_{SL}) – sagital plane). Throughout the static balance tasks the knees had to be fully stretched, however, they had to be active and not in a position of locking the joint. During the active balance tasks the trunk was lean forward and 40 to 50° flexed position was sustained at the knees and hips. Subjects were instructed to focus on the reference point marked ion the wall in front of them and to stand as still as possible throughout the balance task. For the SLCE vision was restricted using a dark band put over the eyes of a subject. Static balance tasks lasted for 60 s, while both dynamic balance tasks lasted for 40 s. Each task was carried out three times. Random order and 3- to 5-minute rest intervals between the repetitions were used in order to minimize learning effect and potential fatigue development.

Data Analysis

Measurement values of COP sway (i.e. body sway (BS)) were acquired by the use of a force plate (AMTI, Watertown, USA) with a sampling frequency of 1000 Hz and signals were stored on a personal computer for further analysis. The COP curve was quantified with custom-written software (LabView, 8.1; NI, Texas, USA) using the following parameters: the velocity of the common COP movement (V_{Σ}), the velocity in anterior-posterior and medial-lateral directions ($V_{a\text{-}p}$ and $V_{m\text{-}l}$, respectively), the average amplitudes of COP sway in anterior-posterior and medial-lateral directions ($A_{a\text{-}p}$ and $A_{m\text{-}l}$), and the median frequencies of oscillation calculated from the power spectrum in anterior-posterior and medial-lateral directions ($F_{a\text{-}p}$ and $F_{m\text{-}l}$) and their sum value (F_{Σ}). All the parameters were calculated as an average value of the 60-second trial.

The test on the electronic tilt board (TB) was conducted in two ways. The first way tested the ability of dynamic both-legs-parallel balancing in the medio-lateral direction, whereas in the second one, the participant was trying to maintain his balance in the position of single leg support and his instability in the antero-posterior direction. In both tests, the subject's hands were on his hips, with his gaze directed at a reference point two meters in front of him. The participant had been instructed to return to the position of active balancing as soon as a loss of balance occurred. An electronic position sensor built in the device and a micro computer calculated the parameters below which reflected the quality of performance of the balance task: (i) time percentage of active balancing (R_{AB}), (ii) normalized number of losses in balance – number of touches with edge of the balance board (E_{10s}), (iii) mean angle velocity during active balancing (V_{AB}), and (iv) mean oscillation frequency during active balancing (F_{AB}).

For statistical analyses SPSS 13 software (SPSS Inc., Chicago, USA) was used. A three-repetition average of each individual parameter was calculated for each of the balance tasks and taken for further statistical analysis. Descreptive statistics was carried out. Repeated-measures analysis of variance (RANOVA) was used to test the differences among different balance tasks of the same type. Paired t-test were used post-hoc to test the differences in parameters for pairs of the balance tasks. When F ratios were significant, post hoc comparisons of mean values were analyzed using a Bonferroni multiple-comparison test. In case when the distribution turned out not to be normal, non-parametric statistical tests were applied. Additionally, Pearson correlation coefficients were used to observe inter-relations between the measured parameters. An alpha error of 5 % was used to consider the difference statistically significant.

Results

Results of descriptive statistics for all the static balance tests are presented in Table 1. Distributions of $V_{m\text{-}l}$ and $A_{m\text{-}l}$ in PS_{2nd} were not normal and therefore non-paramtric tests were applied. The three COP velocity parameters (V_{Σ}, $Va_{\text{-}p}$ and $V_{m\text{-}l}$) showed statistically significant differences among the balance tasks ($p < 0.001$). Pairwise comparisons of the same velocity parameters revealed differences in all other pairs, but not for the SL_{OE} vs. PS_{2nd}. Very similar results turned out for the amplitude related parameters ($F = 128.8$ and 66.1 for $A_{m\text{-}l}$ and $A_{a\text{-}p}$, respectively). Again, the pairwise comparison did not show statistically significant level for the same comparison of the stances ($p \geq 0.05$). However, frequency parameters (F_{Σ}, $F_{a\text{-}p}$, and $F_{m\text{-}l}$) behaved in a slightly different manner. If only all the three frequency related parameters were statistically significantly different among the tasks ($f = 25.9$ to 70.4, $p < 0.05$), the three more difficult variations (SL_{OE}, SL_{CE}, and PS_{2nd}) were more alike. This was proven with only one out of twelve pairwise comparisons were statistically significant (SL_{CE} vs. PS_{2nd} for F_Σ, $p < 0.05$).

This data show that velocity and amplitude parameters behave in a similar way; however, frequencies do not necessarily mirror these changes. Pearson correlation coefficients supported the observation about the strong interdependency between COP velocity and COP amplitudes (Table 2). However, the correlation between COP velocity and COP frequencies were much lower (average R^2 for all pairs 0.32).

Table 1: Descriptive statistics for COP sway parameters for all static balance tasks.

Param.	Task	Mean	St. Dev.	Min.	Max.	Skew.	Kurt.	K-S p
V_Σ	PS	0.036	0.004	0.028	0.046	0.238	-0.237	0.987
	SL_{OE}	0.064	0.012	0.048	0.092	1.176	0.588	0.995
	SL_{CE}	0.169	0.059	0.098	0.323	1.295	1.346	0.998
	PS_{2nd}	0.067	0.016	0.045	0.122	1.581	3.814	0.381
$V_{m\text{-}l}$	PS	0.021	0.002	0.017	0.026	0.104	-0.366	0.103
	SL_{OE}	0.041	0.009	0.028	0.064	1.313	1.125	0.152
	SL_{CE}	0.094	0.025	0.061	0.166	1.479	2.191	0.255
	PS_{2nd}	0.043	0.015	0.025	0.102	2.456	8.240	0.120
$V_{a\text{-}p}$	PS	0.025	0.003	0.019	0.033	0.269	-0.094	0.897
	SL_{OE}	0.041	0.007	0.032	0.059	0.960	0.068	0.743
	SL_{CE}	0.120	0.052	0.063	0.241	1.202	0.751	0.384
	PS_{2nd}	0.042	0.007	0.029	0.058	0.443	0.078	0.227
$A_{m\text{-}l}$	PS	0.002	0.000	0.001	0.002	0.348	-0.166	0.257
	SL_{OE}	0.005	0.002	0.003	0.010	1.607	1.586	0.676
	SL_{CE}	0.016	0.006	0.009	0.034	1.653	2.923	0.318
	PS_{2nd}	0.005	0.002	0.003	0.014	2.616	9.078	0.588
$A_{a\text{-}p}$	PS	0.002	0.000	0.002	0.003	-0.213	-0.539	0.318
	SL_{OE}	0.005	0.001	0.003	0.008	1.080	0.229	0.357
	SL_{CE}	0.022	0.012	0.009	0.051	1.492	1.737	0.259
	PS_{2nd}	0.005	0.001	0.003	0.008	0.835	0.327	0.186
F_Σ	PS	1.271	0.179	0.991	1.603	0.471	-0.850	0.311
	SL_{OE}	1.472	0.361	1.055	2.279	0.902	-0.070	0.906
	SL_{CE}	1.821	0.318	1.348	2.393	0.355	-1.047	0.606
	PS_{2nd}	1.937	0.336	1.473	2.745	0.624	-0.036	0.297
$F_{m\text{-}l}$	PS	0.807	0.171	0.560	1.162	0.736	-0.350	0.492
	SL_{OE}	0.750	0.220	0.454	1.219	0.737	-0.736	0.402
	SL_{CE}	0.747	0.135	0.531	1.080	0.719	0.383	0.903
	PS_{2nd}	1.192	0.311	0.683	1.885	0.491	-0.171	0.247
$F_{a\text{-}p}$	PS	0.464	0.058	0.400	0.631	1.584	2.324	0.793
	SL_{OE}	0.722	0.187	0.441	1.248	1.253	1.802	0.562
	SL_{CE}	1.074	0.275	0.722	1.755	0.687	-0.222	0.980
	PS_{2nd}	0.744	0.110	0.570	0.966	0.184	-1.061	0.885

Table 2: Correlation coefficients (R2) calculated between velocity and amplitude or velocity and frequency parameters, respectively

	PS		SL_{OE}		SL_{CE}		PS_{2ND}	
	V_{ML}	V_{AP}	V_{ML}	V_{AP}	V_{ML}	V_{AP}	V_{ML}	V_{AP}
A_{ML}	0.90	0.70	0.97	0.82	0.98	0.81	0.99	0.55
A_{AP}	0.72	0.90	0.88	0.96	0.88	0.99	0.41	0.94
F_{ML}	0.28	0.35	0.36	0.39	0.37	0.14	0.36	0.17
F_{AP}	-0.04	-0.33	0.58	0.57	0.52	0.83	0.07	0.57

Results of descriptive statistics for the dynamic balance tests are presented in Table 3. All the parameters were normally distributed.

Table 3: Descriptive statistics for dynamic balance tests on a TB

Param.	Task	Mean	St. Dev.	Min.	Max.	Skew.	Kurt.	K-S p
R_{AB}	TB_{BL}	62.00	7.85	50.33	83.50	0.77	0.82	0.865
	TB_{SL}	60.69	11.67	41.63	88.00	0.69	0.25	0.851
V_{AB}	TB_{BL}	43.83	10.07	29.42	66.15	0.67	-0.10	0.734
	TB_{SL}	40.30	8.98	23.68	55.43	-0.03	-0.99	0.724
E_{10s}	TB_{BL}	5.86	1.76	3.42	10.17	1.06	0.44	0.399
	TB_{SL}	5.18	1.75	1.63	10.13	0.55	1.60	0.741
F_{AB}	TB_{BL}	2.00	1.08	0.93	5.74	2.27	5.36	0.216
	TB_{SL}	2.75	1.15	1.01	7.01	2.04	6.65	0.547

Discussion and conclusion

Results of this study gave us an insight into the postural profile of the young classical female ballet dancers as a specific group of individuals whose conditioning is strongly focused on balance and coordination. Furthermore, using a set of the established balance tests, we are now able to compare results of the female ballet dancers with our previous normative values of healthy control subjects, elderly people, cyclists, soccer players, etc. From that point of view we can conclude that young dancers exhibit higher levels of static balance, which seems less dependent on the visual feedback than it was the case in the other mentioned groups of subjects. Similarly, also the increase in the observed parameters of static and dynamic balance in the single-leg versus the two-legs balance tasks turned out to be less obvious in the group of the female ballet dancers. However, the basic static parallel stance showed values comparable to the normal subjects, while female ballet dancers were dominating also in the dynamic parallel stance task on the tilt board. The intensified active balancing in the 2nd position, involving calf muscles` activity, decreased support area and slightly increased centre of body mass, resulted in the increase of all the observed parameters relative to the normal parallel stance. This results of the 2nd position stance were partly similar to those of the single leg stance (velocity, average amplitudes and mean frequency of the COP), while maximal amplitudes of the COP were not. The latter were consistent with the expectations.

Balance is achieved through the coordination of three body systems: the vestibular system, motor system and visual system. The vestibular system is located in the inner ear, the motor system is made up of muscles, tendons and joints, and the visual system sends signals from the eyes to the brain about the current position of the body. Training allows sportsmen to acquire new balance control abilities, possibly differing according to the discipline practised. The data of Perrin et co-workers (Perrin, Hugel, & Perrot, 2002) indicate that regular pracictice of a high-skill activity facilitates proprioceptive input and improves both performance and balance control. On the other hand, biological process of maturation alone, was also reported (Golomer, Dupui, & Monod, 1997) to have the effect on body sway characteristics (i.e. higher oscilation frequencies and importance of cues).

Dancers, possibly as a result of focused balance training, exhibit different dynamic patterns of postural sway than normal untrained subjects (Schmit, Regis, & Riley, 2005). Explanations for the above-average results of the female ballet dancers in our study, and furthermore the below-average relative change of the body sway parameters after vision elimination, can be searched for in the balance underlying mechanisms.

Previous studies on dancers have shown adapted spinal and supraspinal control mechanisms which are reflected in postural task execution. Simmons (2005) supported the prediction that ballet dancers have significantly faster long-latency neuromuscular responses than controls and are significantly more consistent in muscle activation. His findings basically indicate a superior postural control mechanism in trained dancers and may explain the ability of dancers to maintain static balances over a small base of support. Somehow contrasting to that Nielsen, Crone and Hultborn (1993) reported that the segmental spinal excitability by H/M ratio is significantly larger in the moderately and well-trained subjects than in the untrained subjects but smaller in the ballet dancers. The authors therefore suggested that both the amount and the type of habitual activity may influence the excitability of spinal reflexes.

The relative effect of the vision restriction during balancing dancers was much smaller in ballet as compared to the results of the normal healthy subjects (average relative change in V_{Σ} 264% vs. 395% respectively). Results of our study are supporting the previous reports mentioning the domination of somatosensory/proprioceptive input over the visual in dancers (Golomer & Dupui, 2000). Furthermore, results of the study recently conducted by Jola (2010) additionally support the dominating role of proprioception, since he found out the above average joint repositioning precision in trained ballet dancers. We can say that vision plays an important role in movement learning in dance and provides basic control over balance, spatial orientation and ensemble coordination. Therefore, in order to control their movements, dancers have to rely on proprioception in order to focus visual attention on external cues.

To summarize, we can say that the results of this study provide us with the limited – however important for the start of the research on this field – normative values of two established balance tests in young classical female ballet dancers. Additionally, some basic relationships between the base of support and vision manipulation were revealed suggesting to be training specific. Finally, the general inter-relation between amplitude and velocity of the COP, but not frequency of oscillations, was observed. We believe that this study represent an important first step in the series of studies about specific motor control and motor behavior adaptations taking place as a result of classical ballet dance training.

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MOTOR AND MORPHOLOGICAL DIFFERENCES BETWEEN YOUNG HANDBALL PLAYERS FROM THREE AGE GROUPS

Marko Šibila, Uroš Mohorič & Primož Pori

Abstract

The study aimed to establish whether any statistically significant differences exist between three age categories of elite young Slovenian handball players in terms of the results achieved in some motor and morphological parameters. For this purpose, members of the Slovenian national team born in 1990 and 1991 were selected so that their average respective age was 17, 19 and 21 years. The set of motor measures included 10 parameters covering various motor areas relevant to handball. The measures defining the subjects' morphological status included 8 parameters or appropriately calculated indices (Šibila and Pori, 2009). The number of subjects differed each year, although all three measurements were carried out with the 12 subjects included in our study. All measurements were conducted by the same people, using the same measurement technology. The results were processed with descriptive statistics methods and the differences between the groups were established using an analysis of variance. The results showed that statistically significant differences between young handball players aged 17, 19 and 21 could not be confirmed in any of the studied parameters. Obviously, 17 is the age at which those players who were included by their coaches among the ranks of talented national team players have reached their biological maturity in morphological and motor terms. The majority of morphological characteristics and motor abilities are highly genetically conditioned. Thus, no statistically significant differences were established between players older than 17 years in terms of the discussed parameters. Evidently, the training factors do not provide a sufficiently strong stimulus for the development of motor abilities.

Introduction

The physical part of a team handball game consists of a combination of intense, intermittent activities such as running, sprinting, jumping as well as regular struggles between players – holding and pushing (Jensen, Johansen, & Liwendahl, 1999). Morphological characteristics of the body and motor abilities certainly have a great influence on an outstanding performance in handball (Jensen, Johansen, & Larsson, 1999; Šibila & Pori, 2009, Mohamed, et al., 2009). That is particularly typical of top handball, where the advantages of players with a suitable morphological and motor structure are evident (Rannou, Prioux, Zouhal, Gratas-Delamarche, & Delamarche, 2001). Recent research studies dealing with the morphological profile of a top-level handball player highlighted that they are characterised by a prevailing mesomorphic somatotype with a touch of ectomorphy, that is, with a pronounced longitudinal dimensionality of the skeleton (Šibila & Pori, 2009). In terms of handball players' motor structure, the most prominent are the explosive and elastic power of the legs, arms and shoulder girdle, sprint speed and specific aerobic endurance (Šibila, 1989; Jensen, Johansen & Liwendahl, 1999). Due to the above, measurements of morphological physical characteristics and motor abilities are used in the identification and further selection of talented individuals (Šibila, 1996). Apparently, in sport games performance also correlates with some other abilities, characteristics and qualities (Falk, Lidor, Lander, & Lang, 2004). In Slovenia, the aim of the systematic measurements of handball players at the national level is to objectivise the assessment of an individual player's talent and thus influence their inclusion in national teams at various development levels (Šibila, 2009). In small countries it is particularly important that the monitoring of players' development is systematically supported and underpinned by scientific findings (Bloomfield, Ackland, & Elliot, 1994). In addition, the acquired results are used to help plan the training of the measured individuals (Šibila, 2009). Namely, the selection of talented players is a continuous process of identification of those who, at different development levels, meet the requirements for joining handball teams (Mohamed, et al., 2009). Yet it should be considered that the complexity of identifying talent relates to both a genetic predisposition (Bouchard, Malina, & Pérusse, 1997) and the capacity to improve through intensive training (Ericsson, Krampe, & Tesch-Römer, 1993; Reilly, Williams, Nevill, & Franks, 2000). To acquire relevant data from the discussed areas, a special measurement system was developed in Slovenia for three age categories of young handball players of the national team, namely with a respective average age of 17, 19 and 21 (Šibila, 2009). The applied measurement procedures covered the majority of abilities and characteristics relevant to handball players' efficiency.

Our study aimed to establish whether any statistically significant differences exist between three age categories of elite young Slovenian handball players in terms of the results achieved in some motor and morphological parameters. We wanted to ascertain whether biological development and the effect of training elite Slovenian handball players at an age between 17 and 21 bring about any changes in the morphological physical and motor areas.

Methods

Sample

In the framework of regular measurements of morphological physical characteristics of male handball national team players of younger age categories, we measured 12 players born in 1990/91. The measurements were carried out in 2007, 2008 and 2010. The number of subjects differed each year, although all three measurements were carried out with the 12 subjects included in our study. At the time of measurement, the study subjects were 17.3±0.3, 18.8±0.3 and 20.6±0.3 years old on average. Their average body height was 187.3±5.9 cm and body mass 89.5±11.0 kg.

Variables

The assessment of morphological physical characteristics was based on the standard anthropometric battery with 24 dimensions used to calculate the percentage of muscle and bone mass, subcutaneous fat values and the subject's somatotype (Duquet & Hebbelinck, 1977).

Table1: Sample of variables

Test	Measured capacity	Measuring unit
Body height	Longitudinal dimension of the body	mm
Body weight	Body mass	kg
% of muscle mass	Amount of muscle mass	%
% of bone mass	Amount of bone mass	%
% of body fat	Amount of body fat	%
Ectomorphy	Ectomorphic component of somatotype	share
Mesomorphy	Mesomorphic component of somatotype	share
Endomorphy	Endomorphic component of somatotype	share
5-m sprint – standing start	Sprint speed	seconds
10-m sprint – standing start	Sprint speed	seconds
20-m sprint – standing start	Sprint speed	seconds
5-m sprint – flying start	Sprint speed	seconds
10-m sprint – flying start	Sprint speed	seconds
20-m sprint – flying start	Sprint speed	seconds
"30-15"$_{IFT}$	Aerobic endurance	km/h
VO_2max	Maximal O_2 consumption	ml/min/kg
Squat Jump	Explosive power of leg	cm
Counter Movement Jump	Elastic power of leg	cm

Somatotypes were determined using Heath-Carter's method (Carter, & Heat, 1990). Endomorphic, mesomorphic and ectomorphic components were calculated with a computer on the basis of formulas (Duquet, Van Gheluwe, & Hebbelinck, 1977). The assessment of the explosive and elastic power of the legs was made using the Opto Jump device; the study subjects performed two different jumps: a squat jump (SJ) and a counter movement jump (CMJ). The ability to generate sprint speed was assessed using sprint times over 5, 10 and 20 m with a standing start (T_{5m}, T_{10m} and T_{20m}) and a flying start (FT_{5m}, FT_{10m} and FT_{20m}). Running endurance (maximum aerobic speed) was assessed using the $30\text{-}15_{IFT}$ test (Buchheit, 2005a; Buchheit, 2005b). This is an intermittent fitness test (with interruptions) performed on a handball court – 30 s of running and 15 s of rest. The subjects were running at a pace dictated by a sound signal. The running speed increased with each repetition and the runners persevered until exhaustion or so long as they were capable of running the specific distance foreseen in the interval. The obtained result enables the approximate maximum use of oxygen to be calculated using the following formula: VO_{2max}(ml/min/kg) = 28.3 – 2.15 * G – 0.741 * A – 0.0357 * P + 0.0586 * A * V + 1.03 * V, where: G is gender (1 = male, 2 = female), A is age, P is weight and V is the final velocity recorded in the test. All measurements were conducted by the same people, using the same measurement technology.

Data analysis

The data were analysed using the statistical package SPSS 16.0. Basic parameters of the distribution of variables were calculated (mean, standard deviation, minimum and maximum values, kurtosis, skewness and Kolmogorov-Smirnov test of variables). A one-way analysis of variance (one-way ANOVA) was used to test the differences among the age categories (age 17, 19 and 21 years). A probability level of 0.05 or less was taken to indicate significance.

Results

Table 1 presents the basic statistical characteristics of selected morphologic and motor parameters. The table shows average values, standard deviations, minimum and maximum values, kurtosis, skewness and significance of the Kolmogorov-Smirnov test.

Table 2: Basic statistical characteristics of all parameters and all groups

Parameter	$\bar{x}$	s	min	max	kurt	skew	pK-S
Age	18.9	.8	16.7	20.7			
BH	187.2	5.9	174.0	196.9	-.316	-.551	.712
BM	89.5	11.0	70.1	109.9	-.662	-.024	.481
%MM	46.7	1.8	42.5	50.4	.192	-.249	.602
%BM	15.8	1.3	13.3	18.1	-.948	-.023	.477
%FM	12.7	2.9	8.5	19.4	-.636	-.508	.579
Ecto	2.1	0.7	.2	3.6	1.408	-.851	.881
Meso	5.1	.9	2.9	6.6	-.301	-.154	.606
Endo	3.2	.8	2.1	5.1	-.296	.671	.755
T_{5m}	1.10	.07	.97	1.28	.-.221	.576	.759
T_{10m}	1.85	.10	1.69	2.07	-.651	.452	.562
T_{20m}	3.12	.17	2.86	3.46	-.903	.310	.624
TF_{5m}	.67	.04	.56	.73	1.206	-.595	.517
TF_{10m}	1.29	.06	1.18	1.39	-.998	-.125	.574
TF_{20m}	2.49	.12	2.25	2.72	-.889	.148	.814
"30-15"$_{IFT}$	19.69	1.15	17.5	21.5	-.935	-.181	.793
Vo_{2max}	50.9	2.66	46.20	55.57	-.950	-.128	.532
CJ	35.1	4.9	27.2	44.7	-1.028	.230	.615
CMJ	36.7	5.4	27.9	48.4	-.814	.193	.566

Legend: $\bar{x}$ - average values; s - standard deviations; min – minimum values; max - maximum values; kurt – kurtosis; skew – skewness; pK-S – significance of the Kolmogorov-Smirnov test; : BH - Body height; BM - Body mass; %MM - Amount of muscle mass; %BM - Amount of bone mass; %FM - Amount of body fat; Ecto - Ectomorphic component of somatotype; Meso - Mesomorphic component of somatotype; Endo - Endomorphic component of somatotype; T_{5m} - 5-m sprint – standing start; T_{10m} - 10-m sprint – standing start; T_{20m} - 20-m sprint – standing start; TF_{5m} - 5-m sprint – flying start; TF_{10m} - 10-m sprint – flying start; TF_{20m} - 20-m sprint – flying start; "30-15"$_{IFT}$ – velocity at the end of intermittent fitness test; Vo_{2max} - Maximal O_2 consumption; SJ - Squat Jump; CMJ - Counter Movement Jump.

The data reveal that all measured parameters were normally distributed. The following tables show the results of one-way analyses of variance based on which we established whether there were any statistically significant differences among the three different age categories of players.

Table 3: Mean values and differences in morphological parameters among the three different categories

Parameter	BH	BM	%MM	%BM	%FM	Ecto	Meso	Endo
17 years	186.5	89.2	46.1	15.5	12.8	2.04	4.9	3.1
19 years	187.6	89.3	46.5	15.9	12.9	2.24	5.0	3.3
21 years	187.7	89.9	47.6	16.2	12.7	2.13	5.2	3.2
Sig. F	.872	.984	.984	.449	.984	.803	.801	.845

Legend: BH - Body height; BM - Body mass; %MM - Amount of muscle mass; %BM - Amount of bone mass; %FM - Amount of body fat; Ecto - Ectomorphic component of somatotype; Meso - Mesomorphic component of somatotype; Endo - Endomorphic component of somatotype.

Table 3 shows that no measured and calculated morphological parameter revealed any statistically significant differences between the three different age categories.

Table 4: Mean values and differences in motor parameters among the three different categories

Parameter	T_{5m}	T_{10m}	T_{20m}	TF_{5m}	TF_{10m}	TF_{20m}	"30-15"$_{IFT}$	Vo_{2max}	SJ	CMJ
17 years	1.11	1.86	3.14	.67	1.30	2.51	19.79	50.80	33.3	35.5
19 years	1.10	1.84	3.11	.68	1.30	2.48	19.54	50.66	34.2	37.0
21 years	1.10	1.84	3.11	.66	1.29	2.47	19.75	51.51	37.7	37.5
Sig. F	.971	.912	.905	.575	.889	.727	.858	.714	.064	.624

Legend: T_{5m} - 5-m sprint – standing start; T_{10m} - 10-m sprint – standing start; T_{20m} - 20-m sprint – standing start; TF_{5m} - 5-m sprint – flying start; TF_{10m} - 10-m sprint – flying start; TF_{20m} - 20-m sprint – flying start; "30-15"$_{IFT}$ – velocity at the end of intermittent fitness test; Vo_{2max} - Maximal O_2 consumption; SJ - Squat Jump; CMJ - Counter Movement Jump.

Table 4 shows that no measured and calculated morphological parameter revealed any statistically significant differences between the three different age categories.

Discussion

The results show that statistically significant differences between young handball players aged 17, 19 and 21 could not be confirmed in any of the studied parameters. Obviously, 17 is the age at which those players who were included by their coaches among the ranks of talented national team players have reached their biological maturity in morphological and motor terms. The majority of morphological characteristics and motor abilities are highly genetically conditioned. Thus, no statistically significant differences were established between players older than 17 years in terms of the discussed parameters. Evidently, the training factors do not provide a sufficiently strong stimulus for the development of motor abilities.

The finding with the greatest relevance for practice is that, on average, young handball players reach their biological maturity at the age of 17, after which their biological development alone no longer alters their motor abilities and morphological characteristics.

Some researchers question the use of motor and morphological measurements to identify handball talents and predict players' playing performances, mainly due to large differences in the subjects' biological ages (Lidor, Falk, Arnon, Cohen, & Segal, 2005). The progression from youth to elite sport is namely a complex process and is far from being a mechanics process (Reilly, Williams, Nevill, & Franks, 2005). Maturation is a major confounding variable when it comes to identifying talent during adolescence (Pearson, Naughton, & Torode, 2006). Our results lead us to conclude that the changes are not statistically significant after the age of 17. Therefore, it is reasonable to use the results of motor tests and morphological measurements at this age to be able to reach conclusions about the final biological status of measured players. This category of players could already be termed a performance-related category. It can be concluded that at this age it is reasonable to carry out in-depth and more sophisticated measurements as the feedback is relevant. This is also important from the economic point of view because such measurements are relatively expensive and need to be implemented restrictively. Using the results thereby obtained, coaches can more easily assign players to playing positions and correct any mistakes made in the previous phases of player selection.

The second finding concerns the training stimuli which should be stronger at this age and should accelerate players' development, mainly in terms of their motor abilities. One cannot be satisfied with the situation that, during four years of training, players have not made any progress in terms of their motor abilities. This is particularly important for endurance where the possibility of progress is much higher because the genetic determination is smaller than in motor tasks where high speed and explosiveness is required. It is obvious that in clubs even the most talented players of their generation do not receive sufficiently effective motor training at this age. The results achieved by our study subjects in the motor tests were lower on average than those achieved by players of the best national teams of a comparable age. Thus, the average result achieved by Danish junior members of the national team in the CMJ test was 41.0±0.05 cm, in the T5m test 0.86±0.05 s and in the relative maximum oxygen uptake 58.6±3.8 ml/min/kg. However, the players in our sample are completely comparable with the players in the abovementioned sample in terms of their body height (186±7 cm), body mass (83.7±6.9 kg) and the quantity of subcutaneous fat (13.5±2.6%) (Jensen, Johansen, & Larsson, 1999).

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ACHILLES TENDON DEVELOPMENTAL FACTORS IN CHILDREN

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Abstract

Achilles tendon (AT) is an important connective tissue organ that connects calf muscle mass and calcaneus bone. There has been little research in AT developmental potential in children although it seems to be the basis for a child's motor development, especially of flexibility, strength and speed. There might be a relation between the variance of geometry of AT and the morphologic characteristics of the muscles of the calf, their geometry and the strength parameters of ankle and knee. Our work was aimed to explain AT geometrical characteristics in 4-year old children with several factors, such are: body morphology, calf muscles geometry and architecture, and ankle/knee maximum voluntary torque. Measurements were conducted on 104 children using standard instruments, diagnostic sonography, adapted isometric dynamometers for knee and ankle. Using multiple linear regression we have found a significant relation between AT diameter as a dependent variable with the chosen factors (R = 0.477; P = 0.006). Significant partial correlations were found for: muscle gastrocnemius medialis diameter (R = 0.258; P = 0.018); pennation angle in muscle gastrocnemius medialis (R = -0.195; P = 0.047); and muscle soleus diameter (R = -0.322; P = 0.003). Interestingly, we have not found significant correlation between maximal knee and ankle torques with AT diameter. In conclusion we could confirm that AT diameter is related to calf muscle geometry and architecture but only with 23% of explained variance. Interestingly, the gastrocnemius medialis muscle diameter is positively, while muscle soleus diameter negatively related to AT diameter.

Introduction

Achilles tendon (AT) is an important connective tissue organ that connects calf muscle mass to calcaneus. There has been little research in AT developmental potential in children although it seems to be the basis for a child's motor development, especially of flexibility, strength and speed. AT geometry is closely related to its mechanical properties and therefore to its function.

As far as we know little research is available for AT geometrical development (Koivunen-Niemelä & Parkkola, 1995; Bezerra et al., 2009) and no research has been done on identification of possible developmental factors of AT geometry. AT diameter changes with child age from 4.6 mm at 10 years up to 6.3 mm at 18 years. However, one of the metabolic factors that diminish AT diameter in newborns is parenal administration of drugs for hypercholesterolemia (Tsouli et al., 2009).

Recently, Morse et al. (2008) found about 20% higher gastrocnemius muscle specific force in boys than in men. However, they could not explain itby differences in moment arm length, muscle activation, or architecture, nor with other factors, such as tendinous characteristics and/or changes in moment arm length with contraction. AT physiology was not included in the above study, but it seems that AT might be the reason for the higher gastrocnemius muscle specific force in boys than in men.

In our study, we have investigated some possible factors for AT development in 4-year old children. The null hypothesis is that there is no regression trend between AT diameter (dependent variable) and morphological, gastrocnemius medial and soleus geometrical characteristics, and leg maximal voluntary torques (independent variables).

Methods

Participants

109 (52 boys) 4-year old children were included in the study and 88 (40 boys) of them passed all tests. Descriptive children data are presented in Table 1.

Children's parents gave their written consent prior the study initiation. All testing procedures conformed to the 1964 Declaration of Helsinki and were approved by the Committee for Medical Ethics at the Ministry of Health (Slovenia).

Sonographic measurements

Achilles tendon diameter (D_{AT}), gastrocnemius medialis (GM) and soleus (SO) muscle architecture were measured twice at mid-distance along the mid-sagittal plane in prone position by ultrasound imaging using a digital ultrasonographer (Esaote Mylab 25) fitted with a 7-10 MHz linear probe (Picture 1). As muscle architecture we assessed muscle belly diameter (D_{GM} and D_{SO}), muscle fascicle length (L_{GM}, L_{SO}) and muscle fibre pennation angle (α_{GM}, α_{SO}) as presented in Picture 2B. An average of both measurements was taken into further analysis.

Figure 1: Achilles tendon diameter measurement with ultrasonography

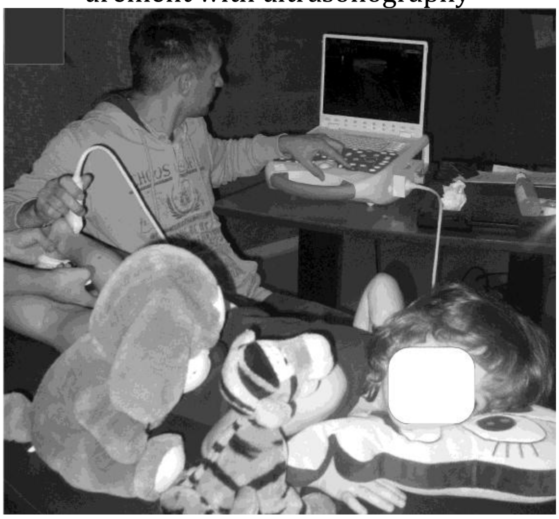
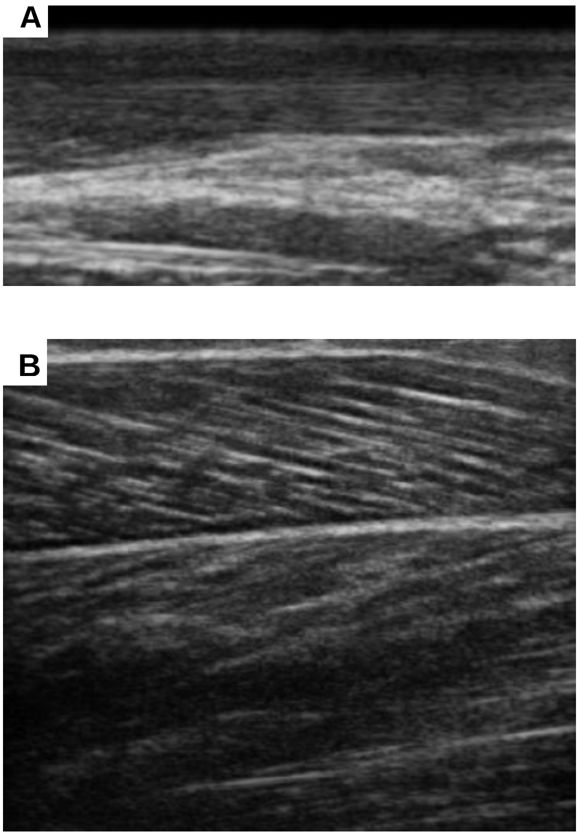


Figure 2: (A) Achilles tendon diameter (D_{AK}) measurement; and (B) gastrocnemius medialis (GM) and soleus (SO) diameter (D), fascicle length (L)a and pennation angle (α) measurements



Maximum voluntary torque measurements

Maximum voluntary torque was measured at knee extension and ankle plantar flexion (Figure 3). Children were motivated to exert three unilateral maximal contractions where the amplitude of the contraction with the highest torque taken in further analysis. The test was carefully explained to children and they were motivated with visual feedback to assure their maximal effort.

Statistics

All data are normally distributed and are expressed as means ± standard deviation if not stated differently. Descriptive analysis includes t-test comparison of gender differences. We have tested two hypotheses: (i) the null hypothesis, that there is no significant correlation between D_{AT} with individual muscle architecture and other morphological parameters, the Pearson product-moment correlation coefficient was used; (ii) and the null hypothesis, that there is no multiple linear regression model that could significantly explain D_{AT}, on the basis of GM, SO architecture and/or morphological parameters. Statistical significance was set at $P < 0.05$.

Figure 3: Maximum voluntary torque measurement in knee extension (left) and ankle plantar flexion (right)

Results

All descriptive data are presented in Table 1 for boys and girls separately. Statistical significant differences were found in fat mass (P = 0.002) and muscle mass (P < 0.001).

Table 1: Descriptive analysis of observed parameters.

	Boys	Girls
N	40	48
Body mass (kg)	18.8 ± 2.6	18.5 ± 2.7
Body height (cm)	108.3 ± 4.4	108,2 ± 4.4
Tibia length (cm)	21.4 ± 1.4	21.5 ± 1.3
Fat mass (%)	15.0 ± 2.9	16.4 ± 2.6*
Muscle mass (kg)	5.9 ± 0.8	5.1 ± 0.7*
GM diameter (mm)	10.0 ± 1.1	10.3 ± 1.8
GM fascicle length (mm)	47.9 ± 11.9	46.3 ± 10.3
GM pennation angle (deg)	14.1 ± 2.8	14.0 ± 3.0
SO diameter (mm)	10.4 ± 1.6	10.7 ± 2.2
SO fascicle length (mm)	54.6 ± 18.3	57.8 ± 17.8
SO pennation angle (deg)	13.2 ± 3.6	13.4 ± 2.7
AT diameter (mm)	2.1 ± 0.3	2.1 ± 0.4
Knee MVC torque (Nm)	38.9 ± 12.0	41.1 ± 11.6
Ankle plantar MVC torque (Nm)	26.9 ± 8.5	28.4 ± 7.0

GM – gastrocnemius medialis; SO – Soleus; AT – Achilles tendon; MVC – Maximum voluntary contraction; * – P < 0.01.

Bivariate Pearson correlation analysis revealed significant correlation between D_{AT} with body mass (R = 0.240; P = 0.017) and D_{GM} (R = 0.307; P = 0.001) while no relation was established with body height (P = 0.092).

Furthermore, a multiple linear regression of D_{AT} revealed significant overall prediction model (Table 2) with R = 0.477 (P = 0.006). The predictors that significantly contribute to overall prediction model were D_{GM} (part R = 0.235; P = 0.018); α_{GM} (part R = -0.175; P = 0.047); and D_{SO} (part R = -0.322; P = 0.003).

Table 2: Multiple linear regression model of Achilles tendon diameter.

Predictor list	B	SE B	β	Part R	P
Constant	0.178 mm	0.035			0.000
Body mass	0.003 mm/kg	0.002	0.259	0.167	0.092
Fat mass	-0.001 mm/%	0.001	-0.071	-0.061	0.531
GM diameter	0.065 mm/mm	0.027	0.312	0.235	0.018*
GM pennation angle	-0.002 mm/deg	0.001	-0.211	-0.175	0.047*
SO diameter	-0.053 mm/mm	0.017	-0.318	-0.298	0.003*
SO pennation angle	-0.001 mm/deg	0.001	0.105	0.099	0.316
Knee MVC torque	0.000 mm/Nm	0.000	-0.029	-0.023	0.817
Ankle plantar MVC torque	0.000 mm/Nm	0.000	0.008	-0.007	0.945

*B – Unstandardized coefficient; SE – Standard error; β – Standardized coefficient; R – Correlation coefficient; P – P-value; * P < 0.05*

Discussion

Power of determination of our multiple regression model was significant at 23% of explained common variance. We used 8 predictors, which could be interpreted as a big number but we want to demonstrate the effect of all possible factors. We limited variance inflation factor at values below two.

Significant factors that affected D_{AT} were four: positive correlation was found in D_{GM}; while negative correlation was found in D_{SO}, and α_{GM}. However, we could not neglect the body mass positive correlation (P = 0.092).

Positive correlation of D_{GM} on D_{AT} was actually expected. GM muscle is directly attached to proximal end of AT and therefore all the exerted GM muscle power is transmitted through AT to calcaneus bone. GM muscle is involved in ankle planter flexion and activates at physical activities where knee joint is (almost) extended.

Surprisingly, we found the same, but negative correlation between D_{SO} and D_{AT}. The posterior aponeurosis and median septum of the SO muscle join with the anterior aponeuroses of the gastrocnemius muscles to form the Achilles tendon. SO muscle is a large and powerful muscle and has a higher proportion of slow muscle fibers than GM muscle (Johnson et al. 1973). Since the sitting ankle MVC torque was insignificant factor of D_{AT}, we could conclude that SO power has no effect on D_{AT}. Other mechanisms have to be searched for to explain the negative correlation between D_{SO} and D_{AT}. As already mentioned, GM muscle activates just at extended knee joint, SO muscle is theoretically active independently of anatomical position of knee joint, however, power sharing effect takes over at extended knee joint. The GM muscle takes over the larger proportion of power generation. This is even more evident at rapid movements where more fast twitch fibers of GM muscle activate. We controlled this with partial correlation between D_{SO} and D_{AT} and controlling for D_{GM}. There was no change between partial correlation and raw Pearson correlation. In summarizing this part of discussion we could conclude that some children are more "sedentary oriented" or with other words are involved in physical activities where knee joint is flexed and therefore are less involved in rapid standing physical actions. This group of children might have thinner D_{AK}. This should be further investigated and experimentally confirmed.

Other two significant contributions to overall regression model of D_{AT} was found in α_{GM}. α_{GM} is negatively related to D_{AT}. α_{GM}. is higher in muscles that exert more muscle force, but is lower in muscles that exert more rapid bursts of muscle force, that is power.

Therefore, we might conclude that GM architecture is mainly related to D_{AT}. Although the regression power of determination is low to medium (23%) we might conclude that selected factors do affect D_{AT}, however, other factors have to be considered in following studies. For causative relationship a longitudinal study is already in progress.

Acknowledgements

The authors are thankful to Slovenian Research Agency for financing the research project "Analysis of fundamental motor pattern, skeletal and muscle adaptation on specific sedentary lifestyle factors amongst 4 to 7 years old children". We are grateful to all children and their parents for permitting us to perform a study of such magnitude. Nevertheless, big thanks also to other researchers and students for their help.

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MONITORING MOTOR ABILITIES OF YOUNG WATER POLO PLAYERS

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Abstract

In order to evaluate motor abilities of a young water polo player specific skill tests in the water should be performed (Falk, Lidor, Lander, & Lang, 2004; Lidor et al., 2005). The battery of eight tests was developed and used to monitor 311 young water polo players from eleven to eighteen years of age divided in four age groups (11 to 12 (G1), 13-14 (G2), 15-16 (G3) and 17-18 (G4) years of age): swimming at distances 5, 25 and 200 meters, swimming 4x5 meters with changing directions, ball dribbling, vertical jump and reach, vertical egg-beater kick and velocity of a throw at the goal. Descriptive statistics and analysis of variance (ANOVA) were used to analyse data. Monitoring the results of particular test through years, the progression of the achieved results was found as expected, probably as the summing effect of the biological and technical development of the growing up players. This progression was the largest when we compared the youngest age groups (G1 and G2) and the smallest when we compared the oldest age groups (G3-G4). This corresponded well to the biological development of the players and perhaps to a lesser extend reflected the change in the structure of training, which was gradually more oriented to the tactical skills and knowledge while the players were growing up. The progress in all observed motor ability tests was very similar with an exception of the vertical egg-beater kick test were it was much larger. The obtained data in our study correspond to the data reported in the literature. We concluded that monitoring the motor ability tests provide useful data to the coaches and could serve as the base for setting some lower and upper norms for every test and for every age group respectively.

Introduction

Since 1995 all Slovenian water polo national age group teams (U-17, U-18, U-19) have successfully qualified for the European Championships. In a certain way this demonstrates the quality of the work with the young players. Annual monitoring of players` morphological characteristics, motor abilities and technical skills contributed greatly to the proper planning and accomplishing of the training process. Besides planning the training process these data can also be used to identify talented players and to position them to the most suitable playing position.

According to the literature the talent identifying process has been divided in the four stages: detection, identification, development and finally selection (Williams & Reilly, 2000). Detection is a process when potential players that are currently not involved in water polo are being discovered. Because of specificity of the sport in question, this stage is limited to the observation of the children during „out of water" sport activities, especially team sports (i.e. soccer, basketball, handball etc) and swimming. An eye of a skilled expert should detect child`s general capabilities such as whole body coordination, game sense, anticipation, decision making, attitude etc. Identification refers to the process of recognition of current players with the potential to become elite players (Williams and Reilly, 2000), by measuring and analyzing physical, physiological, psychological and sociological attributes and technical abilities either alone or in combination (Regnier, Salmela, & Russel, 1993). „Identified" players are then provided with a suitable learning and training environment, which enables them to realize their potential. Finally the most successful players are selected to the team.

Falk, Lidor, Lander and Lang (2004) described three aspects in order to identify talented players in water polo: physiological, psychological and sociological. On the other hand some authors reported that physiology and morphology parameters were not essential in the early detection of talented players and that other factors such as game knowledge and game sense (Hoare & Warr, 2000), team coherence (Reilly, Williams, Nevill, & Franks, 2000), status of maturity (Pienaar, Spamer, & Steyn, 1998), anticipation and decision making (Falk et al., 2004) significantly contributed to the success.

Concerning this issue one of the most important findings was that the tests which required specific technical skills incorporated more relevant information of the abilities of the players than basic motor ability tests (Lidor at al., 2005; Spamer & Coetzee, 2002).Therefore it was reasonable that the battery of tests performed in the water was designed for water polo.

The aim of this study was to analyse the data of specific in-water motoric skill testing of young water polo players of different ages and to show some benefits to the coaches. With this intention the results of the regular annual testing in a period of last four years were collected and analyzed.

Methods

Sample

Most talented Slovenian young water polo players were invited to the testing once every year. Data collected in a period of four years were analyzed.

We divided all 311 tested players in four different age groups: 11 to 12 (labelled G12), 13 to14 (G14), 15 to16 (G16) and 17 to 18 (G18) years of age that consisted of 57, 142, 83 and 29 players respectively.

Variables

- Body height (BH), body mass (BM) and vital capacity (VC) were measured and eight specific tests were performed in the water:
- 5 m swim (S5): player floated in the water with the back of his head in contact with the goal line (as waiting for the start of the game). On a signal (whistle and a swing with an arm), he started swimming with maximum velocity. The time from the starting signal to the moment when the head reached the marked spot that was positioned 5 m from the starting line, was measured. Each player performed this test twice and better result was used for further analysis.
- 25 m swim (S25): on a starting command player pushed with legs off the swimming pool wall and started to swim with maximum velocity to the end of a 25-m distance pool. Each player performed this test twice and better result was used for further analysis.
- 25 m ball dribbling (BD25): player floated at the starting wall of the swimming pool in a horizontal position with his legs on the wall. In on hand he held a ball. On a starting command player pushed off the swimming pool wall, released the ball from the hand, placed it in front of the head and started to dribble the ball with maximum velocity to the end of a 25-m distance pool. Each player performed this test twice and better result was used for further analysis.
- 200 m swim (S200): on a starting command player pushed with legs off the swimming pool wall and started to swim with maximum velocity for 200 meters. Each player performed this test once.
- 4 x 5 m swimming with changing directions (S4X5): player floated in the water with the back of his head in contact with the goal line. On a signal (whistle and a swing with an arm), he started swimming with maximum velocity to the other line which was strained 5 meters away from the starting line. He touched that line and swam back again to the starting line and then he repeated this path once again. Player swam four times five meters with maximum velocity. Each player performed this test once.

- One-hand vertical jump out of the water and reach test (VJW): player jumped out vertically of the water and touched with one hand the measuring scale as high as possible as demonstrated in Figure 1. The distance from the water surface to the spot on a measuring scale was measured. Each player performed this test five times and the best result was used for further analysis. The measuring board had been previously calibrated to the water surface using a small weight on the end of a rope as suggested by Platanou (2006).
- Egg-beater kick in vertical position with a 5 kg weight (VEK): player held the 5 kg weight with both hands above the head in vertical body position and traded water performing egg-beater kicks as demonstrated in Figure 2. Player ended the task when he was not able to keep the elbows out of the water.
- Throw the ball at the goal (TG): Subjects were asked to throw the ball with dominant arm with maximum velocity. The ball was thrown in the direction of the 5m distant radar (Speed Check Personal Sport Radar, Tribar Industries, Quebec, Canada) which measured the velocity of the ball. Radar was positioned behind the net of a water polo goal which protected it from the impact. It was positioned in front of subject's right shoulder, approximately at the height of the release of a ball to enable its most direct (optimal) path to the radar. The throws were executed without faints, like penalty throws. The highest velocity of the five throws was used for further analysis.

Figure 1: Vertical jump out of the water and reach test

Figure 2: Egg-beater kick with additional weight in vertical position

Data analysis

The data were analyzed by the statistical package SPSS 15.0 Descriptive statistics and analysis of variance (ANOVA) were executed. Turkey's post hoc test was applied to check for the differences between the groups. Normality of the data was checked using Smirnov-Kolmogorov test and Levine's test of homogeneity of variance had been done before ANOVA was executed.

Results

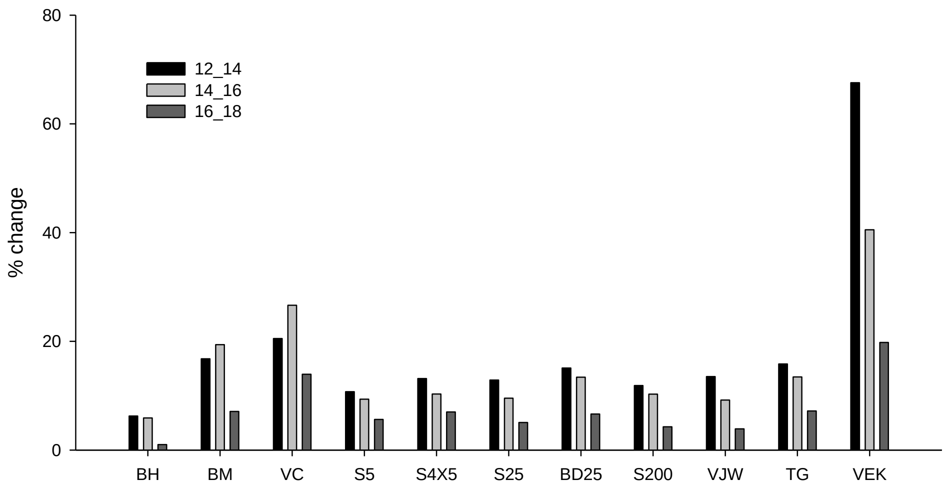
The results of descriptive analysis are presented in table 1. In addition in column labelled "Sig.to" the results of Tukey` s post hoc tests ($p < 0.05$) are marked. ANOVA showed differences between the groups in all observed variables. Executing the post hoc tests we found statistical significance between almost all groups except for BH, BM, S5, BD25, S200 and VEK between G3 and G4 group as presented in Table1.

The average differences in percentage between G1-G2, G2-G3 and G3-G4 are shown in Figure 3.

Table 1: Results of descriptive analysis and ANOVA post hoc test

		Mean	SD	Sig. to (post hoc)	MIN	MAX			Mean	SD	Sig. to (post hoc)	MIN	MAX
BH	G1(11_12)	161,0	7,9	G2,G3,G4	143,4	180,2	BD25	G1(11_12)	19,9	2,9	G2,G3,G4	15,3	27,6
	G2(13_14)	170,3	8,2	G1,G3,G4	151,0	188,4		G2(13_14)	17,2	1,9	G1,G3,G4	13,9	22,8
	G3(15_16)	180,4	6,1	G1,G2	168,0	195,2		G3(15_16)	14,8	1,2	G1,G2	12,7	18,1
	G4(17_18)	181,9	5,1	G1,G2	173,2	192,6		G4(17_18)	13,8	0,8	G1,G2	12,6	16,5
BM	G1(11_12)	54,1	10,2	G2,G3,G4	36,2	78,4	S200	G1(11_12)	202,0	29,2	G2,G3,G4	154,0	280,0
	G2(13_14)	62,6	12,6	G1,G3,G4	39,0	95,0		G2(13_14)	178,0	22,8	G1,G3,G4	137,6	250,0
	G3(15_16)	75,1	10,8	G1,G2	54,4	104,6		G3(15_16)	154,4	15,7	G1,G2	120,0	226,0
	G4(17_18)	78,9	10,1	G1,G2	63,0	107,5		G4(17_18)	151,2	16,7	G1,G2	136,0	199,0
VC	G1(11_12)	3,4	0,6	G2,G3,G4	2,5	4,9	VKW	G1(11_12)	115,7	10,5	G2,G3,G4	90,0	139,0
	G2(13_14)	4,1	0,7	G1,G3,G4	2,5	6,1		G2(13_14)	129,8	11,2	G1,G3,G4	104,0	155,0
	G3(15_16)	5,2	0,7	G1,G2,G4	3,5	7,3		G3(15_16)	141,6	8,6	G1,G2,G4	124,0	158,0
	G4(17_18)	5,9	0,7	G1,G2,G3	4,9	7,8		G4(17_18)	150,6	6,9	G1,G2,G3	126,0	162,0
S5	G1(11_12)	3,8	0,4	G2,G3,G4	3,0	4,6	TG	G1(11_12)	49,2	5,6	G2,G3,G4	38,0	65,0
	G2(13_14)	3,5	0,4	G1,G3,G4	2,3	4,7		G2(13_14)	55,9	5,7	G1,G3,G4	42,0	70,0
	G3(15_16)	3,1	0,3	G1,G2	2,2	3,8		G3(15_16)	63,9	4,9	G1,G2,G4	52,0	82,0
	G4(17_18)	3,0	0,2	G1,G2	2,6	3,5		G4(17_18)	68,2	4,7	G1,G2,G3	61,0	79,0
S4X5	G1(11_12)	17,1	1,7	G2,G3,G4	13,8	20,7	VEK	G1(11_12)	20,5	14,7	G2,G3,G4	2,0	85,0
	G2(13_14)	15,1	1,6	G1,G3,G4	11,4	21,2		G2(13_14)	32,2	21,5	G1,G3,G4	4,2	120,0
	G3(15_16)	13,4	1,2	G1,G2,G4	11,2	18,7		G3(15_16)	45,5	24,5	G1,G2	13,5	120,0
	G4(17_18)	12,6	1,1	G1,G2,G3	10,8	14,6		G4(17_18)	54,5	20,2	G1,G2	21,0	120,0
S25	G1(11_12)	17,8	1,8	G2,G3,G4	14,4	22,8							
	G2(13_14)	15,5	1,4	G1,G3,G4	12,7	20,2							
	G3(15_16)	13,8	0,9	G1,G2,G4	12,2	17,5							
	G4(17_18)	13,0	0,6	G1,G2,G3	12,1	14,7							

Figure 3: The change of the variables in percentage with respect to the different age group



Discussion

The aim of this study was to evaluate motor abilities of young water polo players of different age in order to identify talents and to monitor their athletic development. With this purpose we developed tests that require special motor skills and are therefore executed in the water. All talented Slovenian young water polo players were tested once every year.

First we can observe that the numerous of the different age groups varied. The greatest number of players (142) was in G2 and the lowest (29) in G4. It looks like at the age of 12 (G1) there haven`t been many children involved in water polo yet, however in the next age group (G2) the numerous was the greatest. The age of 13 to 14 years therefore might present the most important period for the coaches, because at that time there is the greatest interest among the children and the greatest number of eventually good players to identify as talented players. On the other hand the G4 age group probably presented to some extent selected population of which some, but not all, latter succeed to play for the senior team.

According to expectations the absolute values of the obtained variables (Table 1) as well as the percentage of change between the age groups showed the progression of the results. The greatest progression can be observed from the G1 to G2 in all observed variables. From G2 to G3 there was a little less progression, while from the age of 16 to 18 the progression was the smallest. This can be observed in all anthropometric, functional and motor ability tests. Note that for the special motor ability tests the average values as well as the standard deviation decreased with increasing age, implying the smaller variability of results, which was probably the result of the selection process. Average progression of results only 4 -7 % was observed from G3 to G4 implying that the specific motor abilities of the 18 year old player are just a little better than of a 16 years old player. To the greatest extent this might be related to the biological development of the players; namely, we found no statistically significant differences in body height and mass between G3 and G4. The second reason was perhaps the structure of training process, which has becoming more oriented on tactics with increasing age.

The progress in all observed motor ability tests is very similar with an exception of the vertical egg-beater kick test. Especially at the younger age the progress was enormous which perhaps showed that the VEK test with an additional weight of 5kg is to demanding for a twelve year old. Additional weight proportional to the weight of the player should be a better solution.

Values of all observing variables showed linear progression implying improvement in measured skills with respect to their age and/or involvement in a sport. Average times of a 25 meters crawl (S25) 15.5 ± 1.4 seconds for G2 and 13.8 ± 0.9 seconds for G3 were better than the average time reported by Bratusa and Dopsaj (2006), which was 16.1 ± 0.7 for junior players of Slovenian water polo team playing at perimeter positions (backs). Unfortunately many other tests that had been performed in that research (i.e. 50 and 1500 m crawl, 25 m backstroke, 25 m crawl using legs only, 10 x 50 m crawl) were not comparable to our data.

Falk et al. (2004) tested 12-14 years old players which corresponds to the group G2 in our study, however only two tests could be compared - S200 and VJW. They reported an average result 177.1 ± 9.6 seconds and 189.2 ± 6.1 seconds for the players that were later selected to the Israel youth (U17) national team or not, respectively. An average result of selected players corresponded perfectly to our result 178.0 ± 22.8. It must be noted that in our study players swam in a 25 m pool (benefit) starting without jumping from the starting block (deficit) and in Falk` s study swimming test was started with the jump of the starting block (benefit) in a 50 m swimming pool (deficit). Very similar results in both studies were obtained in jumping out of the water as well: 129 ± 11 cm for selected and 130 ± 6 cm for non-selected players in Falk et.al (2004), and 129,8 ± 11,2 in our study. Throwing velocity has been measured in several studies, however only adult players were measured and velocities from 65- 84 km/h were reported (Whitting, Puffer, Finerman, Gregor, & Maletis, 1985; Darras, 1999; Elliot & Armour, 1988; Feltner & Taylor, 1997; Stirn & Strojnik, 2006).

Throwing velocities showed progression from G1 to G4, and the highest throwing velocities measured in the oldest players in our study approached to these values; the average velocity was 68,2 ± 4,7 and the highest velocity measured was 79 km/h.

Trying to discus other results of the tests performed in our study in a certain age group of players we found that there is a vast deficit on the subject in the literature. Even when these tests are executed annually in some nations, the collected data is not published but only used by the coaches.

When we evaluate the reasonableness of our testing two other researches should be mentioned. In our previous study (Stirn, 2010a) we showed that the battery of special tests used in our study, significantly differentiated between groups of players of different age. Tests that measured specific skills in the water without the ball (swimming 25 meters, jump out of the water, swimming with changing directions) were better in differentiating younger players (G1 and G2) and tests representing the ball handling skills were better in differentiating (G2 and G3) year old water polo players.G4 group was not included in that study. We concluded that the main principle of progressive learning and developing special motor skills needed and used in water polo as well as an overall involvement in the water polo sport quantified by hours per week spent in a training process, might present the most reasonable cause for this results.

In another study (Stirn, 2010b) we compared players 13 to years of age 14 that were latter selected or not selected to the youth (U16) national teams. Using discriminate analysis we found that swimming tests at distances of 25 and 200 meters, vertical-egg beater kick and throwing velocity can differentiate between selected and non selected group of players, while morphological variables differentiated the groups least.

We can conclude that annual testing of the motor abilities of young water polo players can provide coaches much useful information. It would be reasonably in the future to use the data collected through several years, to set some lower and upper norms for every test and for every age group respectively.

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A MODEL OF ANALYSIS OF PREPARATION FOR 28 KM LONG RUN – A CASE STUDY

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Abstract

Training is used for improvement of specific functional abilities in sport to improve performance. However there is often individual response to specific training and coaches should have a system of evaluation of training effects for each sport discipline and monitoring of training . The aim of the study was to establish a model of analysis of training and its effects to specific functional needs of long distance run. In the research one moderately active subject (age 25 yrs, weight 79 kg) performed long distance endurance training to increase endurance. During the 123 days long experiment heart rate and body weight at rest were monitored. The amount and intensity of exercise during preparation period was monitored with the use of Polar heart rate monitor based on average heart rate during exercise. Four tests of repeated runs on 1200m distance with increasing speed were performed at which blood lactate concentration and pH from blood capillary sample were measured . Three test of run on 4000m on which average running speed and heart rate were measured have also been performed. Tests were performed at the beginning of the experiment, after completing first and second mesocyclus and another after two month of period of no exercise. Exercise resulted in positive changes in all monitored variables. Lactate and pH curve according to the running speed during the test typically moved to the right. Heart rate at rest and during submaximal exertion has fallen. Body weight gradually slightly decreased. In the period after the termination of exercise, all the observed variables returned to approximately the same level as at the beginning of the experiment. The exception is the value of body weight, which remained at slightly lower level. The average speed at the competition on 28 km was close to the lactate threshold during last test of repeated runs on 1200m distance before competition. Proposed model of analysis of preparation seems to be sensitive for evaluation of training effects and preparation to long endurance run.

Introduction

The aim of the exercise in the marathon run is to change the most important functional abilities and characteristics, as well as those less important in such a way that will improve physiological basis for the long duration endurance and consequently competition success. Several methods are used to increase endurance that can be combined in four to five different methods: method of continuous running, the method of repeated runs, method known pyramid, interval method and combined method.

The most common effects of exercise which increase long duration endurance performance are the improvement of oxygen transport (changes in the size of the heart (Blomqvist & Saltin,1983; Ehsani, Hagberg, & Hickson, 1978; Morganroth, Maron, Henry, & Epstein,1975; Poole & Gaesser, 1985), increased stroke volume, reduced heart rate (Blomqvist & Saltin,1983 ; Frick, Elovanio, & Somer, 1967), the increase in blood volume and hemoglobin (Astrand & Ryhming, 1954 ; Fox & Mathews, 1981; Saltin & Rowell,1980) and increase of maximum oxygen consumption (Vo2 max) (Astrand & Ryhming,1954) and peripheral adaptations (increase the density of capillaries in the trained muscles (Astrand & Ryhming,1954), increase in the number, size and area of the internal matrix of mitochondria in trained skeletal muscle cells and increase in enzyme activity and Krebs cycle and respiratory chain (Andersen & Henrickson, 1977; Costill et al.,1979; Henriksson, 1977; Holloszy et al., 1977; Ritzer, Bove, & Carey,1980), increased oxidation of free fatty acids (Costill et al.,1979, Despres et al., 1984; Henriksson, 1977; Holloszy et al., 1977; Pruett, 1970), increase of the concentration of myoglobin (Fox & Mathews, 1981) and increase of the capacity of muscles to store glycogen (Ušaj, & Starc,1990).

General responses to exercise in the experimental conditions are well known. However in various sports, in the practice quantity, intensity, and selected assets of exercise and training varies greatly, even with the same quality runners. It is difficult to understand how much exercise is actually changing the characteristics and capabilities of the athletes as they are at best known to the racing achievements and rarely on the results of tests. Therefore, we do not know well enough which of the available indicators of preparation are changing under the influence of exercise. One possible way to solve the problem is to observe some athletes having in mind knowledge of sports training process and its effects. For this purpose, it's necessary to analyse exercise carried out by individuals, and changes that can be detected in the athlete's functional abilities and characteristics.

The aim of the present study was as precisely as possible to create a model of training and model of changes to the athlete's abilities and characteristics associated with changes in exercise. We were also particularly interested in the time course of changes after the rehearsal period.

Methods

Subjects: In the study voluntarily participated one 25 years old subject, healthy, without contraindications for endurance training. Body weight was 79 kg and height 176 cm.

Tests

a) Tests of repeated runs at 1200 m with increasing speed (TPT1200). This test consists of the 5-12 runs to 1200 m. Running speed was standardized and controlled and was growing by 0.2 m . sec-1. Standardized and controlled velocity is allowed by 50 meter marks on the track and the audio signals at specific time intervals. Impeller regulates its running speed so that when the acoustic signal passing past 50 meter mark. Between the 1200 m runs there is up to 70 seconds-long break for blood samples uptake (Ušaj and Starc, 1990).

b) Running at 4000 m. The result of measurements represents the average running speed and heart rate.

Measurements

At rest:

- Heart rate was measured each morning shortly after awakening, before getting out of bed. The values are obtained by counting the beats in the artery radialis. The measurement lasted 1 minute.
- Body weight was measured every morning immediately after awakening. The values were obtained on the domestic scale to the nearest 0.5 kg.

After and during exercise:

- The speed runs were calculated from the distance of each run and the time required to run at that distance. Runtime was measured with an electronic timer and manually rounded up to 0.1 sec. Time runs at 4000 m was measured with a clock on heart rate monitor PE 3000 (Polar Electro, Finland) and rounded to 1 s.
- Heart rate (HR) was measured using heart rate monitor PE3000 (Polar Electro, Finland). Frequency is measured continuously before each run, during and after treatment. Values were saved and monitored every 15 seconds in the longer tests (TPT 1200) and every 5 seconds in the short tests (4000 m).

- The concentration of lactate in the blood was measured by the analyser Kontron 640 citrat Analayzer (Kontron, Austria). A sample of 20 ml of capillary blood was taken after each run and immediately after samples were mixed with 0.5 ml of diluent and stored for measurement in the tube. Accuracy was ±0.2 mmol . l-1l .
- Measurement of capillary blood pH was done by microanalayzer BMS33 (Radio well, Denmark). Samples of 60-80 ml were saved in properly sealed capillary tubes at a temperature of 4 oC for a maximum of two hours. The accuracy of the measurement was ± 0.005 pH units. Blood samples for measurement of lactate concentration and pH of blood were taken from the earlobe.
- Analysis of the lactate curve: the value of lactate threshold was determined by two component analysis of the kinetics of blood lactate concentration (Ušaj & Starc,1990). It is based on two exponential curves break point of interpolation curves (Ušaj & Starc,1990). Point is defined with the speed of run (VLT) and the concentration of lactate (LALT). Usually they are further analysed by calculating the running speed at a predetermined concentration of blood lactate 4 mmol / l, also known as the criterion of Onset of blood lactate accumulation (OBLA) (Ušaj & Starc,1990). The same procedure was used to analyse the kinetics of pH (Ušaj & Starc,1990). Break point of interpolation of two curves represents the threshold of acidosis (TA) with a speed run (VTA) and pH (pHTA).

Experimental design:

The experiment was carried out during the period of 123 days and was divided into two parts: the period of preparation for the competition (28 km run), and the period after the competition were no exercise was performed (detraining). During the exercise period three types of exercise were performed:

- Type A: exercise with low intensity. Heart rate during exercise was between 130 and 150 b.min-1 or 45-60 % of Vo2 max.(Astrand & Ryhming, 1954)
- Type B: exercise with medium intensity. Heart rate during exercise was between 150 and 160 b.min-1 or 60-70 % of Vo2 max.(Astrand & Ryhming, 1954)
- Type C: exercise with high intensity. Heart rate during exercise was above 160 b.min-1 and above 70 % of VO2 max (Astrand & Ryhming, 1954).

Results

During first 10 days of exercise period heart rate decreased from 65 b.min-1 to 52 b.min-^{1}. In following days heart rate oscillatedbetween 55 to 58 b.min^{-1}. During the period of detraining heart rate increased to values from 59 to 67 b.min^{-1}.

During the exercise period of experiment body weight decreased from 79 kg to77 kg. After the competition body weight decreased to 75 kg (for 2 kg) and was relatively stable during the detraining period (between 75 and 76,5 kg).

Weekly comparison of planed and performed volume of exercise shows that the planned exercise was performed only during three weeks (Figure 3).

Figure 4 shows that have been performed in terms of intensity of exercise compared to the plan only type C of exercise and tests, while the type of exercise A and B were performed in much smaller quantities of the plan.

Figure 1: Resting heart rate during experiment

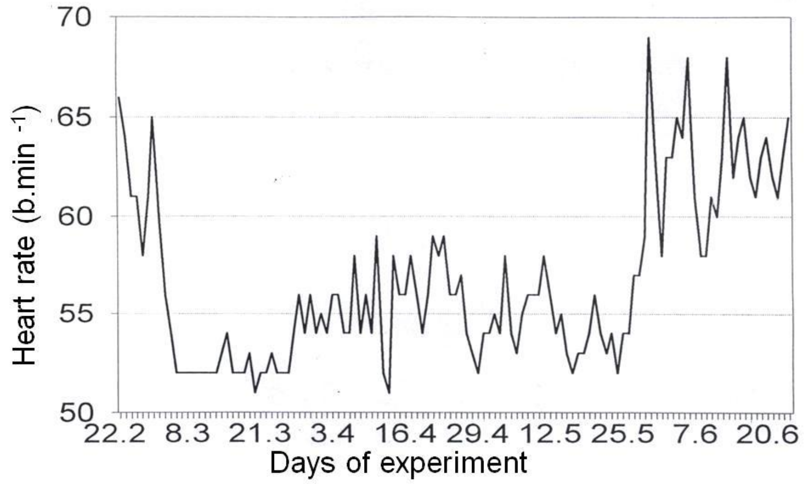

Figure 2: Body weight during experiment

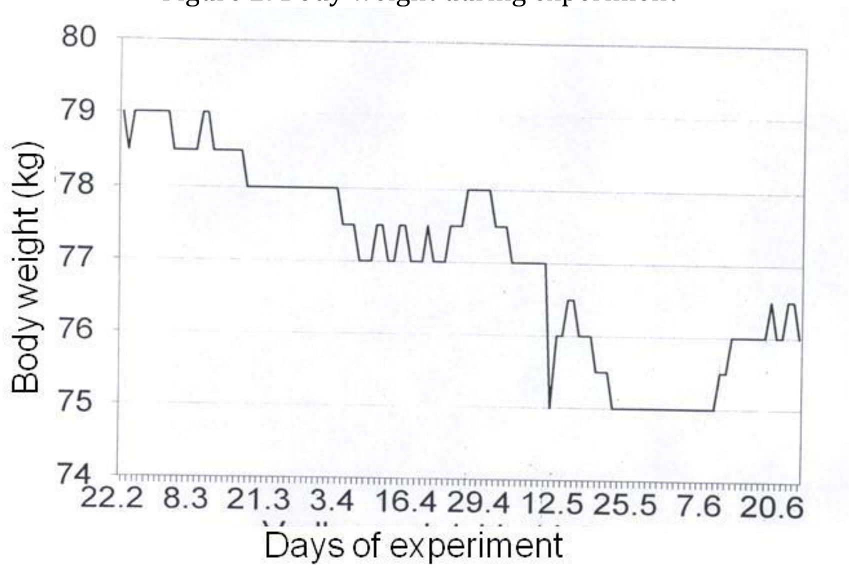

Figure 3: Weekly performed exercise according to weekly plans of volume of exercise (in km)

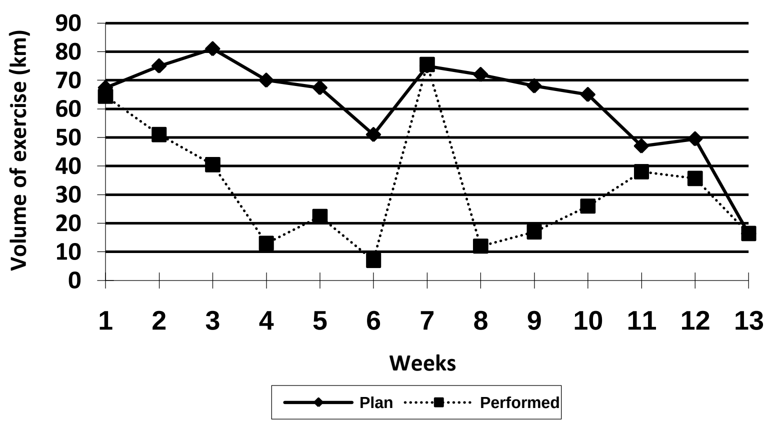

Figure 4: Overall comparison of planed and performed volume of exercise according to the intensity of exercise

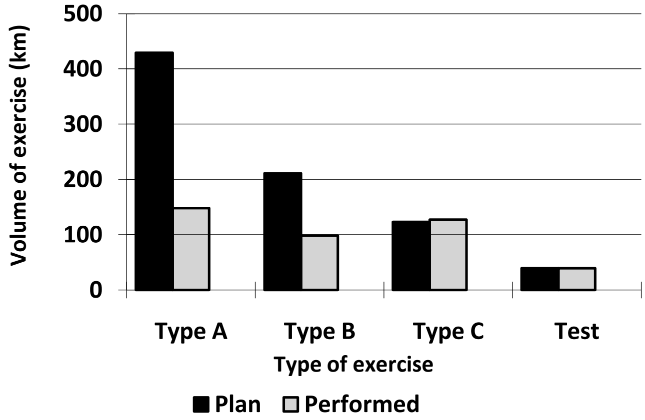

Table 1: Test results in February, March, May and June and the results obtained on the competition

	UNITS	FEBRUARY	MARCH	MAY	JUNE
TEST 5-7 x 1200 m					
v_{LT}	(m.s^{-1})	3,6	3,7	3,9	-
LA_{LT}	(mmol.l^{-1})	3,8	2,2	2,4	-
HR_{LT}	(b.min^{-1})	166	157	161	-
v_{OBLA}	(m.s^{-1})	3,7	4,1	4,2	-
HR_{vOBLA}	(b.min^{-1})	167	170	169	-
v_{TA}	(m.s^{-1})	3,8	4,2	4,0	3,8
pH_{TA}	1	7.400	7.370	7.385	7.400
HR_{TA}	(b.min^{-1})	171	174	164	171
TEST 4000 m					
4000 m (t)	(min:sec)	15:52	14:53	14:42	-
v_{4000}	(m.s^{-1})	4,2	4,5	4,5	-
HR_{4000}	(b.min^{-1})	175	176	176	-
COMPETITION					
v_{comp}	(m.s^{-1})	-	-	3,9	-
HR_{comp}	(b.min^{-1})	-	-	173	-

EXPLANATION OF ABBREVIATIONS: V_{LT} - the speed at lactate threshold; V_{PA} - speed at threshold of acidosis; v_{OBLA} - speed at OBLA threshold; v_{4000} - average speed in the course of 4000 m; v_{comp} - average speed of 28 km run; LA_{LT} - lactate concentration at LT ; HR_{LT} - heart rate at lactate threshold; pH_{PA} - pH at threshold of acidosis; HR_{TA} - heart rate at the threshold of acidosis; HR_{vOBLA} - heart rate, determined by the criterion of OBLA; HR4000 - average heart rate during the 4000 m; v_{comp} – average speed during competition; HR_{comp} - average heart rate during competition.

FEBRUARY: The results of the first test 7 x 1200 m show a high concentration of lactate at LT. Speed vLT and vOBLA, lactate concentration at LT, heart rate at LT and heart rate at vOBLA were almost identical (Table 1). Speed at lactate threshold practically coincided with the speed at OBLA. The speed at the threshold of acidosis was slightly faster than the speed of LT and similar to speed at lactate concentration of 4 mmol / l. The same is true for heart rate (Table 1). The average speed during 4000m test was 4.20 m.s^{-1}. Average heart rate during the test was 175 b.min^{-1}.

MARCH: Compared with the February testing, there have been positive changes in indicators that indicate the level of endurance. After the first mesocycle VLT was approximately 2% higher compared to the first testing. The value of lactate at LT was 42% lower than at the February test, which shows positive changes in metabolism. At the LT there was also lower heart rate compared with the February testing. OBLA speed obtained in March was 12% higher than in February. There was slightly increased heart rate at that running speed. Speed at threshold of acidosis was increased by 10% compared to February, at a slightly lower pH values. There were slightly higher values of the HR at the threshold of acidosis (Table 1). The average running speed of the test 4000m was 6.4% higher than in February. At the higher average speed run the average HR during a test was similar to the one in February (Table 1.).

MAY: Test results for may show that positive changes continued also in the second mesocycle. According to the March testing, the VLT increased by approximately 5% . At the same time were lactate concentration and HR slightly higher than in march, probably due to higher speeds at LT (Table 1). VOBLA in May increased about 2% in comparison to March testing and in total for 15% in comparison to the February testing. VTA in comparison to march fell by around 4%, with slightly higher values of pHTA in comparison to march. Heart rate at TA was lower than in march. The average speed of the test 4000m slightly increased in comparison to March (a total of about 8% compared to February). Average HR during the test was similar to March and only slightly higher than February's (Table1).

JUNE: The results of the June tests for objective reasons, include only the changes of pH. They were characterized by a marked reduction of VTA in comparison with that of May (about 6%) and were slightly lower than at the beginning of the experiment. Heart rate at vTA was equal to that at the beginning of the experiment (Table 1).

COMPETITION: The average velocity at the competition was similar to the vLT and vTA in May. Heart rate during competition was however on average 10 b.min-1 higher than at LT and 4 b.min-1 higher than at vTA in May.

Discussion

Body weight at rest

Change of body weight is associated with human metabolism. Metabolism is the process of exchange of energy compounds and energy in the body. Metabolic processes can be carried out in two directions: towards the predominant synthesis of biologically important compounds from substances ingested with food, or in the direction of the prevailing degradation of energy compounds. The first process is called anabolic the second catabolic. A general characteristic of athletes whose training is directed to increasing of long duration endurance is the low percentage of body fat and slightly lower average body weight compared with other athletes (Fox & Mathews, 1981). These characteristics apply mainly to the top marathon runners. The explanation for this phenomenon can be found in the type of exercise to increase long duration endurance. During the long duration endurance exercise there is increase of the percentage of use of free fatty acids to meet energy needs.

In our experiment has been a gradual reduction in body weight during exercise period (in eleven weeks for about 4%). From our results is possible to conclude that during the exercise period catabolic and anabolic processes were in a large balance and body weight had a gradual decline. From the results of the experiment can be concluded that the reduction of body mass was mainly due to reduction of body fat.

Comparing the first and second mesocycle shows that in the first mesocycle exercise led to a gradual reduction in body weight. Body weight the day after the race was for 2 kg less than on the previous day. This sharp decrease can be attributed to dehydration and use of glycogen reserves. This assumption is confirmed by the body weight increase by 1.5 kg next day after the competition. Interesting was body weight change between the 81st and 88th day of experiment. Although exercise during and after the competition was neither intensive nor extensive in terms of quantity, the weight gradually decreased, despite the same diet during this period. The explanation is that even after the termination of exercise there were conducted fairly intensive catabolic processes. Probably these processes can be attributed to increased activity of endocrine glands that regulate metabolism through hormones. Long duration endurance exercise has an important influence on the hormonal control of metabolism of fats and carbohydrates and the regulation of body fluids in the body (Astrand & Ryhming, 1954).

Changes in the period without exercise can be attributed to approximately the same diet during and after exercise, which at the end of exercise altered the quantity of energy equivalent of food intake and energy consumed in favour of the first. This resulted in accumulation of fat and carbohydrates in the body.

Similar changes in body weight as a result of exercise reported by various authors (Coyle et al., 1984; Hurley et al., 1984). A common feature of these findings is that reductions are not pronounced. We can conclude that the pronounced reduction in the percentage of body fat and weight loss, which was found in the studies of marathon runners, should be protracted for longer period of training.

Heart rate at rest

Long duration endurance exercise can cause three major changes that are discovered during the the heart function at rest: decreased heart rate, changes in the size of the heart and increased stroke volume.

The mechanisms that cause these changes are described as a phenomenon of 'sports heart' and are complex and should include changes in the myocardium, peripheral circulation and autonomic nervous system (Ehsani, Hagberg, & Hickson, 1978). The so called "Sports heart" depends on the type of sporting activity, exercise volume and intensity, sports, sex and age (Morganroth, Maron, Henry, & Epstein, 1975). In our experiment the training to increase long duration exercise resulted in bradycardia. The occurrence of bradycardia was the most pronounced when were compared trained with untrained subjects and was more expressed when untrained subjects performed a training program, and less pronounced in comparision to the trained persons in the period of preparation for the competition (Frick, Elovanio, & Somer, 1967).

We can conclude that in our experiment, the occurrence of bradycardia occurred mainly due to changes in the functioning of the sympathetic nervous system and the parasympathetic nerve (the N. vagus increased tone) or by a combination of both changes. This is demonstrated by the results of research on the impact of autonomic nervous system on the occurrence of bradycardia. It was also found that the occurrence of bradycardia was more pronounced during exercise than at rest (Fox & Mathews, 1981). From our results is also visible that the heart rate at rest rapidly increased during the detraining period. An increase in resting heart rate at the end of exercise period can be attributed to the same factors that led to bradycardia, but the changes were reversed.

Test results

To monitor the characteristics of changes in blood lactate concentration was established method of determining the anaerobic threshold according to different criteria and use of the name aerobic threshold, lactate threshold, ventilation threshold and OBLA criterion. Endurance exercise leads to increase of lactate threshold, anaerobic threshold and ventilation threshold observed in tests with gradually and steadily increased load (Aunola, 1991; Denis et al., 1982 ; Hurley et al., 1984 ; Ivy et al., 1980; Pruett, 1970). It is also known that the load at which was increased accumulation of lactate was higher in more robust and less endurance athletes or untrained subjects (Hurley et al., 1984; Ivy et al., 1980; Karlsson, Nordesjo, Jorfeldt, & Saltin,1972).

Changes in our experiment, resulting in metabolism after the first mesocycle, reflected in significantly lower concentration of lactic acid at the LT and increased OBLA and TA speed. The exercise also increases the ability to use lactate from the blood of both loaded as unloaded muscles (Brooks, 1986 ; Hurley et al., 1984 ; Ivy et al., 1980 ; Poole & Gaesser, 1985). Changes can also be attributed to the reduction of the release of catecholamines during submaximal exercise due to endurance training (Lehmann et al., 1984; Poole & Gaesser, 1985; Winder et al., 1978).

It is possible that the results obtained in the increase of vOBLA were also result of the improved mechanical efficiency of running. Exercise performed in the second mesocycle did not cause significant changes in vOBLA, slightly more pronounced was increase in VLT. Training in this period caused positive changes in muscle metabolism, and less on other systems.

The period without exercise resulted in highly negative changes in the values of all observable indicators depending on endurance. These changes after detraining were reported also in other studies on the impact of detraining to the organism (Coyle et al. 1984; Saltin & Rowell, 1980).

The results of our tests are similar to those already previously known information about the positive impact of endurance training to improve muscle metabolism and related indicators (Denis et al., 1982, Hurley et al., 1984; Karlsson, Nordesjo, Jorfeldt, & Saltin, 1972; Poole & Gaesser, 1985). This is particularly true for the method of training with a continuous running. It is true that in other studies observed positive effects of a combination of the methods of training both in terms of muscle metabolism as well as the increase in Vo2 max (Hurley et al., 1984, Poole & Gaesser, 1985). Perhaps, in our case, a relatively small improvement in the indicators monitored in the second mesocycle can be attributed to only 50% of the planned implementation of training and long illness a few days before testing. Similarly, other research suggests the deterioration of muscle metabolism after a period without training (Saltin & Rowell, 1980).

By monitoring heart rate during the tests we can evaluate the effort for a given load in terms of cardio-vascular system. Endurance exercise causes an increase in the heart, increase the maximum cardiac output and stroke volume, resulting in reduced heart rate in submaximal burden to small changes in maximum heart rate if a change does occur (Blomqvist & Saltin, 1983; Denis et al., 1982). In addition to these changes have a significant impact in reducing heart rate during exercise and changes in the autonomic nervous system, which is reflected in reduced plasma concentration of catecholamines in the increased burden as a result of reduction in sympathetic activity and an increase in activity parasimpatikus (Frick, Elovanio, & Somer, 1967; Lehmann et al., 1984). From the results we can see that the cardiovascular system responded positively to the training done so after the first as well as the second mesocycle.

The test results at 4000 m showed that all the values of the average speed obtained at the end of the run were significantly higher than at the OBLA criterion during 5-7 test runs times at 1200 m. The average heart rate was significantly higher during the 4000m test as the value of heart rate at vOBLA and acidosis threshold, suggesting that it is likely because the whole run was at higher speeds, as required by the OBLA criterion and the threshold of acidosis.

Average heart rate in the competition has been substantially higher than those that meet the testing criteria lactate threshold. Probably, this may be attributed to the motivation during the race, which was reflected in the increased sympathetic functioning at the day of the competition.

Conclusions

The experiment showed that the increase in exercise endurance in previously moderately active person caused positive changes in all monitored indicators of long term endurance. Lactate curve, according to the running speed during the test significantly shifted to the right, particularly after first mesocycle and to a lesser extent after the second mesocycle. The same is true for the pH curve.

Cardiovascular system positively responded during exercise period by lowering heart rate at rest and during the submaximal effort. Changes in heart rate at rest, primarily at the beginning of the experiment were more pronounced than the differences between submaximal efforts. Body weight during the experiment slightly and gradually decreased.

In the period after the competition (detraining period) all observed indicators returned to approximately the same values as at the beginning of the experiment. The exception is the value of body weight, which remained at a slightly lower level.

The average speed at the competition on 28 km run was most similar to that provided by lactate threshold.

We can conclude that proposed model of monitoring the effects of long duration endurance exercise was very sensitive to the training and detraining and can be used to estimate long endurance transformation process.

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RELATIONS BETWEEN SOME MOTOR ABILITIES WITH THE RESULTS ACHIEVED IN SHOT PUT

Gorana Tešanović & Goran Bošnjak

Abstract

The purpose of this study was to find out which of the motor tests for coordination, flexibility and explosive strength mainly refers to the ability for achieving high results in the glide shot put. The following tests static flexibility test - shoulder, deep forward bend on the bench, throwing ball from lying position, the standing long jump, squat content with the load, dribbling by hand, slalom two balls with legs and shot put that weights 5kg, were applied on 115 first grade secondary schools pupils in Banja Luka, of age 15 years ± 6 months. The ratio between motor abilities coordination, flexibility, explosive strength and the results achieved in shot put was determined by the application of regression analysis. The results obtained by statistical analysis showed that the applied tests have statistical significance on a level of p =. 000, and that 58.1% predict results to be achieved in the shot put. Also, they showed that the test throwing medicine ball from lying position has the greatest statistical significance (.000). Research has shown that the explosive strength and leg flexibility are associated with the highest achievements in the glide shot put and that the coordination of arms can partially affect, but the static leg strength, coordination of a leg and flexibility of the arms is not important for achieving results in the shot put. It is essential that the tests throwing medicine ball from lying position, a deep forward bend on the bench and the standing long jump may be used as valid indicators in the prediction of results and for the selection of younger ages.

Introduction

In the age of modern technology, when biomechanical analysis is used in prediction of achieving top results in sports, it is desirable to apply the standardized motor tests and anthropometrical methods in the training process of young children.

The shot put is an athletics discipline that requires a mastery of technical performance and the timely performance of kinetic chain movements. Technology could indicate the angles of ejection, the forces that should be reported to the props, the speed of movement and the expulsion of the devices and the deficiencies in the performance of technique, but the selection is more successful if we find practicable methods of detecting potential and learning of the proper technique in work with younger children. Čoh & Štubec (2008) have identified some of the key elements in the rotational technique of the shot put that generate the competition results achieved in shot put. They showed that the most important guideline of the rotational technique is the release velocity, produced by the horizontal and vertical velocity vectors. Also, attention is drawn that the length of the path in the final acceleration phase depends on the lowest point of the throw, the maximum amortization of the knee and a height of the release point.

When examining the results achieved in the shot put, one needs to take into account the angle of the throw, where the science has suggested that the most optimal angle relative to the base, above which the ball needs to be thrown, is between 36-40° for men, and 37-42° for women (Tončev, 1991). There are many factors that can affect the results achieved in the shot put, one of them being the morphological characteristics and motor skills of the throwers, as well as the weight of balls, which could affect the technical performance and the throw.

In their paper, Idrizović, Idrizović, Stanković, Nićin & Marušić, R. (2001) pointed to the necessity of learning the laws of the relation between morphology characteristics and motor abilities, because the motor abilities can only be manifested via the morphology structure of the entity, and that the efficiency of motor manifestation directly depends on the anthropometric dimensions.

The dominant motor skills, essential in achieving excellent results in the shot put, are the explosive strength, speed and agility. The coordination and flexibility are also necessary for effective learning techniques of the shot put, which will result in achieving a greater range of motions in performances and prevention of injuries. Poprawski & Winkler (1977) cited the importance of power development, ways of the transmission of force and the velocity of shot put. Working with younger children and beginners requires the application of methods that will most effectively demonstrate the existence of talent for the particular sports discipline.

Mihajlović, Bošnjak and Jakovljević (2010) carried out a research with a goal to define correlations and the internal influence of the results accomplished through tests of 100m running, 800m/1500m running, long jump and shot put. Testing was done on a sample of 383 students. Based on the analysis and processing of obtained data, the correlations and mutual influence of these results were confirmed. Based on the results achieved in the shot put, it is possible to predict the results in the running at 100m and 800m and in the long jump in the female examinees, while the possible prediction is for results in the long jump in the male examinees. A study was conducted at the sample of the students (Žuvela, Maleš & Čerkez, 2009) having the main goal to establish the effects of the two experimental models for motor skill learning in the acquisition of skills in the field of athletic throws (Discus Throw, Shot Put and Javelin Throw).

The shot put is a complex technical discipline, which requires a proper execution of the kinetic chain movements, so it is very difficult to determine whether it will be the globe thrower when it starts work with the beginners. There are many reasons for this. Although the young thrower throws the balls of low weight at the beginning of the training process, it is difficult to expect that he will take advantage of his all explosive strength, speed and agility, even when he knows and is able to perform the techniques of the shot put. According to the research by Korica & Vidaković (2007) that had been carried out year by year, there are statistically significant differences between the sexes in some types of throwing.

The shot put thrower has to have absolute knowledge of the principle of throwing balls and a flawless execution of technique to be able to use their maximum of explosive strength, the optimal speed and agility when throwing a ball. Therefore, in working with younger children and the beginners, who have shown affinity for the shot put, it is desirable to pay attention to their motor skills, coordination, flexibility and strength. These motor skills indicate the possibility of quick learning and mastering techniques, the achieving a large range of motion and imparting of a high initial speed on a ball. Because that it is necessary to determine the motor tests, whose application will not spend much time in the training process and can predict the success in the glide shot put. The tests have to be such to determinethe existence of opportunities for achieving greater distances, in order to have the elements for early selection. The purpose of this study was to determine which of the tests used for motor coordination, flexibility and strength mainly refers the ability to achieve the high results in the glide shot put.

The aim of the research is to determine the relation between coordination, flexibility, explosive strength and the results achieved in the shot put, as well as to determine the way the aforementioned motor abilities influenced the results achieved in shot put.

Methods

Sample

The whole sample derived from the population of the pupils of the first grade secondary schools in Banja Luka, with the total of 12 schools. The chronological age of the examinees was between 6 months below, or above, 15 years of age. The test population encompassed

112 male examinees, which designed a nomination scale. The sample used determined a choice of technique to be a random number table. None of the pupils was a member of any sports club or was involved in any training process.

The research was conducted in September and October 2009 at the city stadium and the premises of the Technical School in Banja Luka. All examinees attended the same curriculum and program for secondary schools and were not practicing out-of-school activities. The sample was taken at random, bearing in mind that every pupil had the same chance to be selected, which indicates that the sample was representative thus enabling generalization of obtained data. The shot put testing was carried out at the stadium, while the measuring of the motor test was done at the Technical School in Banja Luka. The pupils had a shot put training for 6 weeks. All measuring was done in the morning hours, and the shot put testing was done after adequate warming up and stretching exercises.

Variables

The level of motor ability of the pupils was determined via the application of a set of 7 standardized motor tests (Table 1) for strength (standing long jump, throwing medical ball from the lying position and squat content with the load), flexibility (static flexibility test - shoulder, deep forward bend on the bench), coordination (dribbling by hand, slalom two balls with legs), while, for the determination of the result in the shot put, the shot put that weighing 5kg was used. The reason for selecting a ball of this weight lies in the fact that it is much easier to manipulate with that weight then with the ball thrown by senior throwers (7.260 g). Also the ball of 5 kg is the ball which is predicted by IAAF rules for the competitions of these ages.

The tests were conducted in the morning hours. The sequence of the applied variables was established in accordance with the significance of motor abilities in the accomplishment of the shot put results and according to the effort that the muscle had to exert in order to resolve the task: strength variables were tested first, then the coordination variables, and then the flexibility.

Prior to any test, the pupils were given an explanation and illustration how the tests were to be done correctly, with an emphasis on the proper performance, due to getting as plausible results as possible.

Table 1: Sample of variables

Test	Measured capacity	Measur-ing unit
Static flexibility test - shoulder	Flexibility of the shoulders	cm
Deep forward bend on the bench	Flexibility of the legs	cm
Throwing medical ball from the lying position	Muscular endurance of the torso and shoulder girdle	m
Standing long jump	Power of legs	cm
Squat content with the load	Power endurance of legs	Seconds
Dribbling by hand	Coordination of the arms	Seconds
Slalom two balls with legs	Coordination of the legs	Seconds
Shot put	Ability for achieving results	cm

Data analysis

To process the data, we used the statistical package SPSS 11.0 for Windows. Fully to implement the set tasks and therewith prove or reject the hypothesis of this research, a mathematical-statistic procedure was applied.

In order to formulate valid conclusions, we calculated the following:

- The basic statistical guidelines of manifested motor abilities of arithmetic mean
- Regression causality between the motor abilities and the shot-put results,

- Correlations causality between the motor abilities and the shot-put results.

The relation between the coordination, flexibility and explosive strength and the results achieved in shot put are presented via two systems:

- Predication system: static flexibility test - shoulder, deep forward bend on the bench, standing long jump, throwing medical ball from the lying position, squat content with the load, dribbling by hand, slalom two balls with legs.
- Criteria system: shot put (5 kg).

Results

As we can see from results presented in Table 2, the results achieved in eight motor tests are not representative. It could be said that the result are poorer and not in a high range. There could be many reasons for that. One of them is the fact that many of these pupils did not have proper lessons of physical education in the elementary school. Also, there are no sports organizations which can animate the pupils of all ages to exercise in Bosnia and Herzegovina.

Table 2: The medium value measuring variables

VARIABLES	MEDIUM VALUE
Static flexibility test - shoulder	89..2957 ± 1.3887
Deep forward bend on the bench	22.0174 ± .7133
Throwing medical ball from the lying position	10.3830 ± .1807
Standing long jump	183.1719 ± 2.3999
Squat content with the load	38.4428 ± 2.0484
Dribbling by hand	9.0066 ± 0.979
Slalom two balls with legs	22.6453 ± .3701
Shot-put	8.6210 ± .1302

By analyzing the presented guideline in Table 2, we see that there is a greater discrepancy of results in standing long jump and squat content with the load.

Table 3: Multiple determination coefficient

MODEL	R	R^2	Corrected R^2	Standard error assessment	R Square Change	F Change	df1	df2	Sig. F Change
	.762[a]	.581	.553	.93292	.581	21.182	7	107	.000

[a]Predication system: static flexibility test - shoulder, deep forward bend on the bench, standing long jump, throwing medical ball from the lying position, squat content with the load, dribbling by hand, slalom two balls with legs

[b]Criterion variable: shot put

Table 4: Regression and residual square sum

MODEL	Sum of deviation squares	Liberty degree	Variance assessment	F - value	Significance
Regression	129.049	7	18.436	21.128	.000[a]
Residual	93.126	107	.870		
Total	222.174	114			

[a]Predication system: static flexibility test - shoulder, deep forward bend on the bench, standing long jump, throwing medical ball from the lying position, squat content with the load, dribbling by hand, slalom two balls with legs

[b]Criterion variable: shot put

Determination of regressive relation between the predicative measuring of anthropometric dimensions and the criterion variable (shot put) individually, was done by the application of regression analysis which includes the following parameters: the correlation coefficient vector (R), the partial correlation coefficient vector (Part R), the standardized partial regression coefficients vector (Beta), the standardized partial regression coefficients vector (t), the importance of the beta coefficient (significance), determination coefficient as a measure for common variability between the criterion variable and the predication variable system, that have an impact on the examined feature (R), coefficient of the multiple correlation between the criterion variable and the predication variables system (R^2), size of the F correlation (F) and the level of the F correlation significance (p).

Table 5: Model and coefficients

MODEL	Non-standardized coefficient		Standardized coefficient	t	Significance
	B	Std. error	Beta		
CONSTANT	1.483	1.554		.955	.342
Static flexibility test - shoulder	-4.00E-03	.007	-.043	-.590	.556
Deep forward bend on the bench	2.319E-02	.014	0.127	1.666	.099
Throwing medical ball from the lying position	.476	.053	0.166	8.958	.000
Standing long jump	7.291E-03	.004	0.134	1.644	.103
Squat content with the load	-2.80E-03	.004	-.044	-.655	.514
Dribbling by hand	-7.44E-02	.110	-.056	-.676	.501
Slalom two balls with legs	-656E-03	.025	-.019	-.262	.794

Criterion variable: shot put

Table 6: Correlations

	Static flexibility test - shoulder	Deep forward bend on the bench	Throwing medical ball from the lying position	Standing long jump	Squat content with the load	Dribbling by hand	Slalom two balls with legs	Shot put
Static flexibility test - shoulder	1							
	.							
Deep forward bend on the bench	-.395^{++}	1						
	.000	.						
Throwing medical ball from the lying position	-.025	.355^{++}	1					
	.790	.000	.					
Standing long jump	-.328^{++}	.429^{++}	.425^{++}	1				
	.000	.000	.000	.				
Squat content with the load	-.190^{+}	.244^{++}	.085	.331^{++}	1			
	.042	.009	.368	.000	.			
Dribbling by hand	-.323^{++}	.379^{++}	.346^{++}	.495^{++}	.212^{+}	1		
	.000	.000	.000	.000	.023	.		
Slalom two balls with legs	-.203^{+}	.177	.142	.204^{+}	.122	.469^{++}	1	
	.030	.059	.131	.029	.193	.000	.	
Shot put	-.123	.401^{++}	.738^{++}	.437^{++}	.081	.283^{++}	.102	1
	.189	.000	.000	.000	.388	.002	.278	.

$^{++}$Correlation is significant at the 0.01 level (2-tailed)

$^{+}$ Correlation is significant at the 0.01 level (2-tailed)

Discussion

Results obtained by regression analysis in Table 3 indicate that a statistically significant influence of motor tests was established as a predication system (p=.000) on the results achieved in shot put as a criterion variable at the multivariate level.

Insight into Table 5 shows that a set of motor tests and the obtained results of the criterion variable have 58.1% of the information in common. The multiple correlation coefficient is .762 which corroborates the previous statement.

On the basis of the standardized partial coefficients vector (BETA) and its significance, an analysis was carried out to determine the influence of the motor abilities on result in shot put at an univariate level, which leads to conclusion that the throwing medical ball from the lying position has a statistically significant influence to results achieved in shot put (.000). All the other tests, according to results obtained by regression analysis (Table 5) do not have statistically significant influence on the achieved result in shot put: deep forward bend on the bench (.099), standing long jump (.103), dribbling by hand (.501), squat content with the load (.514), static flexibility test - shoulder (.556) and slalom two balls with legs (.794).

As the regression model has not shown statistically significant influence in explaining criterion variable, a correlation analysis was performed. The results of correlation matrix given in Table 6 show statistically significant correlations between the variables throwing medicinal ball from the lying position (.738), standing long jump (.437), deep forward bend on the bench (.401), dribbling by hand (.283) with achieved results in the shot put. It may be noticed that those correlations are not high (except at throwing medicinal from the lying position test), but they do exist.

Throwing medicinal ball from lying position test is a test for assessment of the explosive strength of hands; standing long jump is a test assessing the explosive strength of legs, while the deep forward bend on the bench is a test for assessing flexibility of legs. The research has shown that these motoric abilities may influence on the achieved results in the glide shot put. The reason for that lies in the fact that the explosive strength of legs provides faster overtaking of the shot and timely taking of the position for maximum strain, creating “space” for faster and more energetic acting by the explosive strength of the hand to the shot. By this, at putting the shot out, the initial velocity is announced and a longer shot is achieved.

A partial role of legs flexibility in achieving better results in the glide shot put may be interpreted with a possibility of achiving higher movement amplitudes. As in the phase of overtaking the device with backward technique the so-called “glide” step is taken, better flexibility of the legs may provide a better taking of the initial position prior to making a “glide” step, a better swing with the leg and a better taking of the position just prior to making a maximum strain. This is to achieve better quality and timely performance of chain of movements, as well as acting on the shot with bigger forces.

Flexibility of the hands provides bigger amplitude of hand movements, meaning also a longer duration of acting onto the device. However, due to its weight, a shot may not be thrown as a ball or a spear, the shot is put by “pushing” it towards the front and up, thus this very movement is limited and it does not require a long effect on the device, thus it is understandable that it was shown that static flexibility test - shoulder does not have influence on achieving results in the glide shot put.

Smaller statistical significance was shown by dribbling by hand test. The reason for that lies in the fact that hand movements, at the glide shot putting, are not complex.

Also, the test of squat content with the load has shown insignificant influence on the achieved result in the shot put. When doing the glide shot put, the starting position is a part of the whole technique which is static compared to all other shot put parts. However, this static part does not last very long, in terms of time duration, thus bigger static strength for performance of this part is not necessary, and it is understandable why influences of the static strength are not of importance for achieving of better results in the shot put.

Researching on the relation between the results in the test slalom two balls with legs and achieved results in the shot put, it proved that coordination of the legs, as motor ability, does not affect the result. The reason for that is in the fact that leg movements, at the shot put, are relatively simple and are done with high velocity and in small space.

Taking into account all the aforementioned, it may be concluded that the results achieved in motor tests are not on a high level. There are many reasons for that. One reason can be because the pupils are unable and do not know enough about how to use the maximum of theirs motor skills, for which much more time needs to be spent in training of the performance of these techniques.

In this research, the objective was to determine the relation between the motor abilities coordination, flexibility, strength and the results achieved in the shot put. The applied regression analysis and the correlation analysis, the predication variables coefficient correlation analysis and the criterion variable showed that there was astatistically significant importance between the explosive strength of the hands and legs, and the flexibility of the leg associated with the highest achievements in the shot put, coordination of hands can partly affect, but the the static leg strength, coordination of the leg and flexibility of hands has no importance for achieving results in the shot put. It is essential that the tests throwing medicine ball from lying position, a deep forward bend on the bench and the standing long jump may be used as valid indicators in the prediction of results and for the selection in the shot put of younger ages.

Tilinger, Kovar & Hlavata (2005) in their studies on the dynamic progress of performances in track-and--field athletes in the running, throwing and jumping discovered that the sprinters started their specialized training, as a rule, at the age of 16 years and they attained their top performances between the ages of 24 - 25 years. For throwers the beginning of specialized training was also at the age of 17 and their top performance came at 26 - 27 years; for jumpers it was all the little earlier – beginning at 14 - 15 years of age and the top of performance between 23 - 24 years of age.

If we take into account the above-mentioned study, stating that the specialization in the training process of the throwing starts with 17 years, we can say that this research is applied in the relevant age of 15 ± 6 months. Also this research showed that using three valid motor test: throwing medicine ball from lying position, a deep forward bend on the bench and the standing long jump, we have opportunity for a timely selection for the shot put in these ages.

In line with the aforementioned, including the results obtained in this research, one can conclude that the motor ability space, which is consisted of strength, flexibility and coordination, plays an important role in the achievement of results in shot put. When it comes to motor abilities that have an influence of the achievement of results in shot put, this research has shown that attention should be paid to explosive strength, flexibility of the legs and the coordination of the arms, because some of the said abilities may lead to the achievement of better results in shot put, while the static leg strength, coordination of a legs and flexibility of the arms has no influence of the result. Thus, when we are talking about the selection or working with younger children and beginners, it is recommended to determine the level of their explosive power, coordination of hand and flexibility of the legs. Choosing of this way we can select those that have a solid base to start the training techniques of the shot put, what will help to reduce loss of time and the energy.

This research has shown that there is no a single element or factor that can be neglected in the training process and that each of them may be decisive for the accomplishment of a better result, both in shot put as well as in other sport disciplines.

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CORRELATION AND GENDER DIFFERENCES BETWEEN LACTATE RECOVERY PARAMETERS AND 100M FREESTYLE RESULTS AT YOUTH SWIMMERS

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Abstract

The aim of the present study was: a) the correlation between lactate parameters and 100m freestyle results and b) differences between blood lactate recovery parameters the two genders at youth swimmers. The sample of this study consisted of 15 swimmers, of them 9 were male of Age=16±1, BH=180±5 and BW=70±8 and 6 were female of Age=16±0.5, BH=168±7 and BW=59±5. Subjects performed 100m freestyle with maximum intensity (100_{VEL}). Performance time was recorded and Heart rate (HR) was estimated after the test. For the determination of maximum accumulation of lactic acid (La_{MAX}), blood capillary samples were taken in 3rd, 5th and 7th min post exercise. The results of this study showed that there is statistical significant relationship between 100_{VEL} and system of blood lactate recovery parameters as predictor variables at $R^2_{adj} = 0.9762$, Standard Error = 0.6853, $F_{ANOVA\ of\ Regresion} = 83.01$, $p = 0.000$. Statistically significant differences between male and female swimmers was only found at: t_La_{MAX} – t = 1.982, p = 0.039 (347.4±72.4 vs 261.8±87.2 sec for male and female swimmers, respectively).

Introduction

Maximal performances in swimming depend on the maximal metabolic power of the athlete and on the economy of locomotion. The amount of metabolic energy spent in transporting the body mass of the subject over a unit of distance has been defined as the energy cost of locomotion (Di Prampero, 1986). A significant amount of energy is derived from anaerobic energy release. The amount of anaerobic energy depends on the distance and velocity at which swims are performed (Strumbelj, 2002).

Diagnosing in swimming is the process which is focused on the evaluation of the preparedness of the athletes in relation to the training load as much as other various factors, in order to control the training process (Korcek, 1992). This process is continuous and intentional so that it the effectiveness of the training process can be improved. The response of the organism to the training load thus provides the information about the athlete's preparedness. The utility of assessing [BLa] for swimmers is important of a variety of training a and competitive purposes (Vescovi, Falenchuk, & Wells, 2010).

In competitive swimming, coaches and swimmers need to achieve more efficient and faster swim speeds, using data such blood lactate accumulation in muscles to improve high speed endurance during swim training (Olbrecht, 2000; Nomura & Shimoyama, 2002). Competitive swimming events consist of different distances from 50m to 1500m and it takes approximately 23 seconds to 14 minutes 30 seconds to complete swimming those distance events (Olbrecht, 2000; Ogita, 2006). Short duration bouts of high intensity exercise rely largely on non- oxidative energy metabolism, resulting in the accumulation of muscle and blood lactate [BLa] (Di Prampero, 1986; Strumbelj, 2002).

Peak blood lactate concentration for swimming events could be an indicator of swimming effort, especially if the race is fast as it occurs following swimming competitions. Provided the competition does not last significantly longer than 2 min, the necessary energy is provided mainly through the lactic anaerobic system (Elliott & Haber, 1983). Peak [BLa] concentration following maximal exercise has a direct relationship with performance in swim events ranging between 100m and 800m (Olbrecht, 2000). The highest lactate levels have been recorded following the swimming distances of 100m and 200m (Vescovi, Falenchuk, & Wells, 2010).

Review of the scientific literature revealed that peak blood lactate levels are not significantly different between the two genders (Chatard, 1988; Jacobs, 1983), suggesting that the capacity to produce high lactate levels in the blood is probably acquired through training (Avlonitou, 1996).

The aim of the present study was: a) the correlation between lactate parameters and 100m freestyle results and b) differences between blood lactate recovery parameters the two genders at youth swimmers.

Methods

Sample

The sample of this study consisted of 15 swimmers, all active short and middle distance swimmers, of them 9 were male of Age=16±1, BH=180±5 and BW=70±8 and 6 were female of Age=16±0.5, BH=168±7 and BW=59±5. The test took place in an open swimming pool of 50m during the precompetitive phase of summer period. After a standardized warm up of 600m with the guidance of the coach and 10 minutes of rest, subjects performed 100m freestyle with maximum intensity (100_{VEL}) as a criteria variable.

Variables

Performance time in each 50m was recorded. Heart rate (HR) was estimated the first 10 seconds after the test. Blood capillary samples were taken in in 3rd, 5th and 7th min post exercise in order to determine the maximum accumulation of lactic acid (La_{MAX}) and were analysed with the portable analyzer SCOUT LACTATE GERMANY. The seven following variables were used as blood recovery lactate parameters:

1. La_{PEAK}, blood lactate concentration at zero time after the 100 m all-out trial, estimated using the backward method from polynomial mathematical equation, expressed in mmol/L;
2. La_{MAX}, maximal blood lactate concentration in recovery period of time after the 100 m all-out trial, estimated from polynomial mathematical equation method, expressed in mmol/L;
3. t_La_{MAX}, time needed to reach maximal blood lactate concentration in recovery period of time after the 100 m all-out trial, estimated from polynomial mathematical equation method, expressed in sec;
4. Index $La_{PEAK}/100_{VEL}$, index calculated as relation between blood lactate concentration peak value and 100 m all-out bout average velocity, expressed as index value;
5. Index $La_{MAX}/100_{VEL}$, index calculated as relation between maximal blood lactate concentration value and 100 m all-out bout average velocity, expressed as index value;
6. Index HR/La_{PEAK}, index calculated as relation between blood lactate concentration peak value and heart rate measured 10 seconds after 100 m all-out bout average velocity, expressed as index value;
7. Index HR/La_{MAX}, index calculated as relation between maximal blood lactate concentration value and heart rate measured 10 seconds after 100 m all-out bout average velocity, expressed as index value.

All mentioned above variables served as a sets of predictive variables. Multiple regression analysis (MRA) was used for the determination of relation between criteria and set of predictor variables. ANOVA and Student's t test we used for gender differences calculations.

Results

The results of MRA showed that at general level there is statistical significant relationship between 100_{VEL} and system of predictor variables at $R^2_{adj} = 0.9762$, Standard Error = 0.6853, $F_{ANOVA\ of\ Regresion} = 83.01$, $p = 0.000$ (Table 2). At partial level only two variables are statistically significantly related with 100_{VEL} as well as: La_{MAX} – t = - 6.21, p = 0.000, and Index $La_{MAX}/100_{VEL}$ – t = 4.78, p = 0.002. Concerning the gender differences (Table 1), only statistically significant differences between male and female swimmers was found at: t_La_{MAX} – t = 1.982, p = 0.039 (347.4±72.4 vs 261.8±87.2 sec for male and female swimmers, respectively).

Table 1: Values in means and SD in analysed variables

100m free	100m Time (s)	La_{Peak} (mmol/L)	La_{Max} (mmol/L)	La_{max}_t (s)	$La_{PEAK}/100_{VEL}$ (Index)	$La_{Max}/100_{VEL}$ (index)	HR/La_{Peak} (index)	HR/La_{Max} (index)
Male	58,83±2,33	7,18±2,27	8,75±1,03	347±72*	4,24±1,63	5,16±0,70	27,84±8,52	20,80±3.99
Female	66,17±2,79	6,82±2,35	7,77±1,14	262±88*	4,48±1,49	5,13±0,71	29,54±11,01	23,11±3,23

*Statistical significant difference between gender

Table 2: Multiple regresion statistics

Regression Statistics	
Multiple R	0.9940
R Square	0.9881
Adj. R Square	0.9762
St. Error	0.6853
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	7	272.92	38.99	83.01	0.000
Residual	7	3.29	0.47		
Total	14	276.21			

	Coefficients	*Stand. Error*	*t Stat*	*P-value*
Intercept	61.479	7.821	7.861	0.0001
La_{max}_t	-0.002	0.003	-0.614	0.558
La_{Max}	-8.398	1.352	-6.211	0.000
$La_{Max}/100_{VEL}$	13.683	2.864	4.778	0.002
HR/La_{Max}	0.004	0.231	0.015	0.988
La_{Peak}	1.019	1.888	0.541	0.606
$La_{PEAK}/100_{VEL}$	-1.659	3.405	-0.487	0.641
HR/La_{Peak}	0.022	0.087	0.2574	0.804

Discussion and conclusion

The results of multiple regression analysis showed that there is general statistically significant correlation between the predicted variable in relation to performance time in 100m freestyle swimming and blood lactate parameters in recovery after the test in the level of $R^2_{adj} = 0.9762$, Standard Error = 0.6853, $F_{ANOVA\ of\ Regresion} = 83.01$, $p = 0.000$ (Table 2). At partial level only two variables are statistically significantly related with 100_{VEL} as well as: La_{MAX} – t = - 6.21, p = 0.000, and Index $La_{MAX}/100_{VEL}$ – t = 4.78, p = 0.002 (Table 2). This specific model has very small level of error of the predicted variable of the achieved result in 100m freestyle and this only ±0.6853sec.

In individual case, the correlation of this criteria and of the predicted variable validates that there is inversely proportional relation (negative) between the criteria that is performance time in 100m and maximum accumulation of lactic acid in blood, a fact that shows that the smaller the time of 100m freestyle the higher level of blood lactate concentration. This is expected because swimming intensity in 100m freestyle energetically depends on the development of glycolytic procedures, that means from the development of anaerobic lactic mechanism of swimmer (Olbrecht, 2000; Rodriguez & Mader 2002; Strumbelj, Usaj, Kapus, Bednarik, & Kapus, 2002; Vescovi, Falenchuk, & Wells, 2010).

However, the results showed that $La_{MAX}/100_{VEL}$ has statistically significant correlation to the results in 100m freestyle swimming and with proportional positive relation ($t = 4.78$, $p = 0.002$). In other words, as higher is the velocity in 100m freestyle (higher swimming intensity achieved in specific distance) so are the changes in the values of this index. Generally we observe that this index presents the relationship between maximum concentration of lactic acid and swimming velocity in 100m freestyle and numerically expresses how much blood lactate accumulation is achieved in stable swimming velocity from 1m/sec. That means that a swimmer has low blood lactate concentration in stable velocity of 1m/sec. These values show that for the same value of maximum accumulation of lactic acid, the distance of 100m freestyle can be swam with higher intensity. Such results can prove that the determination of this index has measurable ability to be important index of metabolic efficiency in swimming in relation to the distance of 100m and this fact of course must me confirmed in next researches.

At general level, we can conclude that the test of 100m freestyle can be simple and useful tool to estimate the swimmers blood lactate recovery characteristics (Olbrecht, 2000). It's mean that one trial all-out 100m freestyle testing could be useful and simply method to checking the swimmers lactate characteristics at high intensity anaerobic specific strain. The results showed that variables as well as La_{MAX} and Index $La_{MAX}/100_{VEL}$ could be useful measurements for those detecting, regardless to gender at youth age.

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EFFECTS OF THE PROGRAM OF WATER POLO SCHOOL ON TRANSFORMATION PROCESSES OF MOTOR CAPABILITIES OF BOYS

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Abstract

The objective of this research was to determine the effects of the water polo school program to transformation processes of motor capabilities of boys at age of 12 years. Testing was performed on the sample of 56 boys in the age of 12±0,9 years. The examinees were divided into two subsamples, experimental group of water polo school (n=21) and a control group of boys not active in sports (n=35). In addition to regular school classes of physical education, the experimental group also attended water polo school program, while the control group attended only regular school physical education classes without additional sport activities. A total of 13 motor tests were applied. Central and dispersive parameters demonstrated differences between the groups whereby the difference of covariance matrices was statistically significant (Sig.= ,000). Observing the results of discriminative analysis with indicators of significant variations between experimental and control group in motor capabilities, a statistically significant canonic discriminative function was obtained that had a statistically significant value (Canon. Correlation = ,777). Results of multivariate analysis of the variance demonstrated that the applied program of the water polo school combined with regular physical education classes in the school had led to statistically significant quantitative changes in multivariate space of analyzed variables. It can be concluded that the water polo school program made an impact on transformation processes. The research demonstrated that the attendants of an annual water polo school program had significantly improved basic motor capabilities in comparison to their peer group not active in sports.

Introduction

According to the theory of transformation processes, impacts of various program curricula are mutually varied. Variability of impacts depend on quality of curriculum program and on specificity of dimensions to be influenced (Rađo,1997). Many authors argue that human capabilities and characteristics can be developed most successfully in the so-called sensible phases (Stojanović 1987, Metvejev 2000, Spamer 2002). In accordance with that, positive effects of transformation processes can only be expected provided methodical formation of training work has been adjusted to individual capabilities and characteristics of the person (Kondrić et al., 2002).

In the ontogenesis period, in which, by natural laws, the most significant development of certain capabilities and characteristics of a person takes place, it comes to increment of adaptive potential and creation of especially favorable prerequisites for formation of certain motor skills (Spamer, 2002). Unfortunately, the physical education classes in school are the only form of motor activities for the most of young people (Kovač, 2007).

According to some authors, the children of school age should participate in number of activities ranging from moderate to energetic intensity at least 60 minutes a day (Strong et al., 2005). In a training process which is based on development of anthropological characteristics of children, efficient procedures should be applied in terms of selection of working methods, organization forms, intensity of weight and relaxation (Drabik, 1996). Specific motor capabilities are acquired by nature of an applied sport as a result of a training process (Aleksandrovic et al., 2004).

To date, a number of research reports have been focused on impacts of especially programmed physical education classes and programmed sport training to motor capabilities of boys. Higher motor and functional capabilities of children actively involved in sports compared to children non-active in sports, can also be attributed, in addition to endogenous factors, to primarily exogenous factors, i.e. transformation processes in sport clubs and physical education classes (Batričević, 2008).

The research reports demonstrated that particularly programmed sport activities containing elements of athletics and sport games, have made significantly positive changes to motor capabilities of boys, particularly in the field of coordination, resistance, speed and explosive strength. A question was posed about to which extent activities in water environment influence basic motor capabilities on dry land. In exercising with water resistance, the advantages of muscle strengthening, but also improvement of explosive strength, such as strike, aerobic capabilities, coordination, flexibilities and agility are emphasized with reduction of pressure to joint structures (Kravitz, 1997).

Having in mind that water polo, due to nature of game and movement in water environment, requires a high level of physical readiness and adaptation (Radovanovic, 2006), the objective of this research was to determine effects of water polo school programs onto transformation processes of motor capabilities of boys at the age of 12 years.

Methods

Sample

The testing was performed on the sample of 56 boys from Sarajevo primary schools, in the age group of 12±0,9 years, height 154±4 cm, weight: 53±4 kg. The examinees were divided into two subsamples, experimental group of water polo school (n=21) and the control group of boys not active in sports (n=35). In the time period of one academic year, the control group (G1) attended regular physical education classes in the school without any additional sport activities, while the experimental group (G2) attended experimental water polo school program (three times a week/ one hour) in addition to regular physical education classes in the school (two hours/a week). In course of the experimental program, the skills of water movements, swimming techniques, ball exercises were trained, in the framework of individual tactics in attack and individual tactics of defense.

Variables

Table 1: Sample of variables

Variable	Test	Measured capacity	Measuring unit
LJFP	Standing Long Jump	assessment of explosive strength	cm
JJ	Standing high Jumping	assessment of explosive strength	cm
RHZ20	20 m Running with High Start	sprint speed assessment	seconds
HT	Arm/hand plate tapping – 20 s.	assessment speed of alternate movement	no. of repetit.
THFW	Foot tapping against the wall- 10 s.	speed assessment of individ. movements	no. of repetit.
PU	Push-ups	assessment of repetitive strength	no. of repetit.
ABS	Abdominal sit-ups	muscular endurance of the torso	no. of repetit.
MIA	Movement/mobility in air	co-ordination assessment body movement	seconds
SS	Side steps	co-ordination assessment	seconds
FB	Forward/flexibility front bench bent	assessment of flexibility	cm
LLF	Lateral leg flexibility	assessment of flexibility	cm
B1L	Balance on one leg/foot open eyes	balance assessment	seconds
B2L	Balance on two legs/ foot	balance assessment	seconds

Data from the Sport educational chart were used in the analysis. Throughout the research, a battery of 13 motor tests was applied (Table 1). The selection of motor tests is based on the model modified battery (Kurelić et al., 1975; Mikić, 1999). All the tests have suitable measuring characteristics. The model is hierarchic and based on the functional mechanisms responsible for latent motor abilities.

Data analysis

For analysis of quantitative values of variables and their relations, the discriminative analysis was used at invariant and multivariate level. Basic parameters of the distribution of variables were calculated (mean, standard deviation, F-ratio, p). For determination of quantitative differences a discriminative analysis in manifest space was used (Rađo, 2002). The analysis of research results was processed by a statistical package SPSS 7.0 and Statistic 5.0.

Results

Table 2 shows basic descriptive parameters of control and experimental groups. By t-test analysis for independent samples, it is observed that statistically significant difference is present in majority of testing variables. Based on the presented data it can be observed that the boys, who were additionally involved in the water polo school program, have achieved better results in tests of explosive strength assessment, speed of individual arm movements, coordination, flexibility and balance than the boys who only attended physical education classes in the school without any additional sport activities (Table 2). A similar structure was also obtained in research reports to date by other authors (Batričević, 2008; Blašković, 1993) on occasion of testing differences of motor capabilities of children active in sports and their non-active peers.

Table 2: Value of arithmetic mean, standard deviations and t-tests of motor capabilities with experimental and control groups

	Mean G1	Mean G2	t-value	df	p	N G1	N G2	Std. Dev G1	Std. Dev G2	F-ratio Varia.	p Varia.
LJFP	140,05	158,33	-3,917	54	,0002*	35	21	15,15	19,51	1,65	,18
JJ	25,51	30,66	-3,313	54	,0016*	35	21	5,15	6,36	1,52	,27
RHZ20	4,71	4,66	,422	54	,6743	35	21	,51	,44	1,34	,48
THFW	15,88	16,71	-1,966	54	,0543	35	21	1,32	1,82	1,89	,09
HT	16,57	17,38	-2,097	54	,0406*	35	21	1,33	1,49	1,26	,53
SS	12,20	10,97	2,778	54	,0075*	35	21	1,67	1,50	1,24	,61
MIA	7,11	5,95	2,792	54	,0072*	35	21	1,40	1,67	1,42	,35
PU	5,08	9,80	-1,926	54	,0592	35	21	6,73	11,65	2,99	,00
ABS	37,68	48,00	-1,611	54	,1128	35	21	21,45	25,86	1,45	,32
FB	34,31	32,66	,960	54	,3411	35	21	6,40	5,87	1,18	,69
LLF	157,37	166,19	-3,546	54	,0008*	35	21	7,57	11,03	2,12	,05
B2L	6,02	14,09	-3,467	54	,0010*	35	21	4,30	12,66	8,67	,00
B1L	13,11	18,47	-1,954	54	,0558	35	21	11,03	7,73	2,03	,09

Considering that central and dispersive parameters indicate to differences between the groups, discriminative analysis was used in further analysis. Table 3 shows that covariance matrix is statistically significant (Sig.= ,00). Observing the results of discriminative analysis with indicators of significance difference between experimental and control group in motor capabilities, a significant canonic discriminative function with statistically significant value (Canon. Correlation = ,77) was obtained. Results of multivariate variance analysis demonstrate that the water polo school program in combination with physical education classes in the school have led to statistically significant quantitative changes in multivariate space of analyzed variables (Table 3).

Table 3: Significance of isolated discriminatory functions

Function	Eigenv.	% of Variance	Cumulative %	Canonical Correlation	Test of Function (s)	Wilks' Lambda	Chi-square	df	Sig.
1	1,52	100,0	100,0	,77	1	,39	43,08	13	,00

Statistic significance of changes clearly demonstrated how the implemented program had distanced group centroids in the space of tested variables. Out of 13 variables, 9 have positive and 4 negative asymmetry. On a negative end of discriminative function, there are variables which are characteristic for boys not active in sports, and on a positive end the boys who, in addition to regular physical education classes in the school, were involved in the water polo school program (Table 4).

Table 4: Position of group centroids in a discriminative function

group	Function 1
1- Not active in sports	-,940
2- Water polo school	1,566

According to the results of categorized correlation of tests (Table 5), the positive end is best defined by: standing long jump (,43), lateral leg flexibility (,39), balance on two feet (,38), standing high jumping (,36), hand tapping (,23), foot tapping against the wall (,21), balance on one foot (,21), push-ups (,21) and abdominal sit-ups (,17). On a negative pole, there are the following variables: mobility in air (-,30), side steps (-,30), flexibility in front bent (-,10) and 20m running with high start (-,04)

Table 5: Categorized correlations of tests with experimental and control group

	Function 1
LJFP	,432
LLF	,391
B2L	,382
JJ	,365
HT	,231
THFW	,217
B1L	,215
PU	,212
ABS	,178
MIA	-,308
SS	-,306
FB	-,106
RHZ20M	-,047

Discussion

Having in mind that the water polo belongs to the category of the polistructural complex movements, the question of this research was to examine whether statistically significant transformations exist in the space of motor capabilities of boys who attended the water polo school program. The experimental group demonstrated better results in majority of tests of constructed battery. This can be explained by a fact that during implementation of the water polo school program, the boys participated in activities that required coordinated work of muscular system in order to reach maximum body movement efficiency in water environment. The exercising program in water, where basic elements of water polo sport are continuously applied, such as coordinated leg and arms movements, swift turns, change of movement direction, ball passing, ball shooting, has significant influence on improvement of basic motor capabilities of boys at this age. In this way, torso, pelvic and shoulder region are strengthened which represent a key for connecting movements of lower and upper extremities. Results of application of experimental program in water demonstrated that achieved effects made an impact on transformation with the experimental group. The research confirmed that the water polo school program leads to enhancement of results of majority of basic motor capabilities with this population. In water environment the forces to extremities manifest differently that on a dry land thus the body spontaneously adjusts to those other movements and becomes more motorically capable. From the obtained results it can be concluded that it is definitely possible to achieve transformation effects in a motor space by applying water school program as an additional contents of sport activities with boys at the age of 12. Based on that, it can be concluded that the process of additional physical exercise in water, in which basic elements of water polo games are present, makes significantly better impact on transformation processes than the application of only physical education classes in the school. Additional sport activities can be treated as determinant for efficient and harmonious transformation process focused on development of all child properties. Based on that, children can only feel a positive transformation as active participants in physical exercises and sports. In any case, out-of-school involvement of students and additional physical activities in the form of systemic exercise in water demonstrated that they provide positive effects on basic motor capabilities of children.

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INFLUENCE OF WEIGHT STATUS ON FUNCTIONAL CHARACTERISTICS OF ITALIAN SCHOOL CHILDREN (12-13 YEARS)

Stefania Toselli, Gabriele Semprini, Franco Merni, Andrea Ceciliani, Federico Spiga & Patricia Brasili

Abstract

The performance levels achieved in different motor skills change from early childhood through adolescence. Motor and strength performance are related with body size and composition. In particular, weight status have important implications in affecting the performance. Aim of this study is to evaluate the motor performance in children of different gender, age and weight status. The sample included 391 children (M 193; F 198) from Bologna, Emilia-Romagna, Italy, aged 12-13 years. Height and weight were measured and the BMI was derived. BMI was categorized into normal, overweight and obese using International Obesity Task Force (IOTF) thresholds for gender and exact age. Underweight was assessed using the thresholds of Cole et al. (2007). The following tests (Adam et al., 1988; Carbonaro et al., 1988) were carried out: sit and reach (SR), backward dynamic balance walking on a square beam (BDB), 10-m dash run (DR), hand grip (HG), standing broad jump (SBJ), sitting basketball throw (SBT). Three way ANOVA was used to analyze the differences in each performance test between genders, age and weight status group. Gender differences ($p<0.01$) were found in all the motor tests except balance test. Females performed better in SR, males in all the other tests. Age and weight status differences were observed for SBT, SBJ, HG and DR. Overweight subjects performed better than their counterparts in SBT and HG. The SR and BDB showed no significant differences ($p>0.01$) among any groups according to the considered classifications. Differences among age, gender and weight status were noted in tests requiring both absolute (handgrip and throw) and relative (speed run and standing broad jump) strength. Overweight subjects obtained better results in upper limb strength tests, and worse results in weight-bearing tests. Flexibility and coordination tasks (BDB and SR) did not show significant differences according to age and weight status. In conclusion, weight status influences functional characteristics requiring strength, but are not related to balance and flexibility.

Introduction

The prevalence of weight status disorders among children is rising in the European region (Jackson-Leach, & Lobstein, 2006).

The prevalence of overweight (including obesity) in 11-13 years old range from 5% to more than 25% (HHO, 2009), across central and northern Europe is about 10–18% (Lobstein & Frelut, 2003).

Insufficient physical activity (PA), alongside unhealthy dietary habits, is proposed as one of the major contributors to childhood obesity (Lobstein, Baur, & Uauy, 2004). Recent reports have shown that inactive subjects are exposed to increased metabolic and cardiovascular risk irrespective of their weight status (Ekelund, Anderssen, Froberg, Sardinha, Andersen, & Brage, 2007).

Further, it has been reported that reducing inactivity in obese subjects can enhance weight loss and reduce morbidity independently of weight loss (Lobstein, Baur & Uauy, 2004).

The performance levels achieved in different motor skills change from early childhood through adolescence. Motor and strength performance are related with body size and composition. In particular, weight status have important implications in affecting the performance.

Previous studies using objective methods to investigate the relationship between physical activity and adiposity have shown conflicting results, while some studies show overweight status or adiposity to be inversely related to physical activity measures (Ekelund, Aman, Yngve , Renman, Westerterp, & Sjöström, 2002; Trost, Kerr, Ward, & Pate, 2001) and others report no association (Ekelund, Poortvliet, Nilsson, Yngve, Holmberg, & Sjöström, 2001; van Sluijs, Skidmore, Mwanza, Jones, Callaghan, Ekelund et al., 2008; Treuth, Hou, Young, & Maynard, 2005).

The objective of the present study was to determine the prevalence of weight status and their association with motor performance among adolescents attending a second grade school in Bologna (Italy), taking into account gender and age.

Methods

The sample included 391 children (M 193; F 198) from Bologna, Emilia-Romagna, Italy, aged 12-13 years.

Height and weight were measured and the BMI (weight/heght^2) was derived. BMI was categorized into normal, overweight and obese using International Obesity Task Force (IOTF) thresholds for gender and exact age. Underweight was assessed using the thresholds of Cole et al. (2007).

For the purpose of this study the overweight and obesity were considered joined. The following tests were executed (two/three trials - the best one considered for further analyses):

- Backward dynamic balance test (BDB): participants had to walk backward on a square beam (side length: 70 cm; thickness: 4 cm; height 10 cm.) with two stance for each side. The trial finished when the subject returned to the start side. Starting with one foot on the beam, time (accuracy: 1/100 seconds) was recorded from the second foot take-off from the ground, and stopped at its foot-strike on the fifth side. A clockwise and counter-clockwise trial was performed (Carbonaro et al., 1988).
- 10-m dash run (DR): subjects run 10 meters at the maximum speed, after 15m used for the acceleration, and this time (accuracy: 1/100 seconds) was recorded with photocell survey (Capizzi et. al 1979).
- Standing broad jump (SBJ) to assess explosive strength of lower limbs: the subjects attempted to jump as far as possible, with swinging of the arms and bending of the knees to provide forward drive, landing on both feet without falling backwards. A two foot take-off and landing jump was used and the longest distance jumped was recorded (cm.). (Eurofit 1988).
- Basketball throw (SBT) for explosive strength of upper limbs: subjects had to throw a basketball ball as far as possible (cm.), from a sitting position on the floor and with two hands from the chest (cm.). (Carbonaro et al., 1988).
- Sit & Reach (SR) for flexibility: participants sat on the ground with straight legs and had to reach forward as far as possible. A standard reach box was used, measurements in cm. (Eurofit 1988).
- Hand-grip (HG) for Static strength: a calibrated hand dynamometer with adjustable grip (Takei scientific instruments) was used (Eurofit 1988).

T-Tests were performed to examine gender differences in the considered age classes in anthropometric parameters and physical fitness .

Three way ANOVA was used to analyze differences in each performance test among weight status groups, both on the whole sample and separately for gender and age.

Results

Table 1 shows that performance tests significantly differs between gender for 12 and 13 years old subjects. Males was significantly taller than females at 13 years. Females performed better in sit and reach, males in all the other tests, both at 12 and 13 years.

Table 1: Mean values and standard deviations for anthropometric characters and motor tests (t-test: *p < 0.05; **p < 0.01)

	males		females		
12 Years old					
	mean	SD	mean	SD	p-value
HEIGHT (cm)	153.58	7.61	154.31	6.46	
WEIGHT (kg)	46.46	10.27	45.09	8.90	
BMI	19.54	3.27	18.82	2.97	
SR (cm)	35.82	6.70	41.06	7.23	**
SBJ (cm)	162.24	18.99	149.84	20.39	**
SBT (cm)	555.88	87.54	491.08	74.79	**
DR (sec)	1.62	0.13	1.68	0.12	**
HG (kg)	20.45	5.05	18.84	3.95	*
BDB (sec)	9.50	2.79	10.60	3.88	*
13 Years old					
	mean	SD	mean	SD	
HEIGHT (cm)	160.37	8.53	158.36	5.29	*
WEIGHT (kg)	51.95	9.74	50.04	8.25	
BMI	20.04	2.61	19.89	3.04	
SR (cm)	34.28	7.17	43.25	9.02	**
SBJ (cm)	173.18	22.42	159.26	23.49	**
SBT (cm)	637.03	116.44	546.22	69.14	**
DR (sec)	1.56	0.14	1.63	0.13	**
HG (kg)	25.41	6.51	23.77	4.37	*
BDB (sec)	8.81	2.52	10.02	3.18	**

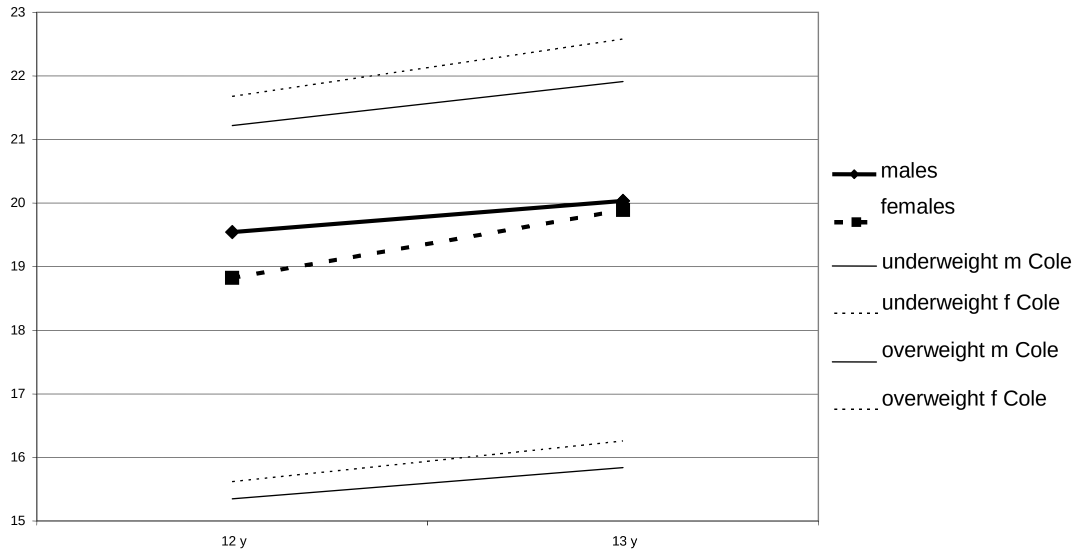
From Figure 1 it can be observed that the mean values for BMI in our sample, compared with the Cole's cut-off for overweight and underweight, show a tendency toward highest values.

Considering the motor test in relation to weight status, the ANOVA carried out on the whole sample (Table 2) shows no significant relations among weight status and sit-and-reach and backward dynamic balance walking on a square beam. This trend is observed also when ANOVA is applied separately to genders and ages.

For 10-m dash run the overweight/obese subjects show significant worse results than normal weight and underweight subjects, but when ANOVA is carried out keeping the two genders and age separately, the difference is significant only for 13 years old males (p associated to Test HSD of Tukey: 0.000979 NW/OW)

In standing broad jump a gradual trend is observed in performance, obtaining the underweight subject the best results and the overweight/obese the worst. Nevertheless, from the ANOVA carried out considering gender and ages separately, no significant differences are observed in males, while in females significant results are noted between overweight/obese subjects and normal weight and underweight subjects (p associated to Test HSD of Tukey-12y: 0.002180 UW/OW , 0.008083 NW/OW ; 13 y . 0.001914 UW/OW , 0.009473 NW/OW).

Figure 1: Mean values of BMI in our samples and Cole cut-offs



As regards weight status, females show higher percentage of underweight and lower percentage of overweight/obesity (Figure 2) than males.

Figure 2: Prevalence of weight status in males and females 12,13 years old.

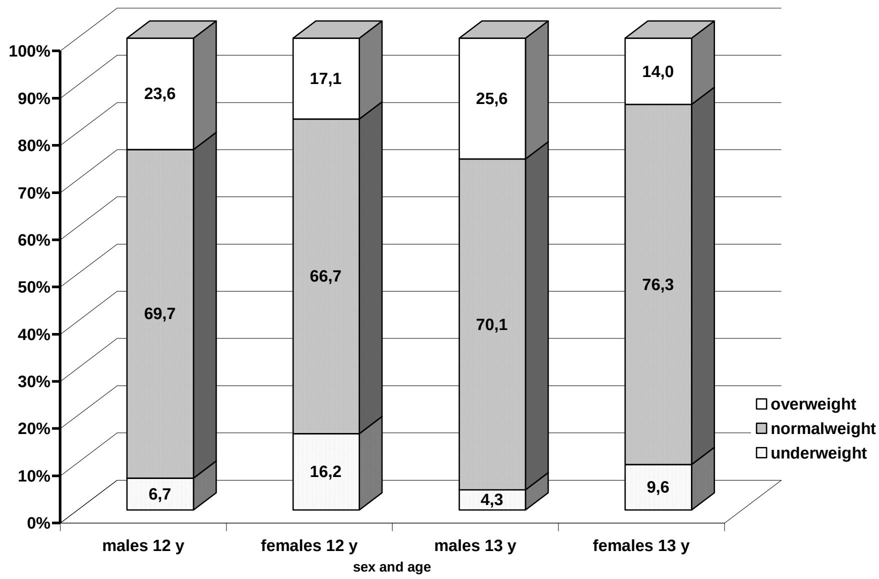


Table 2: Three way ANOVA (significance level) for motor test in relation to weight status (UW=underweight, NW= normalweight, OW= overweight and obese) on the whole sample

	WEIGHT STATUS POST HOC		
PERFORMANCE TEST	UW vs NW	NW vs OW	UW vs OW
STANDING BROAD JUMP	NS	0.001	0.002
10 m DASH RUN	NS	0.009	0.001
SITTING BASKETBALL THROW	0.001	0.001	0.001
HAND GRIP	0.001	0.002	0.001
SIT & REACH	NS	NS	NS
BACK DYNAMIC BALANCE	NS	NS	NS

Also as regards hand grip and sitting basketball throw a gradual increasing trend is observed, but for this tests the best results are noted for overweight/obese subjects and the worst for underweight.

For hand grip significant differences are observed between overweight/obese subjects and subjects of the other categories at 12 years in males (p associated to Test HSD of Tukey: 0.004627 UW/OW, 0.001632 NW/OW) and at 13 in females (p associated to Test HSD of Tukey: 0.000154 UW/OW, 0.000887 UW/NW) ; in 12 years old females the differences are significant only between overweight/obese and underweight (p associated to Test HSD of Tukey: 0.034793 UW/OW) .

For sitting basketball throw the differences between overweight/obese and underweight subjects are always significant (p associated to Test HSD of Tukey - males 12y 0.001444 UW/OW, 13y 0.012978 UW/OW ; females : 12y 0.023628 UW/OW, 13y 0.031285 UW/OW). In addition significant differences are noticed in 12 years old males between overweight/obese and normal weight (p associated to Test HSD of Tukey- 0.002120 NW/OW) , and in all the age groups females between normal weight and underweight (p associated to Test HSD of Tukey – 12y 0.025453 UW/NW , 13y 0.046706 UW/NW).

Discussion

The prevalence of overweight/obesity observed in our study (boys: 23.6% at 12y, 25.6% at 13 y; girls: 17.1% at 12 y, 14.0% at 13 y) is in accordance with the data reported on the central-north Italian population (Cacciari et al., 2006) and by WHO (2009) (15% in females and 26% in males), from which emerge that these values are among the highest of Europe. The prevalence of underweight (boys: 6.7% at 12y, 4.3% at 13 y; girls: 16.2% at 12 y, 9.6% at 13 y) reported in the present study is higher than Portugal (boys: 3.9%; girls: 5.6%) (Marques-Vidal et al., 2008), but lower than Turkey (boys: 14.4%; girls: 11.1%) (Oner et al., 2004).

The worse results regarding of overweight/obese subjects in standing long jump performance are in agreement with previous studies (that states that with the accumulation of body fat explosive strength, speed and agility of children declines (Shang et al., 2010; Bovet et al., 2007; Casajus et al, 2007; Chen et al., 2006).

As regards speed run test the obtained results are more inconsistent, only for 13 years old boys the performance of overweight/obese subjects is worse than in normal weight.

These tests, requiring propulsion and lifting of body, were disadvantage in overweight and obese children due to the extra body load to be moved while performing these tests.

Differences among age, gender and weight status were noted in tests requiring isometric strength (handgrip or power performance without body displacement as in throwing from a sitting position). In this case the overweight subjects show better performances than the other two weight groups. These results are in accord to literature (Shang et al., 2010; Bovet et al., 2007) from which emerge that overweight and obesity subjects can perform equally well or even better than subjects with normal weight in tests that require mainly strength and that are insensitive to body weight.

Some gender difference in relation to age in the performance could be interpreted as related to different times of maturation of the adolescents in the considered period.

Flexibility and coordination tasks (BDB and SR) did not show significant differences according to age and weight status. In conclusion, balance and flexibility tests are not related to weight status.

All strength tests are related to weight status but a distinction is necessary: in the case subjects have to perform against the gravity forces the overweight ones result the worst. On the contrary when the strength expression is isometric or the required power does not involve total body movement the overweight group result the best one. Therefore it is important to pay attention to the biomechanics involved in the different strength tests analyzed. This findings can help researchers to understand the literature conflicting results in different group strength performances.

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ANALYSIS OF CHILDREN'S INJURIES SUSTAINED DURING KINDERGARTEN SPORT ACTIVITIES

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Abstract

The study aimed to analyse children's injuries sustained during organised and unorganised sport activities in kindergartens in Ljubljana, Slovenia. We aimed to establish whether there were any gender differences in the frequency of sustaining injuries. The sample of subjects consisted of 178 parents of 3- to 6-year-old children (the sample comprised 48.3 percent male and 51.7 percent female subjects). The data were processed with the SPSS statistical software package, the frequencies were calculated and a Chi-square test performed. It was established that in the year preceding the date of the survey 26.4 percent of the children in kindergartens were injured, most of them only once. The number of injuries was statistically significantly higher for boys than for girls. As many as 60 percent of children in kindergarten engage in organised sport activities only once a week, more than one-half in a playroom and one-quarter even in a hallway. Three-quarters of children sustained an injury during free play, mostly in an open-air playground. More than one-half of the injuries sustained during an organised sport activity took place in a playroom and a good one-third in a hallway, mostly due to an unexpected situation. The injuries mostly included contusions; the head was most frequently injured. One-quarter of the injured children were taken to a hospital emergency room; in most cases the teacher informed the parents about the accident, applied a compress to the contusion or in some cases bandaged the injury or applied some cream. A written record of the accident was only prepared for a good one-third of cases. It was established that many factors influenced the prevention of injuries. These include the responsibility of the kindergarten (sport programmes, professional qualifications of teachers etc.) and others (e.g. material conditions) of the local community. Therefore, concerted action is required to achieve positive changes for the benefit of children and adolescents.

Introduction

Children can suffer an injury during school physical education classes, in clubs, in associations providing various sport activities under expert guidance as well as in their leisure time (Mota, Santos, Guerra, Ribero, & Darte 2003). Abernethy, MacAuley, McNally, & McCann (2003) reported the results of a study showing that during physical education classes children and adolescents receive 20 percent of bodily injuries, during organised sport activity 62 percent and during unorganised sport activity or one without expert guidance 18 percent. Hergenroeder (1998) found that injuries sustained by children and adolescents during an unorganised sport activity account for 40 percent. Knight, Vernon, Fines & Dean (1999) established that injuries suffered during physical education classes are more common at the beginning of the school year, in the morning.

According to some estimates, 3 percent of kindergarten children annually sustain an injury of a kind requiring medical attention (Briss, Sacks, Addiss, Krewsnow & Oneil, 1994, in Papalia, Wendkos Olds & Duskin Feldman, 2003). Similar results were also reported by Rok Simon (2002); in the Slovenian kindergartens where she conducted the study 4 percent of children sustained injuries and half of them were treated by a physician, which is one-half more than in primary school (Čuk, Bučar, Videmšek, & Hosta, 2007). Some European studies have established that the annual incidence of injuries sustained in the playground and treated at a hospital emergency room was between 4 and 7 per 1,000 children (Sengolge & Vincenten, 2006), whereas in the Slovenian kindergartens the respective figure is 2 to 8 per 1,000 children (Rok Simon, 2002).

Children are most susceptible to injuries to the head and those parts of the body which are in the most intensive growth phase, such as for example the ends of long bones which have not yet fully ossified. The most frequent injuries include bone fractures; about 15 percent of all bone fractures are suffered in childhood. Fractures are twice more common with boys than with girls (Videmšek, Mlinar, Meško, & Karpljuk, 2008).

The results of a study (Huber, Marshand-Martella, Martella, & Wood, 1996) show that the parents of 3- to 5-year-old children stated the following types of accidents: stumbling over an object (80 percent), slipping on ice (59 percent), on a wet floor (60 percent), in a tub (48 percent), injuries suffered because of the inappropriate use of toys and other equipment (1 percent); teachers and pre-school teachers also added accidents in the children's playground (45 percent). The authors reported that in the USA every month 400 children aged up to 4 years sustain a fatal injury and that more deaths from an injury are recorded in the countryside than in urban areas. As many as two-thirds of fractures and head injuries are sustained at home or near the home. Phelan (2001) found that three-quarters of injuries (excluding deaths from an injury) were sustained in public children's playgrounds near kindergartens and schools. More than 70 percent of fatal injuries were sustained in a home courtyard; as many as 56 percent of children suffocated, and 20 percent died after they hit the surface of the playground. A study by Tinsworth (2001) revealed that, in public playgrounds, most injuries occur on climbers, whereas swings are responsible for most injuries in home playgrounds. Suecoff (1999) argues that poorly maintained playgrounds increase the hazard of sustaining an injury, especially with pre-school children.

The study aimed to analyse children's injuries sustained during organised and unorganised sport activities in kindergartens in Ljubljana, Slovenia.

Methods

Sample of subjects

The sample of subjects studied here includes 178 parents of 3- to 6-year-old children from 7 different kindergartens in Ljubljana. The sample comprised 48.3% male and 51.7% female subjects.

Sample of variables

This research is based on a questionnaire of 25 questions on injuries. The questionnaire includes questions about age, gender, organised and unorganised physical activity in the kindergarten, the area of sport activities, the frequency of injury, the location and type of injuries, and measures taken by professional staff in the case of an accident.

Procedures

The data were processed with the SPSS software (Statistical Package for the Social Sciences). Frequency tables were generated with the help of the FREQUENCY sub-program. The probability relations among the variables were tested by a Chi-square at a significance level of less than 5% (P=0.05).

Results

Slightly more than one-half (59.6 percent) of the children participate in organised motor/sport activities in kindergarten only once a week, 31.5 percent twice and 7.9 percent three times a week. Only 1 percent of children engage in organised motor/sport activities under a pre-school teacher's expert guidance every day. Slightly less than one-half of the children engage in organised activities for 20 to 30 minutes, others for 30 to 45 minutes. About one-half of the children participate in a spontaneous physical activity for one-half to one hour a day (without any expert guidance), whereas others participate for more than one hour.

56.7 percent of the children of the surveyed parents engage in motor/sport activities in the playroom where they spend most of their time in kindergarten and where other activities take place, 11.2 percent do this in a multi-purpose room and 24.7 percent even in a hallway. Only one-third of the children perform motor/sport activities in a sports hall and 77.5 percent in an outdoor playground.

In the past year, over one-quarter of the children (26.4 percent) sustained an injury in the kindergarten, most of them (93.6 percent) only once. 63 percent of 4-year-old children were injured, 19.1 percent of 3-year-olds, 17 percent of children aged less than 3 years and none among the 5-year-olds.

Most children sustained an injury in the morning, only 6.4 percent in the afternoon. Cross-tabulation of variables on the time of injury and the gender of the injured did not confirm any statistically significant differences between the time of injury of boys and that of girls (p=0.241).

76.6 percent of the children were injured during free play and only 23.4 percent during an organised motor/sport activity.

During free play, children most often sustained an injury in an outdoor playground and others in the playroom where other activities also take place. Cross-tabulation of variables on the place of injury during free play and the gender of the injured did not confirm any statistically significant differences between boys and girls (p=0.728).

23.4 percent of all injuries sustained in kindergarten occurred during an organised motor/sport activity or under the expert guidance of pre-school teachers.

More than half of the injuries sustained during an organised sport activity occurred in a playroom and more than one-third in the hallway. Cross-tabulation of variables on the place of activity where the injury was sustained and the gender of the injured did not confirm any statistically significant differences (p=0.728).

63.6 percent of the children were injured while playing elementary games with a ball and others during a chasing game. It is interesting that none of the children sustained an injury while performing natural types of movements (walking, running, crawling, creeping, climbing, jumping, hopping etc.) and none of them while performing the basic elements of different sports (cycling, rollerblading, scooter riding, dancing, hockey, snow games etc.).

Most pre-school teachers (82 percent) do not ask children to wear suitable sports shoes used specifically for motor/sport activities, and two-thirds of pre-school teachers do not insist on them putting on suitable clothes (trousers and vest) before engaging in motor/sport activities. Despite the above, parents reported that as many as 93.4 percent of children wore appropriate sport shoes at the time of an injury, whereas other parents were not informed about this.

Two-thirds of accidents occurred due to an unexpected situation, 27.7 percent were due to a quarrel with peers (a child intentionally pushes or trips their peer or inflicts an injury in any other way) and 6.4 percent were due to a child's tiredness. Cross-tabulation of variables on the cause of injury and gender of the injured did not confirm any statistically significant differences (p=0.166).

Most injuries included blows, followed by cuts, sprains, abrasions and the least fractures.

Children most often injured their head (51.1 percent), legs (40.4 percent) and arms (17 percent).

In one-quarter of accidents, a child was taken to a hospital emergency room. In 68.1 percent of the cases the pre-school teacher applied a compress, in 19.1 percent they bandaged the injury, in 17 percent they applied some cream, whereas only in 2.1 percent immobilisation was required and in the same percentage a massage of the injured part of the body. In one-quarter of accidents no intervention was necessary. In nearly two-thirds of accidents (63.8 percent) the pre-school teachers informed the parents.

Over one-half of accidents did not result in a child's absence from kindergarten, in 27.7 percent of cases children were absent for one day and only in 17 percent of cases for several days. None of the injured children was absent for more than one week.

Only in 38.3 percent of cases were written records made about the injury, 17 percent of parents were not informed whether written records had been made or not, whereas in other cases no written records were taken. 85.1 percent of parents were satisfied with the way the pre-school teacher handled the situation at the time of accident, and the rest were only partly satisfied.

Discussion

It was established that in the past year more than one-quarter of the children in kindergartens sustained an injury, most of them only once.

It is interesting that the injured children did not include any five-year-olds in spite of the fact that the study involved most children from this age group. Nearly two-thirds of 4-year-old children were injured. The study by Rok Simon (2007b) showed that injuries sustained in kindergarten which require medical attention are more frequent with children aged between 4 and 6, whereas less serious injuries are more frequent with the youngest children.

Most children sustained an injury in the period between morning snack and lunch, as many as three-quarters during free play or during unorganised physical activities which were not conducted under the expert guidance of pre-school teachers. Knight, Vernon, Fines and Dean (1999) established that children in kindergarten injure themselves most frequently in the morning, whereas the study by Eberl et al. (2009) showed that pre-school children suffer most injuries in the period before and after lunch.

More than one-half of children of the surveyed parents perform activities in a playroom, one-quarter in a hallway, some in a multi-purpose room and the majority in an outdoor playground when the weather permits it. In view of the scarcity of areas designed for sport activities it is no surprise that the study results revealed that more than half of the injuries sustained during an organised sport activity occurred in a playroom, and a good one-third even in a hallway. Rok Simon (2007b) established that, in kindergarten, children are most often injured after colliding with a radiator, furniture or other equipment, and in a playground after hitting a play structure or due to inappropriately designed playground (e.g. concrete edgings). In an appropriately large and well-equipped sport playroom or outdoor children's playground the likelihood of sustaining an injury is lower; moreover, suitable areas enable children to vent their accumulated energy and satisfy their need for movement and play (Čuk, Bučar, Videmšek & Hosta, 2007).

Nearly two-thirds of the children were injured while carrying out elementary games with a ball. Over two-thirds of the accidents during free play occurred in an outdoor children's playground. The results of other researchers (Briss, Sacks, Addiss, Krewsnow & Oneil, 1994, in Papalia, Wendkos Olds & Duskin Feldman, 2003; Eberl et al., 2009) showed that many accidents occur in children's playgrounds – nearly one-half of all accidents in kindergarten. According to the abovementioned authors, 20 percent of cases involve falls resulting in scull and brain injuries.

Our study revealed that the children's injuries mostly included contusions and much fewer cuts, sprains, abrasions and fractures. The studied children most often sustained a head injury, which corresponds to the results of the study by Rok Simon (2007a) using a sample of pre-school and school children where the most common injuries were those to the head and face, with wounds, contusions and abrasions most frequently being reported. The reason for sustaining a head injury probably lies in the fact that the head is relatively big compared to other parts of the body and is therefore the most exposed (Rok Simon, 2002). According to physicians, most injuries sustained during physical education classes are generally not very serious. Miller and Spicer (1998) established that one-quarter of injuries sustained during physical education classes are serious (fractures, dislocations, brain injuries etc.) while the remaining three-quarters are not that serious (wounds, sprains, strains etc.). Eberl et al. (2009) reported similar findings; 24 percent of injuries sustained in kindergartens are classified as serious.

The bulk of accidents occurred due to an unexpected situation, slightly less due to a quarrel with peers (a child intentionally pushes or trips their peer or inflicts an injury in any other way) and a child's tiredness. One of the studies (Eberl et al., 2009) showed that most parents (47 percent) believe that accidents in kindergartens are unpredictable, whereas up to 18 percent believe that their incidence could decrease if children are under appropriate supervision. The results of the study by Rok Simon (2007a) showed that children were under supervision at the time they suffered an injury, but they injured themselves as a result of an inappropriately equipped room and a lack of protection.

Our study revealed that in most cases the pre-school teacher informed the parents. In two-thirds of accidents the teacher applied a compress, whereas in one-fifth of cases the injury was bandaged and some cream was applied, respectively. In one-quarter of the accidents, a child was taken to a hospital emergency room. With more than one-half of cases, the injured child was not absent from kindergarten, and in other cases only for a day or several days. Rok Simon (2007a) established that nearly one-half of the injuries sustained by pre-school children in kindergartens require medical attention.

The study results showed that most parents were satisfied with pre-school teacher's action after the occurrence of the injury. Nevertheless, it should be noted that in only a good third of cases were written records of the accident taken.

Physical activity in kindergarten is quite specific in terms of the nature of the teaching process and the possibility that the participants in the education process are injured. Pre-school teachers and physical education teachers strive to systematically, gradually and comprehensively prepare their pupils for more demanding tasks, although it is impossible to completely eliminate the possibility of injuries (Corbin, 2002).

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THE RELATIONSHIP BETWEEN ORGANIZATIONAL JUSTICE AND ORGANIZATIONAL EFFECTNESS PERCIEVED BY SPORT CENTER EMPLOYEE

Jae-Keun Yang

Abstract

The purpose of the study is to examine the relationship between organizational justice and organizational effectiveness that perceived by sport center employee. To accomplish the purpose of the study, sport center employees are subjected to questionnaire and based on simple random sampling, total of 332 are used for final data analysis. By utilizing SPSS 17.0, multiple regression analysis is implemented and the results are as follows. Organizational justice perceived by sport center employees influences on the organizational effectiveness. Distributive justice and procedural justice that are the sub-factor of organizational justice influence on sub-factor of organizational effectiveness, job satisfaction and organizational commitment.

Introduction

After the economic development era of 70s and 80s, sport has became very important part and has been popularized in Korea since 1990s from the area of elite sport to sport for all. Because of the sport popularization various programs has been developed at community-based sport center which result in steady incensement of sport center visitors (Won & Jin, 2001; Jeong, 2005). However, because of economical crisis recently, community-based sport centers have struggled with difficult management circumstance and even faced bankruptcy (Sam, 2009).

According to the motivation theory, most of employees engaged in organization expect a fair evaluation toward their duties performed and achievements and hope that the evaluation is properly reflected on the rewarding system. If employees think they are improperly treated as to rewarding for their achievements, they dissatisfy with their salaries and even loss their will to perform their duties resulting from dissatisfaction of distributive justice (Kyeong, 2002). There can be good achievement for the organization perspectives, but organizational effectiveness should not be enhanced if there is no fair process and procedures regarding rewarding and decision-making system in the organization with negative impact on employees' mental and behavior. Accordingly because organizational justice influences on organizational effectiveness (Floger & Konovsky, 1989; McFarlin & Sweeney, 1992), development approach for organizational justice should be considered to improve organizational effectiveness.

So to speak, it is very important to consider (Suk & Jin, 2008) that desirable human resource management can reach the result of improvement of organizational effectiveness (Truss & Gratton, 1994) and accomplishment of the goal of organization as well (Wright & McMahan, 1992). Accordingly, in the very competitive circumstance, in order to manage the sport center successfully and effectively, manager or director of the sport center should newly recognize their employees as their internal clients and support them without passive perception toward their employees (Kwan, 2004). In other words, efficient human resource management is very important task to develop the effectiveness (Nam & Keun, 2002) in the organization and achieve their goals (Suk & Jin, 2008). In this context, proper understanding of organizational justice of sport center employees will result in an effective human resource management while developing organizational effectiveness. Therefore, this study is to examine the relationship between organizational justice and organizational effectiveness perceived by sport center employees.

Reserch methods

Sport center employees who are working in Seoul are subjected to questionnaire and based on simple random sampling, total of 350 are collected from employees from 16 different sport centres. Among the collected data, 332 are used for practical analysis and individual characteristics are shown on Table1. Based on the theories and precedent studies of various useful academic disciplines, questionnaire consists of 4 individual characteristics including sex, age, educational background, and job position. For the questionnaire of organizational justice, questionnaire from Lee Byung Kwan (2005) based on the precedent study of Greenberg (1987), Price and Mueller (1986) are utilized and for that if organizational effectiveness, questionnaire from Kim Soon Ha (2005) based on the precedent study of Dalton, Toder, Spendolini, Fielding and Porter (1980) are utilized. By utilizing SPSSWIN 17.0, frequency analysis and multiple regression analysis are implemented.

Table 1: Individual characteristics

Character	Classification	Frequency	Ratio(%)
Sex	Male	254	76.5
	Female	78	23.5
Age	20's	164	49.4
	30's	127	38.3
	Over 40's	41	12.3
Education level	High school graduation and under	137	41.3
	Undergraduate student/graduation	166	50.0
	Graduate student/graduation	29	8.7
Occupation	Sport instructor	223	67.2
	general staffs/others	109	32.8

Table 2: The influence of organizational justice on organizational effectiveness

Variables	Job Satisfaction			Organizational Commitment		
	b	β	t	b	β	t
Distributive Justice	.439	.398	8.726***	.272	.285	4.705***
Procedural Justice	.509	.416	9.130***	.116	.110	1.808
R^2		.505			.126	
F		167.955***			23.715***	
***p<.001						

Results

As mentioned on Table 2., distributive justice and procedural justice that are sub-factor of organizational justice influence on job satisfaction and for the relative effectiveness, job satisfaction are influenced by procedural justice (β=.416) and distributive justice (β=.398). Explanatory power of job satisfaction toward organizational justice variables is 50.5%. In addition, distributive justice influences on organizational commitment (β=.285) and explanatory power of organizational commitment toward organizational justice variables is 12.6%.

Discussion and conclusion

This study examines the relationship between organizational justice and organizational effectiveness perceived by sport center employees and the result is that organizational justice influences on organizational effectiveness. This result is correspond with the facts that distributive justice and procedural justice significantly influence on organizational commitment that increases a commitment and belongingness toward organization supported by Lee Dong June and Kim Do Jin (2007). The result also supports the fact that if employees recognize that the procedure of human resource management is fair, they will positively behaves without satisfaction of personal reward and salary in the organization (Young-Joon & Jong-Wook, 2004). The result is also correspond with the facts that procedural justice can produce the trust in the organization from the study of Brockener and Siegel (1996) and employees' perception toward the level of fairness in relation to all systems and decision-making implementing in the organization will influence to recognize the organization positively by increasing job satisfaction. Additionally, Wong, Ngo and Wong (2002) insist that the level of trust toward organization is increased when level of perception for distributive justice and procedural justice is getting high, i.e., organizational commitment is increased because both distributive justice and procedural justice positively influence on the level of trust toward organization. Accordingly, it inspires employees with stability and pride for their job by providing an environment to enjoy their working life and establishing loyalty and good human relation (Bong, 2004). In this context, sport center manager or director should make an effort to provide an environment for which employees can work with prides while performing fair human resource management procedure and decision-making.

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