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Social perspective

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Politechnika Opolska
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ul. Prószkowska 76
45-758 Opole
budynek nr 9 p. 23

www.jpe-health.pwsz.raciborz.edu.pl

jpe_health@onet.eu

Administrative editor: Katarzyna Kasowska, Piotr Mucha
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THE USE OF THE WALKING IMPAIRMENT QUESTIONNAIRE (WIQ) IN PATIENTS WITH LOWER LIMB ISCHEMIA STAGE IIB ACCORDING TO THE FONTAINE CLASSIFICATION

Żanna Fiodorenko-Dumas PhD, Marta Majewska Pulsakowska PhD,

Małgorzata Paprocka-Borowicz Prof., Ilias Dumas PhD

Wroclaw Medical University, Departament of Physiotherapy, Poland

Abstract

Chronic lower limb ischemia significantly impairs the everyday functioning of the patient as it progresses. Patients complain of the inability to walk longer distances, climb stairs or walk briskly.

The aim of this study was to assess the influence of chronic lower limb ischemia on the long-term results measured using the Walking Impairment Questionnaire (WIQ), as well as to establish a relationship between our results and selected variables, i.e. BMI (Body Mass Index), ICD (Intermittent Claudication Index), ACD (Absolute Claudication Index) and gender.

Materials and Methods.

The research group consisted of 50 individuals diagnosed with lower limb ischemia stage IIb according to the Fontaine classification. All of the patients experienced intermittent claudication after walking a distance of less than 200 m. The mean age was 64,4±6,0 years for men (n=38) and 62,7±6,9 years for women (n=12). BMI for both sexes was 27,1±4,1 kg/m². The study used the WIQ questionnaire, which consists of 21 items and evaluates walking speed, walking distance and stair climbing. In order to obtain information concerning gender, age and BMI of the patients, an original survey was created and distributed. In addition, the patients were evaluated using the treadmill stress test, which helps to determine the severity of claudication among patients.

Results.

Our research showed no correlation between the WIQ score and the gender of the patient. A statistically significant correlation was found between ICD, ACD and WIQ scores (rho=0,760, rho=0,770). No relationship was observed between the BMI and WIQ score (p=0,612). Scores in the individual WIQ domains strongly correlated with the total score obtained in the questionnaire.

Conclusions.

The WIQ questionnaire proved to be a reliable tool for assessing motor function and disorders in patients with chronic lower limb ischemia. The results of the treadmill stress test complied with the score of the questionnaire. There was no correlation between the WIQ score and gender, as well as with the BMI of the patients.

Key words: *WIQ, claudication, lower limb ischemia, walking*

Introduction

In recent times, peripheral arterial diseases have increasingly become a focus of attention, including lower extremity arterial disease (LEAD-*lower extremities coronary artery diseases*). LEAD significantly increases the risk of death and is the leading cause of lower-extremity amputation. Ischemia and hypoxia of the limb's tissues stimulate endogenous compensating processes, such as angiogenesis and arteriogenesis. Unfortunately, both of these processes are insufficient in terms of their ability to provide the tissues with an adequate amount of oxygen and nutrients (11,16). The diagnosis of this disease consists not only in imaging, interviewing and the measurement of the ankle-brachial index (ABI), but also of the evaluation of the claudication distance (ICD), which can be based on a subjective assessment by the patient

(obtained from the interview) or objective tools, such as the treadmill test in standardized conditions, or the 6 Minute Walk Test. Claudication is defined as the pain of lower extremities which occurs when walking and forces the patient to stop. The pain subsides after a short rest and reappears after resuming walking. In cities, the pain frequently forces a patient to stop in front of shop windows, hence the common name of the disease: "window-shoppers disease". The assessment of the distance that a person can walk without pain, as well as the total distance achievable despite the pain can help to understand the problem that the patient has in coping with it. The progression of the disease causes the lower limbs to lose muscle strength, and as a result, longer walks become impossible (4, 5). An easily visible symptom is the reduction in the weight and circumference of the limb. The skin is also affected: it becomes paler, cooler and thinner, and hair is scarcer. In advanced stages, slow-healing ulcers may occur. Another characteristic symptom is the weakening of the pulse on the limb affected. In a healthy person, the pulse should be easily palpable on all the arteries that lie close to the skin. When atherosclerotic process affects the vessels, their walls become rigid and the pulse becomes imperceptible. On the lower limb, the pulse should be felt in the groin, below the knee, on the lateral side of the ankle and on the dorsum of the foot. It is important to self-control the pulse in these locations (1, 7, 9, 15, 19).

Standard diagnostic methods are often complemented by standardized questionnaires, in which a patient subjectively evaluates the severity of the disease and indicates the domains of life that have become completely dominated by the ongoing pathological process, making it impossible for them to function normally. The Walking Impairment Questionnaire is one of many questionnaires designed to evaluate the severity of walking impairment as seen by the patient (13, 14).

The incidence of chronic lower limb ischemia depends on age. The majority of the patients are over 55 years old. Atherosclerotic lesions in abdominal aorta and arteries of the lower extremities are found in 20 percent of Europeans and Americans in this age group. 30 percent of the population over 75 years of age is affected. Men are affected twice as often as women; however, in patients over 70 years of age as well as in patients with diabetes, the incidence is similar for both genders. 30,000 new cases are reported in Poland every year (3,5).

The aim of this study was to assess the influence of the chronic lower limb ischemia on the long-term results in the Walking Impairment Questionnaire (WIQ) as well as to establish a relationship between our results and selected variables, i.e. BMI (Body Mass Index), ICD (Intermittent Claudication Index), ACD (Absolute Claudication Index) and gender..

Materials and methods

The research group consisted of 50 individuals diagnosed with lower limb ischemia stage IIb according to the Fontaine classification. All of the patients presented claudication after walking a distance of less than 200 m. The mean age was 64,4±6,0 years for men (n=38) and 62,7±6,9 years for women (n=12). BMI for both sexes was 27,1±4,1 kg/m².

The exclusion criteria were as follows:

- trophic changes of the lower limbs,
- sensory disorders due to ischemia (sensory neuropathies) without intermittent claudication,
- comorbidities that permanently impair motor function,
- comorbidities that are contraindications for the stress test,
- lack of informed and voluntary consent for participation in the research project.

All of the patients were subjected to the treadmill stress test (a test which helps to evaluate the severity of claudication) with the treadmill moving at a constant speed of 3,2 km/h and with an inclination angle of 10 degrees. The patient was to identify the onset of pain due to ischemia caused by the stress test (ICD – Intermittent Claudication Index). The indication for the interruption of the test was the near-maximal pain that made it impossible for the patient to progress (ACD – Absolute Claudication Index). Persons qualifying for the stress test had their EKG assessed by a general practitioner before the test.

Furthermore, the patients completed a WIQ questionnaire (Walking Impairment Questionnaire) which consists of 21 items and evaluates walking speed, walking distance and stair climbing. The questionnaire, as well as the criteria of assessment, are available online at http://www.cebp.nl/vault_public/filesystem/?ID=1458.

In order to obtain information characterizing the group, the participants were also asked about their age, comorbidities, weight and height.

The study was approved by the Bioethics Committee of the Wrocław Medical University: 2, Pasteur Street.

The results obtained enabled determination of the mean, the standard deviation and the Spearman's rank correlation coefficient.

Results

Subject characteristics (sex, BMI and comorbidities) are shown in Table 1.

Table 1. Subject characteristics

Mean values of the parameters in groups		
	female	male
gender	24% (n=12)	76% (n=38)
age	62,7± 6,9 years	64,4±6,0 years
BMI	27,1±4,1 kg/m²	27,4±5,1 kg/m²
comorbidities	Female and male	
diabetes mellitus	32,30% (n=21)	
hypertension	46,15% (n=30)	
history of stroke	7,7% (n=5)	
history of heart attack	12,30% (n=8)	
hypercholesterolemia	1,53% (n=1)	

There were more men than women in the research group; the age differed slightly between the genders; the mean age for women was 62,7±6,9 years and for men 64,4±6,0 years. BMI values were similar for both genders. The most frequent comorbidities were diabetes (21 answers – 32,30%) and hypertension (30 answers – 46,15%).

Table 2. The results of the tests performed

Results of the treadmill test and WIQ questionnaire		
	female	male
ICD	69,21±30,14 m	83,4±43,79 m
ACD	89,46±34,30 m	114,93±58,18 m
Total WIQ	0,688±0,103	0,706±0,130
speed	0,425±0,114	0,593±0,109
distance	0,725±0,052	0,725±0,809
stairs	0,792±0,107	0,794±0,115

The treadmill test enabled evaluation of the average distance after which pain appeared, as well as the sub-maximal pain being the indication for the interruption of the test. Female participants reported ischemic pain more quickly and ultimately covered shorter distances than male participants (89,46±34,30 m vs 114,93±58,18 m). The WIQ scores also differed between the genders, namely in the speed domain (0,425±0,114 vs 0,593±0,109). Other domains of the questionnaire did not differ significantly between the groups and gender did not have a significant impact on the scores (Table 2).

Table 3. The correlations of WIQ score with selected variables

			T_WIQ
Spearman's rho	ICD	Correlation coefficient	,760**
		Significance level (bilateral)	0,01
		N	50
	ACD	Correlation coefficient	,770**
		Significance level (bilateral)	0,01
		N	49
	BMI	Correlation coefficient	,073
		Significance level (bilateral)	,612
		N	50
	T_WIQ	Correlation coefficient	1,000
		Significance level (bilateral)	0,01.
		N	50

The analysis using Spearman's rank correlation coefficient indicated that there was a statistically significant correlation between the distance covered (ICD, ACD) and WIQ questionnaire score ($p<0,01$). The higher the ICD and ACD values, the higher the TWIQ (total WIQ). No correlations were found between the BMI of the participants and their TWIQ (Table 3).

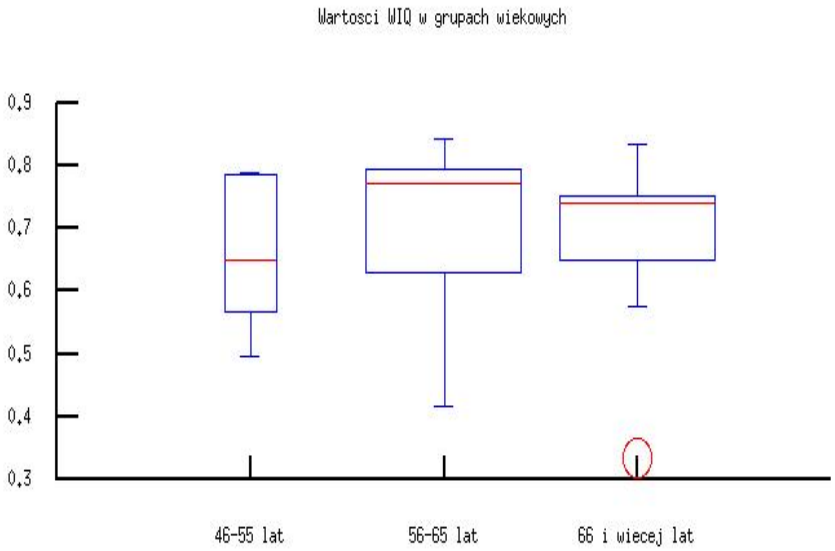

Figure 1. Relationship between the age and the TWIQ score.

It can be noted that patients aged 56-65 scored highest in the TWIQ, whereas the youngest patients, aged 46-55, scored lowest. The differences, however, are not statistically significant (Fig. 1).

The individual components of the WIQ questionnaire, i.e. the walking distance, walking speed and stair climbing were in strong relationship with TWIQ, as shown in Table 4.

Table 4. Correlations between the individual WIQ domains with total WIQ score.

			T_WIQ
Spearman's rho	Distance	Correlation coefficient	,911**
		Significance level (bilateral)	0,05
		N	50
	Speed	Correlation coefficient	,890**
		Significance level (bilateral)	0,05
		N	50
	Stairs	Correlation coefficient	,833**
		Significance level (bilateral)	0,05
		N	50

Discussion

The development of atherosclerosis consists of two stages. Firstly, as a result of existing risk factors, a dysfunction of endothelium occurs, which results in an increase of the permeability of the endothelium to lipoproteins, viruses and bacteria. Accumulating lipoproteins, mainly LDL

(*low density lipoproteins*), are absorbed by monocytes and macrophages and subsequently bound with collagen fibers. This stage is reversible. In the second stage, an atherosclerotic plaque is formed. It is initially unstable, but stabilizes and calcifies over time. Chronic lower limb ischemia develops over many years. Initially, the disease has no symptoms. The development of the disease is facilitated by the progress of civilization. In many cases, the critical changes in the arteries are the first incentive to undergo diagnosis and treatment (16, 17).

The time of intervention is chosen according to the patient's disability level, as well as the potential complications of invasive treatment and expected long-term outcome. Research has proved that the implementation of rehabilitation programs for patients with intermittent claudication leads to clinically significant improvement. Moreover, physical activity can also modify the risk factors of atherosclerosis. In order to provide patients with adequate training programs, their motor function must be evaluated (2, 12,18). The Treadmill test is commonly used for this purpose. Not only is it a diagnostic element, but it also serves to assess the progress of rehabilitation.

Our study proved the treadmill test to be a reliable diagnostic tool. In the research group, patients with femoropopliteal occlusion covered on average 69,21 m (female) and 83,4 m (male) before reporting pain in the lower limbs. Participants covered 14 m (female) and 24 m (male) more before interrupting the test. Kowalski et al (6). also used the treadmill test to evaluate the differences between patients with chronic lower limb ischemia. They used the WIQ questionnaire to assess the individual components of locomotion, which allowed them to emerge domains of interest and assess the impact of training on them. Although our study did not evaluate the progress of rehabilitation, we did use the questionnaire to assess the motor function of our patients. Obtained scores differed between genders, especially in the speed domain. The WIQ speed score was 0,425±0,114 for women and 0,593±0,109 for men. Other domains, such as walking distance and stair climbing did not show statistically significant differences between genders (0,725±0,052 in women vs 0,725±0,809 in men; 0,792±0,107 in women vs 0,794±0,115 in men).

Mayers et al.(10) also used the WIQ questionnaire in their research. The mean age of the patients with chronic lower limb ischemia was 62,1±9,61 years, the score in the distance domain was 0,55±0,42, in the speed domain – 0,48±0,30 and in the stairs domain – 0,56±0,47.

McDemont's paper (8) randomized this questionnaire in a group of patients with chronic lower limb ischemia. The mean age was slightly higher than in our case (71,7±9,8 years). Diabetes was diagnosed in 28,1% of the patients. 21,2% of the respondents had a history of heart attacks. In our study, diabetes was found in 32,30% of the participants, whereas history of heart attacks – in 12,30% of the patients. In McDemont's research, scores in the individual domains were as follows: 0,409± 0,307 in the distance domain; 0,371 ± 0,267 in the speed domain; 0,489 ± 0,296 in the stairs domain. The researchers aimed at establishing a relationship between the results of the 6 Minute Walk Test and the WIQ score. The correlation was statistically significant – the longer the distance walked, the higher the WIQ score in all of the domains. A similar pattern was revealed in our study, as ICD and ACD values correlated positively with the total WIQ score.

No reports concerning the correlation of age or BMI with the WIQ score have been found in literature, which suggest that pain due to lower limb ischemia appears much earlier than discomfort caused by the age or weight of the respondents. Therefore, influence of these parameters on the results of the surveys assessing motor function of the lower limbs should not be expected.

Conclusions

1. Our research showed no correlation between the total WIQ score and gender.
2. There was a statistically significant correlation between the ICD and ACD indexes and the total WIQ score (p=0,760).
3. No statistically significant correlation was found between the BMI and the Total WIQ (p=0,612).

4. The scores in individual WIQ domains (distance, speed, stairs) strongly correlated with the total WIQ score (p>0,01).

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Correspondence

Żanna Fiodorenko-Dumas
Department of Physiotherapy, Wroclaw Medical University
2 Grunwaldzka Street; 50-355 Wroclaw
Phone: +48605955424
E-mail: z.fiodorenko@poczta.onet.pl

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IMPORTANCE OF SPORT ACTIVITIES IN LEISURE TIME AND SCHOOL SETTINGS AMONG SWISS AND FOREIGN CHILDREN
Results from a cross-sectional study in Central Switzerland

Jürgen Kühnis, Nancy Eckert, Debbie Mandel, Egli Sarah, Imholz Patrizia

University of Teacher Education Schwyz, Switzerland

Abstract

The aim of this study was to observe the importance of sport activities among 5th grade pupils in the canton of Schwyz (located in Central Switzerland) and to identify possible differences between children of various nationalities. The cross-sectional study was carried out in 30 randomly selected classes during the school year 2015/2016. The sample (n = 468) consisted of 52.8 % boys and 47.2 % girls, aged 10.8+0.7 years old. Socio-demographic characteristics, interests and participation in sports were established using a standardized questionnaire. The majority of the observed primary school children (85.7%) participate regularly in sports. Approximately 5 hours of sports are practised on average per week; about 18 % are engaged in such activities for more than 7 hours. The percentage of fully sport-abstinent children is around 3.5 %. In accordance with other studies, the influence of immigration backgrounds seems to be mainly moderated by gender. While boys with foreign or Swiss origin are equally enthusiastic about sports, there is clearly a lower level of participation in sports in general and especially in sports clubs among girls who come from an immigrant background. Therefore, they should be considered one of the important target groups for exercise promotion programs.

Key words: *Participation and interest in sports, primary school children, nationality, Central Switzerland*

Introduction

Despite the variety of today's leisure-time opportunities and increased use of digital media in daily routine, sport and physical activities still play an important role in the leisure-time settings of children and adolescents, and are very popular [3, 7, 10, 14, 18]. Sport in all its various organized and informal forms is a key component of a healthy lifestyle [23] and there is no other age group beside children which is so tightly bound to the sport system [19].

Studies show that socio-demographic characteristics such as gender, age, nationality, social-economic status and parents' sports affinity are major predictors of young people's level of interest and participation in sports [2, 3, 4, 9, 10, 11, 14, 21]. There is consistent evidence which demonstrates that boys and younger children show a higher involvement. Moreover, children from socially disadvantaged groups with immigrant backgrounds (especially girls), and with parents who have a low sport-affinity, clearly have a lower level of sports participation than children from privileged and sport-active families. Furthermore, sociological sport research regarding the correlation of sport, ethnicity and gender has become more intense in recent years. According to the current level of knowledge, sport and physical activities are also an important aspect of leisure-time among children with immigrant backgrounds, but primarily for boys [1, 4, 12, 14, 15, 16, 22]. While foreign boys show the same level of interest as native youth, girls from an immigrant background are clearly less sport-active and underrepresented in sport clubs as well. Besides gender, sport participation also depends on the country or region of origin [14, 16, 20]. According to reference studies from Germany and

Switzerland [4, 14], most of the girls from South-Eastern and Eastern Europe are considerably less sport-active and tend to be sport-abstinent more frequently. Moreover, some results from our neighbouring states of Germany and Austria indicate that there is also a correlation between immigrant status and motoric capability [8, 24], i. e. children from an immigrant background (especially girls) show poorer performance compared to native children.

So far, there are only a few studies in Switzerland conducted at primary school age, which analyse the importance of sport activities during leisure time and the school setting among Swiss and foreign children. With this background, the following questions will be addressed:

a) How important are sport activities during leisure time and school settings for children?

b) Are there differences in sport participation and sport clubs membership between nationality groups and

c) What is the role of gender concerning sport activities?

Methods

Procedures and participants

This study is based on a cross-sectional survey in primary schools in the canton of Schwyz (Central Switzerland) focusing on the situation of physical education (PE). After the approval of the educational authority, a cluster sample (based on the cantonal school statistics) consisting of 30 classes of 5th graders was randomly selected. Information from the relevant teachers was obtained in cooperation with the local school administration. Participation of pupils was voluntary, but presupposed the written consent of their parents. The study was conducted from September 2015 to June 2016 and followed a standardized procedure. Each class was supervised by our research team. The pupils needed 19 minutes on average to complete the standardized questionnaire. The definitive dataset included 468 children (aged 10.8+0.7 years), representing a participation rate of 95 %.

Measures and analysis

The short questionnaire included several questions about physical education at school (which are not an objective of this sub-analysis), socio-demographic characteristics (gender, age, nationality and the country of origin of foreign children), the sportiness of the children, and the importance of sports in school and leisure time settings. Duration and frequency of children's sport activities were measured with the questions: “Are you a member of a sports club?” (Answer categories: 1 = no, 2 = former member, 3 = yes, in one sports club, 4 = yes, in more than one sports club) and “How often do you practise sports during your free time (outside school)“? (Answer categories: 1 = never, 2 = seldom, 3 = weekly). Children participating in regular weekly activity (category 3) completed this question by specifying their sports involvement (days and hours per week). For detailed analysis, foreign children were classified (following the general categories of the Swiss federal statistical office www.bfs.admin.ch) in four groups of origin:

a) Western and Northern Europe (i.e. France, Germany, Benelux and Scandinavian countries),

b) Southern Europe (i.e. Portugal, Spain, Italy),

c) South-Eastern and Eastern Europe (i.e. Balkan countries, Turkey, Ukraine, Russia) and

d) outside of Europe (Asia, Africa, America).

Data analysis was performed using SPSS (version 24), Chi-Square Test and non-parametric methods (Mann-Whitney-U and Kruskal-Wallis-Test), which were drawn at significant level of $p < 0.05$.

Results

Participation in sports

The majority of children (85.7 %) do sports weekly; only every seventh adolescent is not active in sport, or is seldom active (table 1a). Approximately 5 hours of sports are practised on average per week; about 18 % are engaged for a longer period of more than 7 hours per week. The percentage of fully sport-abstinent children is around 3.5 %. Boys show a significantly higher sport involvement than girls. While the majority of boys (68.8 %) practise sport activities for 3 or more hours per week, the majority of girls (58.3 %) are active for less than 3 hours per week.

Among nationality groups in general no differences were found, but the differentiated

analysis of children from an immigrant background showed a pronounced gender difference: foreign girls are investing 2.8 hours/week on average for sports, which is only half as much in comparison with foreign boys; furthermore, 31.9 % of foreign girls show clearly low sport participation with none or almost no activity (table 1a). Boys of foreign origin participate on average in 5.8 hours of activity time per week, which is practically the same as for native boys (mean: 5.5 hours); Swiss girls, on the other hand, are more active (mean: 4.1 hours) than foreign girls (mean: 2.8 hours; $p<0.05$). Moreover, a further breakdown by origin groups shows that girls from Western and Northern Europe are equally sportive as Swiss girls with an average of 4.3 hours/week; boys from Western, Northern, Southern- and South-Eastern Europe are even more active than their Swiss colleagues with an average of 6 hours/week. It is primarily girls from Southern, South-East-/Eastern Europe (mean: 2.6 and 2.2) and from outside of Europe (mean: 1.7 hours), who show below-average sport activity.

Table 1a. Participation in sports (outside school time) of 5th grades (n = 468) in canton Schwyz

	participation in sports		**amount of sports activity/week**				
variables	no/seldom	weekly	> 7 hrs.	> 3-7 hrs.	≤ 3 hrs.	0 hrs.	mean±sd
all	**14.3 %**	**85.7 %**	**18.0 %**	**38.5 %**	**40.0 %**	**3.5 %**	**4.8±3.4**
boys	10.5 %	89.5 %	25.5 %	43.3 %	27.3 %	3.9 %	5.6±3.5
girls	18.6 %[b]*	81.4 %	8.9 %***	32.8 %	55.2 %	3.1 %	3.8±2.9[b]**
nationality							
Swiss	12.9 %	87.1 %	19.2 %	37.9 %	40.1 %	2.8 %	4.9±3.3
dual citizens[a]	10.5 %	89.5 %	16.7 %	33.3 %	44.4 %	5.6 %	4.7±4.1
foreigners	20.0 %	80.0 %	13.6 %	42.0 %	38.6 %	5.7 %	4.5±3.4
foreign boys	9.4 %	90.6 %	24.0 %	48.0 %	24.0 %	4.0 %	5.8±3.7
foreign girls	31.9 %[b]**	68.1 %	0 %[b]**	34.2 %	57.9 %	7.9 %	2.8±2.0[b]**

[a] Swiss and other nationalities

[b] significant differences between boys and girls: * $p < .05$, ** $p < .01$, *** $p < .001$

Table 1b. Participation in sports club in comparison to national findings [14]

	canton Schwyz	**Switzerland [14]**
sports club membership	(11y, n = 468)	(10-14y, n = 1525)
All	**73.5 %**	**62 %**
boys	78.9 %	70 %
girls	67.4[b]**	53 %
nationality		
Swiss	76.5 %	66 %
dual citizens[a]	89.5 %	58 %
foreigners	60.0 %[c]**	49 %
foreign boys	73.6 %	63 %
foreign girls	44.7 %[b]**	37 %

[a] Swiss and other nationalities

[b] significant differences between boys and girls and [c] within groups: * $p < .05$, ** $p < .01$, *** $p < .001$

Sports club membership

Overall, 73.5 % are active in at least one sports club (table 1b). Boys in particular, as well as Swiss and citizens with dual nationality are more frequently engaged in sports clubs than girls or foreign children; whereas both differences evolve from a clearly low quota of foreign girls in sports clubs. Their sports club quota of 44.7 % is significantly different from that of young Swiss girls (72.5 %; $p < .001$). Further differentiation in terms of origin groups shows that the percentage of sports club membership among the girls from South-Eastern, Eastern and outside Europe with 32 % and 29 % is much lower in comparison to the girls from Western and Northern Europe (90 %) or Southern Europe (73 %). There are no statistically relevant differences in sport club participation among boys based on their region of origin.

The importance of school sports

For 54.1 % of all interviewed children, physical education (PE) is their favourite subject in school (table 2). PE has a significantly higher relevance among boys; however, this gender difference mainly results from the low popularity among foreign girls (36.2 %). Analogous to the preceding analysis of participation in sports, the lowest popularity of PE with 36 % and 29 % appears among girls from South-Eastern and Eastern Europe, and from girls who come from outside Europe. However, school sports in general obtain a gratifyingly high importance independent of gender and nationality (table 2).

Table 2. Importance of physical education (PE) and sports in school

	PE as favourite subject		**Importance of school sports in general**		
variables	yes	no/others	important[c]	unimportant[c]	mean+sd
all	**54.1 %**	**45.9 %**	**93.6 %**	**6.4 %**	**3.4+0.6**
boys	59.1 %	40.9 %	92.2 %	7.8 %	3.4+0.7
girls	48.4 %[b]*	51.6 %	95.0 %	5.0 %	3.4+0.6
nationality					
Swiss	55.9 %	44.1 %	94.0 %	6.0 %	3.4+0.6
dual citizens[a]	57.9 %	42.1 %	100 %	0 %	3.7+0.5
foreigners	47.0 %	53.0 %	90.9 %	9.1 %	3.4+0.7
foreign boys	56.6 %	43.4 %	90.4 %	9.6 %	3.3+0.7
foreign girls	36.2 %[b]*	63.8 %	91.5	8.5 %	3.4+0.7

[a] Swiss and other nationalities

[b] significant differences between boys and girls: * $p < .05$, ** $p < .01$, *** $p < .001$

[c] including important/rather important and unimportant/rather unimportant respectively

Discussion

In accordance with other sport studies focused on children and adolescents [7, 14, 19], sport activities in leisure time and school settings are highly important for the majority of the interviewed children (tables 1a/b and 2). 85.7 % do sports weekly (outside of the school), 73.5 % are members of sport clubs and 93.6 % of all the children consider sports at school to be very important or important. The present membership quota remains stable at a high level since the last cantonal study in 2012 with a comparative value of 70.1 % [13]. Although our cross-sectional data does not allow causal conclusions, it seems that cantonal sport clubs and associations are successful in attracting school children as new members. In addition, sport clubs' quotas among the school children observed in Central Switzerland are higher than

at national level; according to a nationwide study in 2014 [14], the proportion of sports club membership among 10 and 11 years old in Switzerland is between 62 and 65 %.

Boys engage more in sports and show a higher quota of sport club membership than girls. In accordance with other studies [3, 4, 12, 14, 15, 22], our analysis confirms that this presumed gender difference has its roots in the clearly lower sport participation of foreign girls, while boys from an immigrant background are as involved in sport as Swiss boys. Nearly one-third (31.9 %) of the foreign girls never or only seldom practice sports in their leisure time; their activity time and sports club quota of 44.7 % are significantly different from that of Swiss girls (72.5 %; $p < .001$). Further differentiation based on the region of origin shows that in particular, girls from South-Eastern and Eastern Europe and from outside of Europe are less active. Girls from these regions seem to have limited access to organized and informal sports. According to findings from German studies [5, 12], this fact of a lower level of socialization through sport clubs appears especially to be influenced by traditional gender roles and cultural-religious values and norms, which are conveyed in the family as well as by low socio-economic status, low level of education and possible language barriers. The overall high relevance of PE independent of nationality and gender (table 2) shows, on the other hand, that foreign girls are not fully dissociated from organized sports. Therefore, school settings offer a good opportunity (for example through voluntary, extracurricular sport courses or target-group-specific offers) to reach especially foreign girls (and also indirectly their parents) and to motivate them to participate in a higher level of leisure time sport activity. However, to make this implementation sucessful, relevant gender- and intercultural competence among PE teachers is crucial [6]. Therefore, approaches to heterogeneity in PE classes should be intensified during vocational training and the education of teachers. In addition, sport federations and clubs should also improve cross-cultural competency of the trainers [5, 12, 18].

This study has some limitations. First, the data were collected with a questionnaire. This subjective assessment of sport engagement can lead to general difficulties for children in terms of their ability to realistically estimate their sports behaviour. Also, the tendency of social desirability cannot be excluded [17]. Secondly, due to the cross-sectional design and to the fact that our survey allows no further statements concerning infrastructural, familial characteristics and circumstances, which can have conducive or obstructive influence on sport participation among children, possible can reasons can only be the subject of speculation.

Conclusion

The majority of primary school children in the canton of Schwyz are regularly involved in sports. In accordance with other studies, it appears that girls from immigrant backgrounds are less active and are less seldom inclined to participate in sports clubs. Therefore, they should be considered as one of the important target groups for exercise promotion programs. In addition, our findings clarify the need for differentiated analysis in comparative observation of sports participation among children, both local and from an immigrant background. In order to increase the informative value of this research, qualitative aspects should be analysed, as well as findings in the form of quantitative data as set out in this study.

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Correspondence

Prof. Dr. Dr. Jürgen Kühnis
e-mail: juergen.kuehnis@phsz.ch

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EFFECTIVENESS OF THE “IAAF KIDS' ATHLETICS PROJECT” IN LEVELLING CHANGES OF GENERAL PHYSICAL PERFORMANCE AMONG BOYS OF EARLY SCHOOL AGE

Tomáš Willwéber

Department of Physical Education and Sport, Faculty of Arts, Matej Bel University, Slovak republic

Abstract

The study presents the results of general physical performance among 3rd grade pupils at an elementary school on Ďumbierska street in Banska Bystrica. Results were gained through the application of selected tests and EUROFIT and UNIFIT [5; 2]. The experimental group consisted of 16 subjects (boys), aged 8 – 9 years, who attended athletics preparation within the "IAAF Kids' Athletics" program. The control group accounted for 18 subjects (boys) ofthe same age. The research period lasted nine mesocycles from 15th October 2014 to 17th June 2015. All the results obtained in the input and output measurements were mutually compared and evaluated using statistical methods. The output measurements in the experimental group compared with the control group experienced statistically significant changes at $p \leq 0.05$ in all tests performed. Effect size was confirmed in tests on two medium effects and two large effects.

Key words: *IAAF Kids' athletics, general physical performance, early school age (early childhood), test battery EUROFIT and UNIFIT.*

Introduction

Physical development and motor performance are inextricably linked with the implementation of physical activity. Movement as a living manifestation of a lasting connection and transformed into all functions of the human body and its decline and restrictions that have emerged in recent decades, has been expressed in strongly negative terms. There is evidence that lack of physical activity acts as one of the most important factors causing various health problems such as cardiovascular disease and musculoskeletal weakening suffered by a large percentage of the population. [4] This indicates that physical activity is one of the main basic stimulators in a child's development on the condition that physical activity is not excessive. The child should establish a positive relationship with physical activity and sport in general because thanks to physical activities they consolidate their health and create a healthy lifestyle which is vital for the appropriate functioning of the human body. The author states that in regular-training, boys relative VO2max values rise, while in regular-training of girls these values stagnate [1].

The author reports that, from the first years of education, children are already creating the necessary conditions for carrying out physical activities, yet boys dominate in acquiring these skills [14]. According to [7] the adaptation of motor activity in one of the starting points of training, thereby establishing the ability of a child's body to correspond with the outside environment through the stimulus of homeostasis and influence the number of reactions induced in the body. According to [3] increasing levels of physical and sports performance through a high proportion of versatility in sports training contribute to emotional satisfaction. Physical ability in children is most often manifested by subjective factors, such as greater fatigue resistance, improved movement patterns, greater agility and so on. [12]. On the basis of these characteristics, the ratio of general and special

sports preparation in the early stages ranges from 80 % : 20 % [4; 10].

Athletics provides a broad space for development of coordination abilities, which play a significant role in the development of the basic functions of human motion. Athletics Training also uses means which enable a feel for proper conduct [6]. IAAF Kids' Athletics is a project that provides a broad space for development of coordination abilities to significantly participate in the development of the basic functions of human motion. The principal motor manifestations of Athletics include elementary physical activities such as running, jumping, throwing, and combinations thereof. The contribtution of athletics to the development of fundamental motor skills is indisputable. Athletics for children may make use of unconventional and interesting techniques with which children have the opportunity of trying out various athletics disciplines in a fun and playful way [8; 9; 11].

AIM

The aim of the study was to detect changes of the level of general physical performance among boys of early school age (early childhood) who attended the athletics preparation within the project Kids' Athletics over nine mesocycles.

METHODS

Participants were 3rd grade boys attending the elementary school on Ďumbierska street in Banska Bystrica. The experimental sample consisted of students in III. C. classes who attended a class focusing on athletics training during the school year of 2014/2015. The experimental set featured 16 subjects (boys) aged 8 – 9 years, with an average age of 8.56 ±0.34 year at the beginning of the experimental period. The control group also accounted for pupils of the third year of primary school on Ďumbierska street in Banska Bystrica. The control group consisted of students from III. B. class, who did not attend the athletics class during the school year 2014/2015. The group consisted of 18 subjects (boys) aged 8 – 9 years, with the observed average age of 8.75 ± 0.28 year at the beginning of the experimental period. Therefore, the control group on the days of observation was compared with the older experimental group of about 0.19.

The research period followed lasted nine mesocycles as from 15th September 2014 to 17th June 2015. The period of the experiment was to develop fitness and coordination abilities, and general physical performance of students using a variety of games and exercises. Athletics classes were held at the school gym 2 times a week for 60 minutes, a total of 60 times during the reporting period. Admission testing was done at the beginning of the experimental period. An experimental set of input tests was conducted on 22nd September 2014, finishing at the end of the reporting period on 10th June 2015. An admission test of the control group was conducted on 24th September 2014 and the output at the end of the period 12th June 2015.

We used the following UNIFIT and EUROFIT test batteries to detect the level of general physical abilities and the effect of the IAAF Kids' Athletics project [5; 2]:

1. Sit-and-reach test (EUROFIT)
2. Standing long jump (EUROFIT)
3. Sit-ups in 30 s (EUROFIT)
4. Flexed arm hang (EUROFIT)
5. Shuttle run 4 x 10 meters (UNIFIT)
6. Endurance shuttle run (EUROFIT)

Attended and completed training load was evaluated according to the general and specific training indicators (Table 1). The following general training indicators were chosen: speed exercises, endurance exercises, exercises for coordination, strengthening exercises, locomotive games, and gymnastics. We applied the following indicators in special training preparations focusing on the running drill technique, the jump technique, and the technique of throws and shots.

A clearer view is provided in is Figure 1, which shows an increasing difference in the amount of load in general and specialized training indicators.

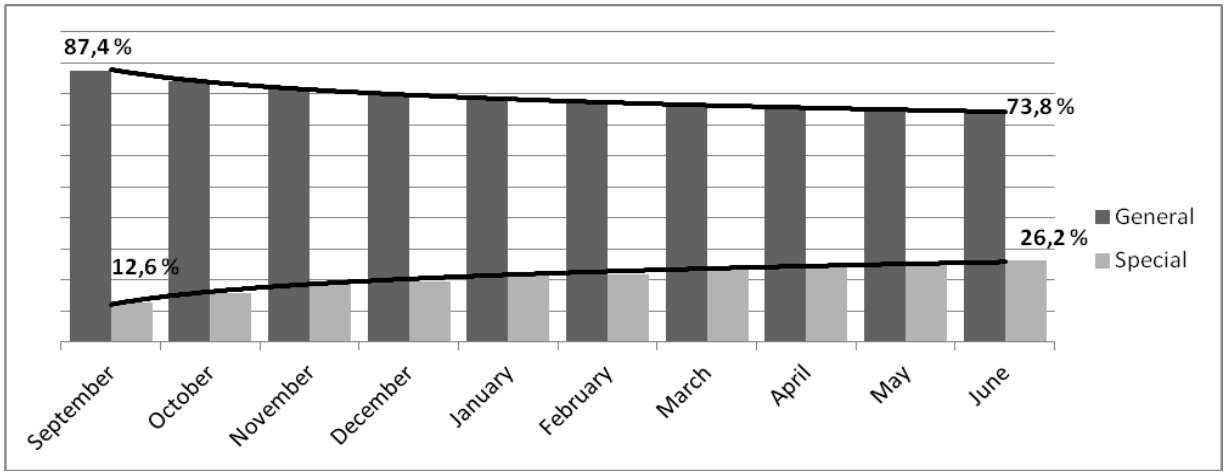
Table 1. Totals of the volume of load in general and special training indicators of the experimental group

Month (training) / Indicators	SE	EE	EC	SE	LG	G	RT	ST	TTS	General / Special content (min) (%)
September (3)	16	24	12	5	45	30	10	5	4	132 / 19 87.4% / 12.6%
October (8)	66	58	52	27	69	33	25	24	9	305 / 58 84.1% / 15.9%
November (8)	69	46	43	45	60	38	27	22	20	301 / 69 81.3% / 18.7%
December (6)	62	38	45	37	42	23	24	20	16	247 / 60 80.5% / 19.5%
January (6)	42	63	33	21	51	42	40	16	15	252 / 71 78.1% / 21.9%
February (7)	72	44	58	31	45	36	32	26	22	286 / 80 78.2% / 21.8%
March (7)	48	67	34	25	54	48	43	25	19	276 / 87 76.1% / 23.9%
April (7)	53	63	38	27	52	42	44	22	21	275 / 87 75.9% / 24.1%
May (7)	44	64	32	23	54	49	46	25	22	266 / 93 74.1% / 25.9%
June (3)	10	23	13	7	24	27	16	12	9	104 / 37 73.8% / 26.2%
Total	482	490	360	248	496	368	307	197	157	**2444 / 661 78.9% / 21.1%**

Legend:

SE – speed exercises
EE – endurance exercises
EC – exercises for coordination
SE – strengthening exercises
LG – locomotive games
G – gymnastics
RT – running technique
ST – jumping technique
TTS – technique of throws and shots

Figure 1. Load volume of general and specialized training indicators



To determine the statistical significance level of somatic parameters and the development of general physical performance and motor abilities, a paired t-test was used with both the experimental and control group; to compare values between files an unpaired t-test was used. We worked with our chosen significance level of $p \leq 0.05$. When evaluating and interpreting the results the methods of logical induction, deduction; methods of analysis, synthesis and comparison were applied. To check the effect of action we used the effect size when we worked and compared with the Cohen's number.

At the beginning of the application period, we also investigated in the experiment the value of the underlying somatic parameters, such as body height and body weight. In the input measurement we recorded the experimental group subjects with an average height of 137.35 ±3.59 cm. We recorded an average body weight of 29.37 ±3.62 kg. In the output measurements, we found an average increase in height in subjects to 141.8 ±3.77 cm (3.24%), and a body weight of 31.58 ±3.32 kg (7.52%). From the data received, we calculated the body mass index (BMI). During input measurement, we calculated a BMI value of 15.57 and during output measurement in the experimental group, we calculated a value of 15.71 (0.91% difference).

In the input measurement we recorded the control group of subjects with an average body height 136.50 ±3.40 cm. We recorded an average body weight of 30.75 ±3.23 kg. In the output measurements, we found an average increase in height in subjects to 140.79 ±4.49 cm (3.14%), and a body weight of 31.74 ±3.62 kg (3.22%). From the data obtained by somatometry we calculated the body mass index (BMI). During input measurement we calculated a BMI value of 16.48 and during output measurement we caltulated the control group value of 16.00 (down 2.88%).

At the end of the experimental period, we found a difference in somatic parameters between the experimental and control groups. The experimental group was observed as having a higher body height of 1.01 cm (0.71%) than in the control group. The control group was conversely recorded as having slightly higher body weight of 0.16 kg (0.51%) in the experimental set. The control group was compared to the experimental group finding a 1.86% higher BMI.

Results

Table 2 presents the level of general physical performance which was monitored in the input and output measurements of the experimental sample who attended the athletics preparation within the project IAAF Kids' Athletics.

In the test, sit-and-reach, focusing on the articular mobility of the body, we registered the improvement of the experimental group from the input measurement 19.7 cm to 21.1 cm in the output measurement, an increase of 1.4 centimeters (7.11 %).

In the test standing long jump with a local focus on the explosive power of the lower limbs, we recorded the longest trial in 162 cm versus 167 cm in output measurements. In the input measurement, subjects achieved an average performance of 130 cm; measurements in output increased 4.1 centimeters (3.15 %) to 134.1 cm.

In the test sit-ups in 30 s, aimed at dynamic and endurance strength of abdominal and hip-thigh muscles, in the experimental group, the average input power was 16.6 correct executions of drills for 30 seconds; the output performance was equal to 18.9 repetitions for 30 seconds, an improvement on the average performance of drills of about 2.3 (13.86 %).

The flexed arm hang test focused on a static muscle strength and endurance of upper limbs: we found significantly positive changes. While at input measurement in the experimental group we found the value of the average performance of 13.86, the output value was of 16.62, which is a significant increase of 2.79 (20.17 %).

In the shuttle run 4 x 10 meters to determine the running speed of a change of direction, we recorded the input measurements in average values of 14.02. In output measurements we recorded a value of 12.77. The results can be perceived positively in an improvement of 1.25, which is 8.93 %.

The endurance shuttle run is another test in which we observed improvement in average results. At the beginning of the experimental

period, we recorded the input measurements: an average value of 27.8 sections. After completion of the research in the output measurements we recorded an average of 32.7 sections performed, an increase of 4.9 sections (17.63 %). The largest number of sections was recorded in the output value measurements and represented value 59.

From the acquired results, we can conclude that the best average performance improvement was observed in the endurance test flexed arm hang, which was an increase of 20.17 %. Other significant positive changes were observed in the endurance shuttle run where there was a mean increase of 17.63 %.

Table 2. General physical performance input – output in the experimental group

	SRT (cm)	SLJ (cm)	SUT (n)	FAH (s)	4 x 10 m (s)	ESR (n)
INPUT						
X	19.7	130	16.6	13.83	14.02	27.8
SD	1.83	11.92	3.47	7.38	1.55	7.5
Max	30	162	22	26,6	17.39	51
Min	12	81	8	2,6	11.25	11
OUTPUT						
X	21.1***	134.1***	18.9***	16.62*	12.77**	32.7***
SD	1.58	11.74	3.59	7.64	1.54	7.28
Max	32	167	25	28.3	16.32	59
Min	13	86	12	5.3	10.64	15
	1.4	4.1	2.3	2.79	-1.25	4.9
MEAN CHANGE	7.11 %	3.15 %	13.86 %	20.17 %	-8.93 %	17.63 %
Cohen's d	**0.82**	0.34	0.65	0.37	**0.81**	0.66

Legend:
SRT – Sit-and-reach test
SUT – Sit-ups in 30 s
4 x 10 m – Shuttle run 4 x 10 meters
SD – standard deviation
n – number
** $p < 0.01$
SLJ – Standing long jump
FAH – Flexed arm hang
ESR – Endurance shuttle run
X – mean
* $p \leq 0.05$
*** $p < 0.001$

In the test sit-and-reach focusing on the articular mobility of the body, we have seen an improvement in the control group from the input measurement 17.67 cm to 18.25 cm in the output measurement, an increase of 0.58 centimeters (3.30 %).

In the standing long jump test for local focus on the explosive power of the lower extremities, average power in the input measurements reached 136.92 cm; measurements in the output was increased by 4.5 cm (3.29 %) to 141.42 cm.

In the sit-ups in 30 s test aimed at dynamic and endurance strength of abdominal and hip-thigh muscles, the control group reached an average input measurement of 16.67 correct executions of repetitions for 30 seconds; the output power was equal to 17.75 repetitions for 30 seconds, an improvement on the average performance exercises by 1.08 (6.5 %).

In the flexed arm hang test focused on static muscle strength and endurance of the upper limbs, we registered the value of the average performance of 14.98 seconds; the output was valued at 17.97 seconds, which is a significant increase on the 2.99 (19.98 %).

Input measurements for the shuttle run of 4 x 10 meters for detecting the running speed of a change of direction were recorded at an average

value of 14.22 seconds; research measurements recorded values of 12.69 seconds. In the results, we can conclude positively with an improvement of 1.53, accounting for 10.75 %.

In the input measurements for the endurance shuttle run, we observed an average value of 23.67 run sections; at the end of the research, we observed in the output measurments approximately 25.75 sections run, an increase of 2.08 sections (8.8 %).

The overall changes for the set of all experimental performed tests revealed a statistically significant positive change at $p \leq 0.05$. In the standing long jump and endurance shuttle run tests, we can conclude statistical significance even at a much lower level of significance.

Statistically significant positive changes occurred in the the control group in four out of six performed tests at $p \leq 0.05$. In the sit and reach test and the test sit-ups in 30 s no statistically significant changes occurred.

Analysis of our results from selected tests indicates [13] that the project "Kids' Athletics" recorded positive performance increases and improved general physical performance.

Table 3. General physical performance input – output in the control group

	SRT (cm)	SLJ (cm)	SUT (n)	FAH (s)	4 x 10 m (s)	ESR (n)
INPUT						
X	17.67	136.92	16.67	14.98	14.22	23.67
SD	4.19	20.39	6.50	11.65	2.91	13.08
Max	24	155	24	43.4	19.1	50
Min	10	82	1	1	12.3	7
OUTPUT						
X	18.25	141.42***	17.75	17.97**	12.69***	25.75**
SD	3.83	19.25	5.66	12.10	2.73	13.76
Max	24	160	24	46.1	16.5	55
Min	11	90	4	3.4	10.4	9
	0.58	4.5	1.08	2.99	-1.53	2.08
MEAN CHANGE	3.30 %	3.29 %	6.5 %	19.98 %	-10.75 %	8.8 %
Cohen's d	0.14	0.35	0.18	0.25	0.54	0.15

Legend:
SRT – Sit-and-reach test
SUT – Sit-ups in 30 s
4 x 10 m – Shuttle run 4 x 10 meters
SD – standard deviation
n – number
** $p < 0.01$
SLJ – Standing long jump
FAH – Flexed arm hang
ESR – Endurance shuttle run
X – mean
* $p \leq 0.05$
*** $p < 0.001$

Conclusion

The results of this study document changes in the level of general physical performance among third grade pupils of elementary school on Ďumbierska street in Banska Bystrica, who attended classes with a focus on athletic improvements. Applying the project "IAAF Kids' Athletics" showed a positive increase in average performance in all tests performed. Based on the evaluation of the results obtained by means of statistical methods, we can say that in all performed tests statistically significant positive changes occurred at $p \leq 0.05$. In the standing long jump and endurance shuttle run tests, we can conclude statistical significance even at a much lower level of significance. In the control group significant positive changes at $p \leq 0.05$

occurred in four out of the six tests conducted statistically. In the sit and reach and the sit-ups in 30 s tests there was no statistically significant occurrence.

In terms of size effects, significant changes were recorded since the four tests conducted during sit-ups in 30 s, and the endurance shuttle run yielded a medium effect, while the sit-and-reach test, and the shuttle run of 4 x 10 m yielded a large effect. Thus, we can conclude statistically significant differences between files and it is unlikely that the observed effect size is significant only due to statistics.

In the sport training of children we recommend at the pre-treatment stage of the sport the maintaining of the ratio of general and special training at 70 % – 80 % : 30 % – 20 % thus avoiding early sports specialization.

Our study confirmed that trainings realized two times a week over nine months can be a sufficient period within which to register and monitor the changes in the level of general physical performance. We predict that we can reach and improve a more significant increase in the level of general physical performance through the application of the project for a period longer than nine mesocycles.

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Correspondence

Tomáš Willwéber
Department of Physical Education and Sport, Faculty of Arts, Matej Bel University
Banská Bystrica, Slovak republic
Phone: +421908912877
E-mail: tomas.willweber@umb.sk

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FAIR PLAY, CHEATING AND GAMESMANSHIP IN YOUNG BASKETBALL TEAMS

F.J. Ponseti; J. Cantallops; A. Muntaner-Mas

University of Balearic Islands

Abstract

The aim of this study was to analyse young basketball players' attitudes towards fair play, winning, enjoyment, hard play and the acceptability of antisocial behaviour in the context of sports teams, such as cheating and gamesmanship. The sample included 230 adolescents (139 boys and 91 girls) with a mean age of 12.5 years (Range: 10-15 years; SD = 2.09 years). Results showed the importance of fun in sports, and the greater acceptance of gamesmanship and cheating among female players.

Key words: *Fair play, cheating, gamesmanship, team sports, young players.*

Introduction

Sport is considered an appropriate instrument for the transference of the practical values of personal and social development, such as: improvement, integration, respect for people and their different capacities, tolerance, cooperation and fair play. The concept of fair play in sports teams can be observed through behaviours such as throwing the ball away when an opponent is injured, not exploiting a disadvantaged opponent, recognizing one's own failure to comply with the rules, and truthfully indicating whether the ball has passed out of bounds.

At the same time, sport is a situation in which anti-social conduct such as doping, foul play, aggression (instrumental or not), cheating and gamesmanship are present. However, according to many studies, positive values and desirable personal qualities for all can be achieved through the correct orientation of sports practice [3, 11].

Anti-social behaviour, such as cheating or gamesmanship, is well recognized among athletes of different ages, gender, and at various competitive levels [8, 10]. These behaviours can be defined as the intention to intimidate or attack the opponent through physical contact, or the intention to deceive and put the opponent at a disadvantage through the use of gamesmanship, including faking injury, wasting time, or trying to unnerve the opponent [12]. All these behaviours result in negative consequences for the opponent and reflect an absence or diminution of fair play [1, 6].

While there are numerous studies aimed at analysing behaviours associated with fair play and sportsmanship [1, 13, 4], there are few studies dedicated to examining the acceptance of antisocial behaviours by team players and, specifically, acceptance of cheating and gamesmanship [9, 5]. These behaviours, unlike those associated with the use of physical violence, are occasionally reinforced by coaches and teammates, who want to have "smart" players on their teams [7]. Therefore, examining the relationship between acceptance of fair play, gamesmanship and cheating is the main goal of this study. These results are closely studied in the current paper.

METHODS

Participants

The sample involved 230 basketball players (139 boys and 91 girls; M age= 12.50 years old, SD= 2.09, range 10–15). These athletes were from competitive teams belonging to federations from the Balearic Islands. Age ranged from: between

10-11 years (44,8%), 12-13 years (30%) and 14-15 (25,2%).

Instruments

In order to assess predisposition to cheating in sports [7]: the study adopted the Attitudes to Moral Derived Decision-making in Youth Sport Questionnaire [4]. It consists of six items and was reported in a previous publication [7] as comprising of two factors: predisposition to the acceptance of cheating, and predisposition to the acceptance of gamesmanship. Each item is rated on a 5-point Likert-type scale where 1 means strongly disagree and 5 strongly agree. Reliability, constructs and factor validity have been described in the same paper.

The fair play attitudes scale (EAF) [2]; consisting of 22 items to assess the attitudes of the players in situations related to a game of football. The items of the questionnaire included different ideas concerning attitudes that occur in sports and for expressing the degree of agreement and/or disagreement regarding these attitudes. Each item is accompanied by a Likert response scale of 1-5, so that 1 means strongly disagree with the statement and 5 fully agree with the sentence. Once they interpreted the factors, variables were generated: victory; fun and hard play.

Procedure

Permission was obtained from coaches and parents of children to participate in the study. Data were collected following the same protocol for all participants. The researcher met with each coach to explain the study. At the end of a training session, participants completed the Spanish version of CDED and EAF questionnaires. The questionnaires took 15 to 20 minutes to complete. All players participated voluntarily in the research. The researcher was present while the participants completed questionnaires and emphasized the opportunity of asking any question that might arise during the process.

Analysis

The average score was calculated for each participant based on the tabulated answers. Differences between genders were tested by t student. Subsequently, an analysis of the descriptive statistics of items of the questionnaire was carried out, along with the significant differences between them, and a predictive analysis between the study variables was performed using the statistical software SPSS 19.0

Results

As illustrated in Table 1, it can be seen how much gamesmanship and cheating is used by basketball players. However, the values obtained are not high. Fun in the game is valued well above hard play and winning the game.

Table 1. Descriptive Statistics from CDED, EAF and Subscales

Questionnaire	Subscale	M	SD	Range
CDED	Gamesmanship	2.40	1.01	1-5
	Cheating	2.60	0.61	1-5
EAF	Victory	2.15	0.62	1-5
	Fun	4.14	0.69	1-5
	Play hard	2.47	0.66	1-5

Note. CDED = “Predisposition to Cheating in Sports” questionnaire; EAF = “Fair play attitudes scale” questionnaire. All scales were rated on a 5-point scale with 1: Strongly disagree, 2: disagree 3: Neither agrees nor disagrees, 4: agree 5: Strongly agree. M: mean; SD: standard deviation.

As shown in Table 2, it is noted that the score for cheating is very low in both cases, boys and girls, although girls present higher scores. Victory and hard play score lower than fun, with victory having the lowest score. This item evaluates whether the objective of the player is to win. Hard play reflects unsportsmanlike behaviours, and it also scores higher in girls and only fun is lowest amongst girls.

Table 2. Comparison of Means on the CDED and EAF by Sport and Gender

	Boy		Girls		Gender comparison	
Subscales	M	SD	M	SD	t	*p*
Gamesmanship (CDED)	2.24	0.97	2.65	1.04	-3,46	.001
Cheating (CDED)	2.49	0.54	2.78	0.70	-3,04	.003
Victory (EAF)	2.09	0.61	2.25	0.63	-1.90	.058
Fun (EAF)	4.20	0.69	4.05	0.69	1.58	.115
Play hard (EAF)	2.40	0.67	2.59	0.66	-2.11	.036

Note. CDED = "Predisposition to Cheating in Sports" questionnaire; EAF = "Fair play attitudes scale" questionnaire. All scales were rated on a 5-point scale with 1: Strongly disagree, 2: disagree 3: Neither agrees nor disagrees, 4: agree 5: Strongly agree. M: mean; SD: standard deviation.

As shown in table 3, some associations have been found between the outcomes studied. All associations indicate a positive relation between correlated outcomes, except in comparisons between victory and fun.

Table 3. Partial correlation adjusted for sex between subscales of CDED and EAF

	Fun (EAF)	Play hard (EAF)	Victory (EAF)	Cheating (CDED)	Gamesmanship (CDED)
Fun (EAF)	___	-.128	-.189**	.174**	-.017
Play hard (EAF)		___	.249***	.269***	.203**
Victory (EAF)			___	.498***	.373***
Cheating (CDED)			.	___	.265***
Gamesmanship (CDED)					___

DISCUSSION

Results show that basketball team players have fun while playing this sport. The sample included in this study scored very high on the fun subscale which indicates that having fun playing is highly recognized among young basketball players. In terms of gender, there are no significant differences in this subscale.

When the sample was analysed together, data show similar acceptation of gamesmanship and cheating behaviours in both genders. However, data obtained in the subscale of cheating for girls' basketball players (which highlights that female players significantly accept their teammates' use of nonaggressive antisocial behaviour, compared with boys) could be confirmed by interpreting partial correlations between cheating and gamesmanship. These high scores could be explained because many coaches openly express their desire to have players ready to take advantage in game situations over their opponents.

Data show a positive correlation between these two antisocial behaviours. In contrast gamesmanship is much more likely than cheating behaviour [14]. In general, all subscales scored more among girl players. Data show that

girls accept significantly more “hard play” compared to boys. Again it shows that hard play is positively associated with willingness towards and an acceptability of antisocial behaviours.

Football players who show willingness towards gamesmanship perform actions that do not infringe game regulations. As was mentioned before, such actions do not infringe sport rules; however they affect the spirit of the game and can even be used to obtain an improper advantage. For instance, trying to unnerve the opponent through discussion or distraction, destabilizing them psychologically, or wasting time when ahead on the scoreboard are examples of this actions. In those cases, there is no willingness to accept cheating, but players try to obtain advantages through developing behaviours not described by the game rules. Moreover, trying to waste time, or feigning injury, is not in the same category as touching the ball with the hands; however, these behaviours are presented by some players during competition [7].

The results of this study should be taken with caution. The small sample, unequal distribution of gender and the impossibility of establishing causal relationships, are limitations to be taken into account when results are interpreted. This research highlights the need for intervention programs in basketballs teams. These programs should, among other areas, encourage positive social behaviours and moral attitudes.

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Correspondence

Ponseti F.J.
University of Balearic Islands, Faculty of Education
Carretera de Valldemossa, Km. 7,5
07122-Palma de Mallorca (Balearic Islands)
Spain
Phone: (+34) 971 173 253
E-mail:xponseti@uib.es

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SOMATIC DEVELOPMENT AND PHYSICAL FITNESS OF SCHOOLGIRLS WITH MILD INTELLECTUAL DISABILITIES - A COMPARATIVE STUDY

Justyna Charaśna–Blachucik[1], Janusz Blachucik[2]

[1] Faculty of Physical Education and Physiotherapy at the Opole University of Technology

[2] Secondary Grammar School no. 3 in Kędzierzyn-Koźle

Abstract

This paper presents the results of a study into somatic development and physical fitness among schoolgirls with mild intellectual disabilities and their able-bodied peers. Comparative analysis of the height and weight of the children was carried out, and results from 60m and 600m runs, long jump, palant ball throw and medicine ball throw were obtained.

Analysis of the data, which were collected from 2012 to 2015, revealed no statistically significant differences in somatic development and physical fitness between schoolgirls with mild intellectual disabilities and their able-bodied peers, who constituted a control group. The results obtained indicate that there is a possibility of integrating schoolgirls with this type of disability with their able-bodied peers during physical education lessons and school sports competitions. A comparative study involving team sports would be very important for school practice.

Key words: *intellectual disabilities, integration, sport, rehabilitation, education.*

Introduction

The importance of an active lifestyle is obvious and familiar in contemporary society. Many papers and studies have already been presented concerning fitness activity, its role and influence on health. This article touches on the subject of physical activity among people with mild intellectual disabilities.

Contemporary methods of therapy for people with intellectual disabilities, integration trends that allow for such people to actively participate in social life, and the development of sport and leisure aim at rehabilitation through sport. Current research has proved groundbreaking with respect to intellectual disability[1]. Awareness in state schools and educational facilities of this issue has resulted in a higher level of interest in the needs of people with intellectual disability within scientific, sporting and educational environments[2].

There are many more papers concerning the physiological characteristics of people with intellectual disabilities, their causes, symptoms, state, and qualification[3] than papers concerning the assessment and description of physical and motor development among people with intellectual disabilities over the course of a few years. People with a disability are very often perceived as weaker, less physically-able, or inferior. This attitude particularly concerns children and young people with mild intellectual

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disabilities. This could not be further from the truth, since people with mild intellectual disabilities do not differ in terms of physical and visual appearance from their able-bodied peers[4], which is shown through observation and time spent with such people. Naturally, they differ in terms of behaviour, perception, memory range, speech, or thought processes. However, such people's emotional and motivational processes develop in an interesting fashion[5]. In reference to attention processes, research conducted shows that people with mild intellectual disabilities demonstrate bottom-up and top-down attention abilities. However, top-down attention is mainly focused on concrete material. Attention divisibility, span, and scope are weaker. The quality of top-down attention (span and divisibility) increases along with an increase in experience. However, the differences in this sphere between people with mild intellectual disabilities and able-bodied people (e.g. at school) are noticeable[6.] Top-down attention is used to perform any tests on motor skills because it is based on the performance of instructions and tasks.

Physical fitness among young people and adults is significant not only in the personal life of an individual, but also in society as a whole. It is strongly tied to health status, efficiency and the readiness to put effort into various activities. The need to improve physical fitness at school age results from a biological and cultural rationale. At this age physical fitness develops naturally, so it encourages its stimulation and correction. It is also the educational period on which the future depends: desired attitudes are adopted, motivation and needs are awakened, a healthy, physically-active lifestyle is encouraged. Therefore, at school age, there is a great chance of enriching physical fitness and forming a desired lifestyle. Consequently, physical education classes should stimulate a process leading to:

- the improvement of students' physical fitness
- students' acquisition of mobility skills specified in the curriculum (technique and tactics)
- the expansion of students' knowledge about physical culture
- students' acquisition of models of such behaviours, physical activities, "life-long sports" that may be used in leisure, arranging free time, so as to allow for life-long participation in physical culture[7]

Physical development of children is very individual, but usually follows a certain pattern. Regular and frequent development control of a child, especially a one-year-old, is vital because it allows for the early detection of possible dysfunctions.

Proper physical development in early childhood is extremely important in terms of intellectual, cognitive, emotional, social, aesthetic, and health development.

People with mild intellectual disabilities can be fully self-dependent. They can play different social roles in adulthood. Most of them do not require continuous care but only support and advice, especially in difficult situations. The progress in terms of rehabilitation, as well as through sport, and the idea of support through activation of people with mild intellectual disabilities provide an optimistic basis for their functioning and development. Nowadays, the prognosis concerning the capabilities and competence regarding the self-dependence of people with mild intellectual disabilities in everyday life is much better than it was assumed to be 20 years ago[8].

Based on existing literature, the studies that have been carried out so far do not state clearly whether physical fitness of children and young people with mild intellectual disabilities differs in relation to their able-bodied peers.

The study that was carried out in the 1980s by Pańczyk[9] concluded that there are no

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differences between a group with mild intellectual disabilities and a control group with normal intellectual capacity. The survey carried out by Baranowski 2003 concerning the physical activity of secondary grammar school students with intellectual diabilities showed that their level of physical activity is much lower than that of their peers with normal intellectual capacity[10]. Another study into physical fitness by Wieczorek 2008[11] shows statistically significant differences between the groups to the benefit of people with normal intellectual capacity. All studies were carried out once and did not span a longer period.

As far as intellectual development is concerned, physical fitness is vital, and it in turn can be monitored by various tests or exams. Appropriate physical fitness tests, the proper interpretation of their results and the provision of students with information concerning the objective and method of testing are indispensable conditions in order to control this process consciously. However, these test should also be useful in a rationally organised physical education process, which is a wide and perceptive diagnosis in reference to a person, team, or environment. This diagnosis is especially important when starting to work with a new group or class, especially at the beginning and end of a school year.

Carrying out physical fitness tests and the analysis of their results are an inherent aspect of the work of a physical education teacher. In the era of a modern and individual approach to the issues associated with physical education at school, the teacher has an opportunity to design their own physical education program, taking into account learning facilities, as well as the capabilities and interests of students. In-depth analyses such as this, provide data on the basis of which one's own vision of controlling the physical education process can be developed.

Therefore, it seems compelling to carry out a study concerning the comparison of physical fitness tests between people with mild intellectual disabilities and people with normal intellectual capacity of the same age, from the same school, and over a course of a few years[12]. The study shows that the students with mild intellectual disabilities, as far as tests including 60m and 600m runs, long jump, palant ball throw, and medicine ball throw are concerned, achieved similar results to students with normal intellectual capacity.

Various analyses may be carried out and compared with others by doing extensive studies of somatic development and physical fitness of all students, both able-bodied and disabled, and by comparing the results obtained over the course of a few years.

The possibility of observing the record of one's own physical development over many years ─ not in the form of grades from physical education, but in the form of specific sport results ─ motivates physical activity in adulthood and at an older age. In such a case, it is possible to compare the progress or regress of one's own physical fitness.[13] [14]

This study was carried out at Secondary Grammar School no. 3 in Kędzierzyn-Koźle by its physical education teachers based on the teachers' own physical fitness tests.

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Aim of the study

The aim of the study is to assess somatic development and physical fitness of 20 schoolgirls with mild intellectual disabilities and 20 schoolgirls with normal intellectual capacity. The schoolgirls tested attend four physical education classes per week, and their age was 13 during the first test in September 2012.

Research questions

The following questions were posed before the study:

1. Are there any differences in physique between the schoolgirls with mild intellectual disabilities and the control group?
2. Which physical fitness tests show the largest differences between the groups tested?

Research data and methods

The study was carried out from 2012 to 2015. A three-year observation of the schoolgirls taking part in the project yielded research data which, after performing a statistical analysis, may contribute to conclusions concerning changes in somatic development and the physical fitness of schoolgirls, both able-bodied and with mild intellectual disabilities.

Physical fitness tests were used as a research technique. They did not change throughout the research. All tests were carried out twice per school year, i.e. in September and May.

To carry out the study, the approval of parents and the management of Secondary Grammar School no. 3 in Kędzierzyn-Koźle was given. The study is regarded as a pilot and preliminary.

TEST 1. 60M RUN

Place: a track on the sport pitches of secondary grammar schools.

Equipment: a stopwatch capable of measuring two times.

Method: the tested schoolgirls run in pairs using a standing start position after a starter (teacher, trained student) who stands near the starting place gives an aural and visual signal. After the start, they run to the finish line in their own lane as fast as possible. The measurement of times, with a precision of 1/10 of a second, is taken by a teacher who stands at the finish line. The test is conducted two times at an interval of about 10 minutes.

Test result: the best time to finish the 60m run, expressed in seconds with a precision of 1/10 of a second.

TEST 2. 600M RUN

Place: a track on the sport pitches of secondary grammar schools.

Equipment: a stopwatch that is capable of measuring ten times.

Method: a group of 10 schoolgirls starts after an acoustic signal is given and runs on the track marked out around the sports pitches in order to run 600 metres as fast as possible. The test is only conducted once.

Test result: the time to finish 600 metres, expressed in seconds with a precision of 1 second.

TEST 3. LONG JUMP

Place: a long jump runway on the sport pitches of secondary grammar schools.

Equipment: a tape measure, a marker used to mark the edges of a footprint on the landing area.

Method: the schoolgirls tested take a run-up of any length. The jump is initiated by a one leg jump from a 1-metre zone. The test is conducted three times at an interval of a few minutes.

Test result: the length of the best jump, counted in centimetres, measured from the edges of toes initiating the jump to the edges of a footprint on the landing area which is the nearest to the edges of toes initiating the jump.

TEST 4. PALANT BALL THROW

Place: a throwing area marked out on the sport pitches of secondary grammar schools.

Equipment: 150g palant balls, markers used to indicate the place where the palant ball falls, a tape measure.

Method: the schoolgirl tested takes a run-up of any length and throws the ball before the edge of the throwing area. After the throw, the line that marks the edge of the throwing area can be crossed. This throwing test is conducted three times in a row.

Test result: the length of the best throw measured from the edge of the throwing area to the place where the ball falls, counted in metres with a precision of 10 centimetres.

TEST 5. MEDICINE BALL THROW

Place: a throwing area marked out on the sport pitches of secondary grammar schools.

Equipment: 3kg medicine ball, markers used to mark the place where the medicine ball falls, a tape measure.

Method: the schoolgirl tested stands with her back to the throwing direction before the edge of the throwing area. While holding the ball with both hands, the schoolgirl swings the ball and does a half-crouch three times. Then she swings the ball energetically above her head with both hands and throws the ball once her body is fully upright and her arms are in a vertical position. After the throw, the line that marks the edge of the throwing area can be crossed. This throwing test is conducted three times in a row.

Test result: the length of the best throw measured from the edge of the throwing area to the place where the ball falls, expressed in metres with a precision of 10 centimetres.

Methods for evaluating the study results

The weight and height of the body were measured, the body mass index (BMI) and Rohrer's index were calculated. The arithmetic mean, standard deviation, and the basic parameters of descriptive statistics were calculated. The t test of the Student was applied to assess the statistical significance of the differences between the average results in the groups compared. Statistical calculations were achieved by means of Microsoft Excel and Statistica programs. The study results were shown on graphs and in tables. In order to interpret the t Student test results, the significance level for independent variables was set at 0.05. In case of independent variables, if $t^o > 2.00$ the difference is statistically significant, and if $t^o < 2.00$ the difference is interpreted as random.

Study results

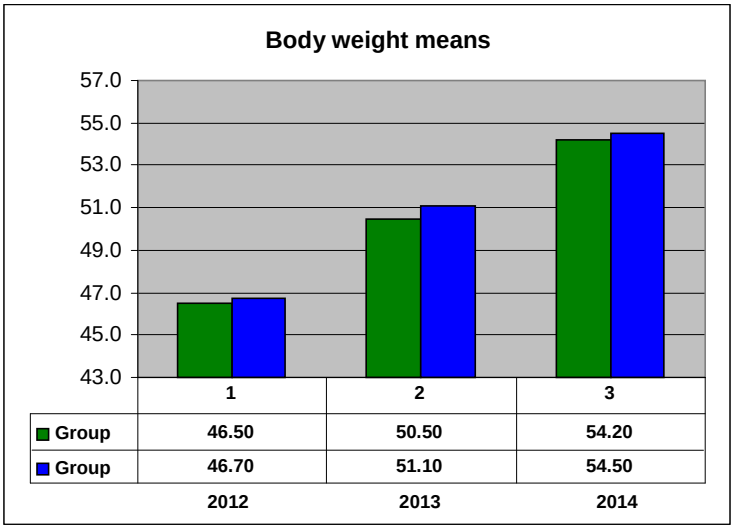
1. Analysis of somatic characteristics

BODY WEIGHT

Table 1. The body weight of the schoolgirls: A - schoolgirls with mild intellectual disabilities - N=20, B - control group - N=20

Parameters	Groups	Body weight		
		09.2012	09.2013	09.2014
Results [min]	A	43	45	49
	B	45	47	51
Results [max]	A	51	52	55
	B	55	56	59
$\bar{X}$	A	46.5	50.5	54.2
	B	46.7	51.1	54.5
S	A	1.84	1.96	1.94
	B	1.95	1.94	1.99
t^o	A B	0.81	0.72	0.79

p > 0.05 – the difference is statistically significant



Graph 1. Body weight mean of the group A and B schoolgirls from 2012 to 2014

Based on the data in Table 1, it can be noticed that very similar results were obtained in both groups tested. The results of group B are slightly better in every test but the differences are minimal. Throughout the whole secondary grammar school education cycle, group A and B schoolgirls have a very similar body weight and only differ slightly. This may mean that the group A and B schoolgirls have a similar physique type.

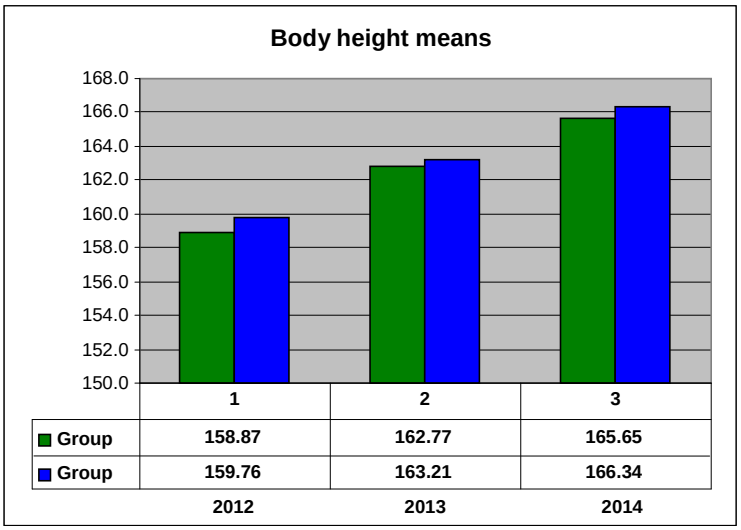
Based on the analysis using the t test of the Student, it is shown that at the significance level of 0.05 the differences between the body weight yearly mean of the group A and B schoolgirls are not statistically significant (t^o>2.00).

BODY HEIGHT

Table 2. The body height of the schoolgirls: A - schoolgirls with mild intellectual disabilities N=20, B - control group N=20

Parameters	Groups	Body height		
		09.2012	09.2013	09.2014
Results [min]	A	152	157	162
	B	154	160	164
Results [max]	A	167	174	181
	B	166	172	180
$\bar{X}$	A	158.87	162.77	165.65
	B	159.76	163.21	166.34
S	A	2.56	2.78	2.86
	B	2.79	3.35	2.98
T^o	A B	1.32	1.21	1.42

* p > 0.05 – the difference is statistically significant



Graph 2. Body height mean of the group A and B schoolgirls from 2012 to 2014

Based on the data in Table 2, it can be noticed that very similar results were obtained in both groups. As in the case of the body weight measurements, the results of group B are slightly better in every test. The mean increase in the body height is at a similar level in group A and B throughout the whole of secondary grammar school education. The differences between the values are not statistically significant in all tests (t^o>2.00).

BMI, ROHRER'S INDEX

Table 3. Body weight to body height ratio:

A - schoolgirls with mild intellectual disabilities N=20, B - control group N=20

Parameters	Groups	Body weight and height		
		09.2012	09.2013	09.2014
Weight	A	46.5	50.5	54.2
	B	46.7	51.1	54.5
Height	A	158.87	162.77	165.65
	B	159.76	163.21	166.34
BMI	A	18.02	19.05	19.70
	B	18.24	19.28	19.81
Rohrer's index	A	1.15	1.16	1.18
	B	1.14	1.18	1.19

Based on the data in Table 3, the BMI reveals that the mean of each group, i.e. group A and group B, has a proper physique according to the obesity classification (WHO). There is a gradual increase in the results in both groups throughout the research period (from 2012 to 2014).

The Rohrer's index indicates that all schoolgirls tested are leptosomatic.

2. Physical fitness analysis

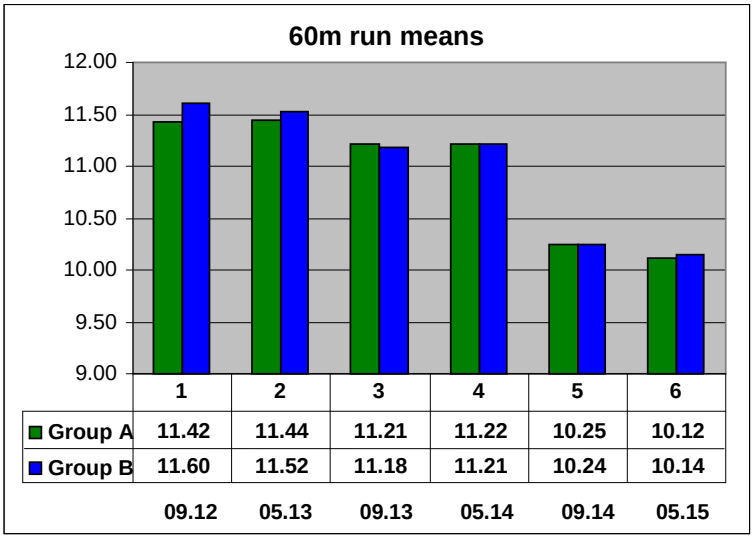
60m run test

Table 4. 60m run results

A - schoolgirls with mild intellectual disabilities N=20, B - control group N=20

Statistical Data	60m run											
	09.2012		05.2013		09.2013		05.2014		09.2014		05.2015	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
Result [min]	10.1	10.1	9.9	9.8	9.7	9.8	9.6	9.7	9.5	9.6	9.5	9.5
Result [max]	14.3	15.1	13.2	13.5	13.1	13.4	12.9	12.7	11.1	11.2	10.8	10.6
$\bar{X}$	11.42	11.60	11.44	11.52	11.21	11.18	11.22	11.21	10.25	10.24	10.12	10.14
S	0.74	0.53	0.84	0.49	0.57	0.84	0.69	0.66	0.76	0.59	0.93	0.78
t°	0.29		0.26		0.20		0.19		0.18		0.15	

p > 0.05 – the difference is statistically significant



Graph 3. 60m run means of the group A and B schoolgirls from 2012 to 2015

Table 4 illustrates the increase in the 60m run mean in September and May of a school year over the course of three years for each of the groups. The results of each group are very similar in every test. The same applies to the increase in the 60m run mean every year.

As in the case of the body height test, the mean results of groups A and B, in tests in particular years, do not differ statistically significantly (t^o>2.00).

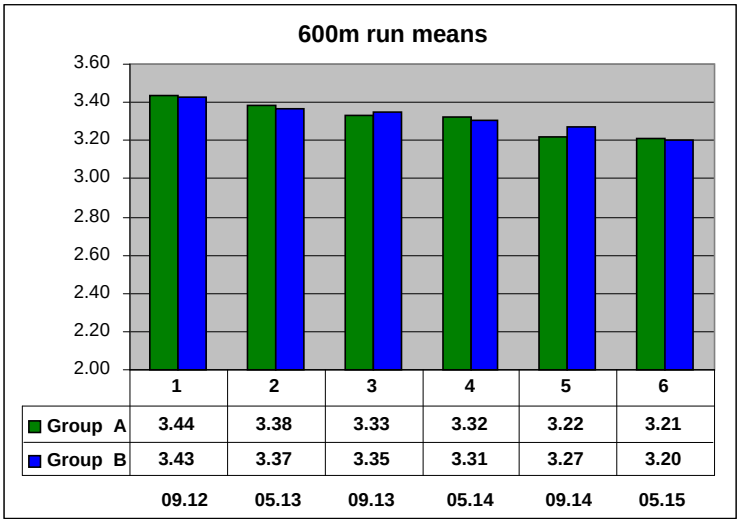
600m run test

Table 5. 600m run results:

A - schoolgirls with mild intellectual disabilities N=20, B - control group N=20

Statistical Data	600m run											
	09.2012		05.2013		09.2013		05.2014		09.2014		05.2015	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
Result [min]	2.59	2.54	2.58	2.51	2.47	2.49	2.41	2.40	2.37	2.35	2.21	2.20
Result [max]	4.15	4.01	4.06	4.02	3.59	3.50	3.58	3.46	3.44	3.45	3.41	3.29
$\bar{X}$	3.44	3.43	3.38	3.37	3.33	3.35	3.32	3.31	3.22	3.27	3.21	3.20
S	1.08	0.96	0.95	0.79	0.93	0.77	1.13	0.97	1.32	1.18	1.23	1.06
t^o	0.33		0.36		0.27		0.26		0.32		0.28	

* p > 0,05 – the difference is statistically significant



Graph 4. The mean 600m run results of the group A and B schoolgirls from 2012 to 2015

As in previous cases, the analysis of the 600m run results in Table 5 allows for the observation that the results in both groups are similar in all tests over the course of three years, and the result means are also very similar. Both groups make progress in results in each test.

The mean results of groups A and B, in tests in particular years, show no statistically significant differences in any phase of the study (t^o>2.00).

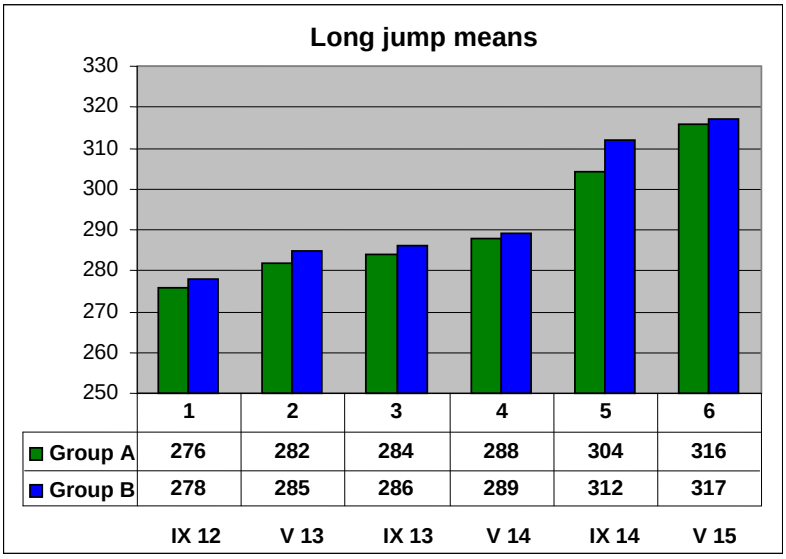
Long jump test

Table 6. Long jump results:

A - schoolgirls with mild intellectual disabilities N=20, B - control group N=20

Statistical data	Long jump											
	09.2012		05.2013		09.2013		05.2014		09.2014		05.2015	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
result [min]	210	256	225	268	234	274	245	278	252	285	255	286
result [max]	313	321	319	323	326	331	331	330	338	336	343	346
$\bar{X}$	276	278	282	285	284	286	288	289	304	312	316	317
S	29.54	27.54	32.64	30.37	31.14	33.32	31.43	33.45	34.58	31.04	32.66	31.12
t^o	0.19		0.29		0.28		0.43		0.41		0.23	

* p > 0,05 – the difference is statistically significant



Graph 5. The mean results of long jump of the group A and B schoolgirls from 2012 to 2015

As in the case of the 600m run, the results in Table 6 clearly show that both groups make progress in each test and year. The results of group B are slightly better in each test, but the mean results of both groups in tests and particular years show, again, no statistically significant differences ($t^o > 2.00$).

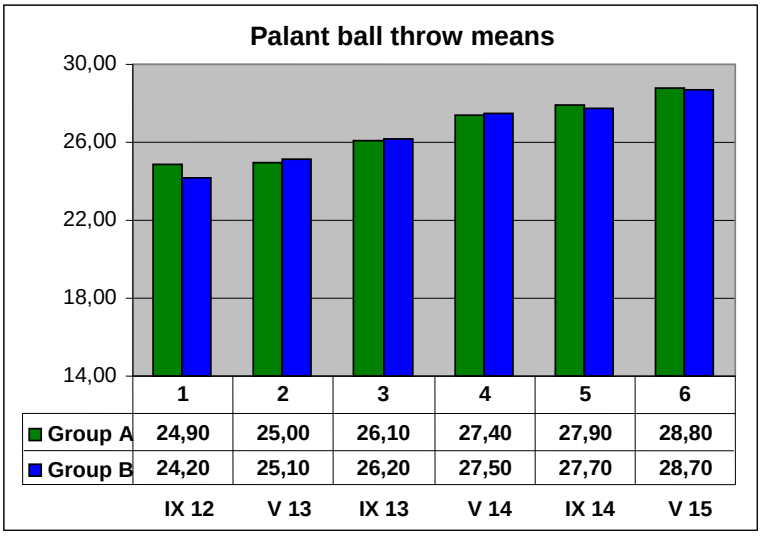
Palant ball throw test

Table 7. Palant ball throw results

A - schoolgirls with mild intellectual disabilities N=20, B - control group N=20

Statistical data	Palant ball throw											
	09.2012		05.2013		09.2013		05.2014		09.2014		05.2015	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
result [min]	16.5	17.2	18.8	18.9	18.4	19.4	20.6	21.1	22.5	23.5	23.2	24.2
result [max]	31.5	30.9	31.5	31.2	32.0	32.8	32.4	32.5	33.7	34.0	34.8	35.5
$\bar{X}$	24.9	24.2	25.0	25.1	26.1	26.2	27.4	27.5	27.9	27.7	28.8	28.7
S	5.56	5.61	5.91	5.42	6.52	5.38	6.15	6.11	6.17	6.37	6.72	6.34
t^o	0.66		0.71		0.65		0.76		0.77		0.46	

* p > 0,05 – the difference is statistically significant



Graph 6. The mean results of palant ball throw of the group A and B schoolgirls from 2012 to 2015

Given the results in Table 7, it is noticeable that the increase in the distance of the palant ball throws is constant throughout the research period in groups A and B. All research results are very similar in both groups.

The mean differences between the groups are not statistically significant in any phase of the study (t^o>2.00).

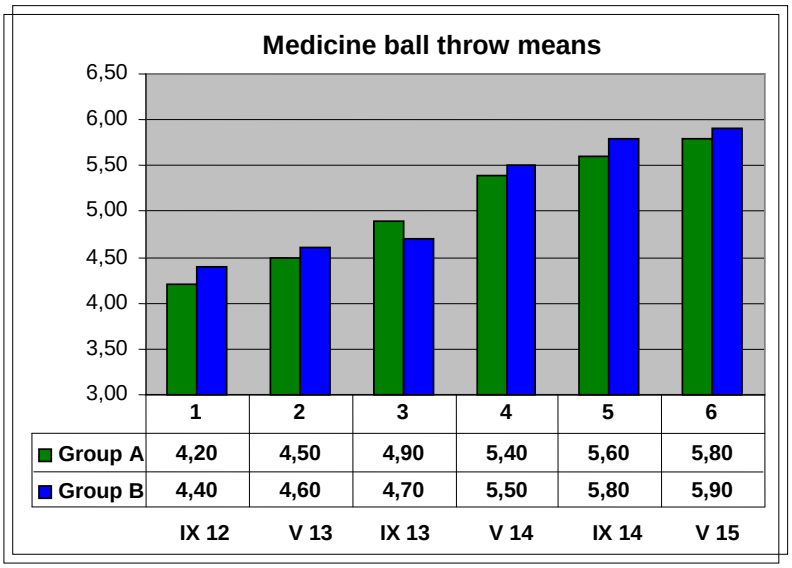
Medicine ball throw test

Table 8. Medicine ball throw results

A - schoolgirls with mild intellectual disabilities N=20, B - control group N=20

Statistical data	Medicine ball throw											
	09.2011		05.2012		09.2012		05.2013		09.2013		05.2014	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
result [min]	2.4	2.2	3.5	3.4	3.8	3.8	3.9	4.0	4.1	4.2	4.3	4.3
result [max]	5.1	5.4	5.3	5.5	5.7	5.9	5.9	6.2	6.3	6.5	6.7	6.8
$\bar{X}$	4.2	4.4	4.5	4.6	4.9	4.7	5.4	5.5	5.6	5.8	5.8	5.9
S	0.91	0.93	0.96	0.83	0.71	0.75	0.77	1.02	1.03	0.89	0.92	1.04
t^o	0.56		0.47		0.76		0.79		0.68		0.57	

* p > 0,05 – the difference is statistically significant



Graph 7. The mean results of medicine ball throw of the group A and B schoolgirls from 2012 to 2015.

The results in Table 8 clearly state that there is a constant increase in results between September 2012 and May 2015 for groups A and B during the whole secondary grammar school education. All mean results achieved by both groups are very similar. Except for September 2013, the results in each test are slightly better in group B.

The medicine ball throw results show that there are no statistically significant differences between the results in groups A and B (t^o>2.00).

Summary

The aim of the paper was to analyse the results of the study carried out over the course of a three years' study of the schoolgirls at Secondary Grammar School no. 3 in Kędzierzyn-Koźle. The study was focused on somatic development and physical fitness.

The research group consisted of schoolgirls with mild intellectual disabilities and able-bodied schoolgirls. The schoolgirls were not

divided into particular groups according to somatic and physical development.

Analysis of the yearly mean increase in body weight and height reveals that there is a constant increase in both in both groups. The differences of the yearly mean increase, both of body weight and height, are not statistically significant in groups A and B.

The BMI clearly indicates that the mean of each group, i.e. group A and group B, has a proper physique according to the obesity classification (WHO). There is a gradual increase in the results in both groups throughout the research period.

Similar conclusions can be drawn from the physical fitness tests. In each physical fitness test, the group A schoolgirls achieve very similar results to the group B schoolgirls, who show no statistical differences.

In the case of the 60m run, both groups achieve very similar results in each test. The mean results of group A and B, in tests in particular years, show no statistically significant differences (t^o>2.00).

By analysing the 600m run tests, it can be noticed that the schoolgirls tested achieve better results in all tests during a school year. The result differences between the groups are not statistically significant.

As far as the long jump test results are concerned, it can be noticed that all groups tested make progress in their results, but also that the results of group B are better than those of group A. However, the mean differences in all tests are not significantly significant.

During the palant ball throw test, as was shown earlier, all results are at a similar level over the course of all years. The mean result differences in group A and B are not statistically significant.

In the last medicine ball throw test, the progress in the results was constant in both groups throughout the whole of secondary grammar school education. All mean results achieved by groups A and B are very similar.

The results of the continuous research conducted from 2012 to 2015 show that the schoolgirls with mild intellectual disabilities achieve similar results to their able-bodied peers. This is reinforced by the fact that there are no statistically significant differences between both groups at a 95% confidence level.

Conclusions

1. There are no statistically significant differences in somatic development (body weight, body height) of the tested schoolgirls with mild intellectual disabilities and their peers with normal intellectual capacity from the control group.
2. None of the five physical fitness tests showed any statistically significant differences between the schoolgirls with mild intellectual disabilities and the schoolgirls with normal intellectual capacity.

The results obtained indicate that there is a possibility of integrating schoolgirls with this type of dysfunction with able-bodied peers during physical education lessons and school sports competitions. A comparative study including team sports would be very important for school practice.

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Correspondence

Justyna Charaśna–Blachucik
Faculty of Physical Education and Physiotherapy at the Opole University of Technology

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THE USE OF NEW TECHNOLOGIES IN DIAGNOSING ASYMMETRY IN MUSCLE ACTIVITY AND MOTOR CONTROL ACTIVITIES BASED ON THE EXAMPLE OF YOUNG HURDLERS

Mariusz Konieczny, Janusz Iskra

Opole University of Technology, Faculty of Physical Education and Physiotherapy

Abstract

Modern technology has created new possibilities for research in the area of regulation and control of movement. The asymmetry of muscle activity and its somatic and functional effects are rarely diagnosed in physical education and the sports activities of children and young people. The authors of this article analyse the problem of asymmetry on the basis of a representative sample of young hurdlers.

Hurdling technique used in 400-m hurdles involves, among others, the necessity of clearing the hurdles with the left and right attacking leg. Differences between the two variants are mainly demonstrated based on analysis of kinematic movement structure focusing on movement of lower limbs.

In this paper, the authors present differences in upper limb movement at the moment of clearing the hurdle in different forms of training.

The application of EMG (electromyography) with image sequence visualisation and registration system was used to analyse the 400 m hurdling technique of eight hurdlers. The hurdlers were first-class and champion-class hurdlers. The electromyograms concerned the work of 5 muscles of the upper limbs, symmetrically on both sides of the body (deltoideus, pectoralis major, biceps brachii, triceps brachii, latissimus dorsi). The analysis concerned three forms of hurdle training related to hurdle clearance first with the right and next with the left leg in three intensities: marching, trotting, and running at maximum speed. Muscle work on the right side of the body was analysed when clearing the hurdle with the left lower limb, and vice versa. All examined hurdlers used the left attacking leg better (regarding the specificity of 400-m hurdling).

The analysis showed significant differences ($p \geq 0.05$) in muscle work of the upper limbs between the right and left side of the body in respective forms of hurdle training. The right upper extremity muscle activity of three repetitions showed high correlation ($r=0.89$) for each performed movement form. Such relationships were not found on the left side of the body when attacking the hurdle with the right leg.

Although asymmetry is inevitable in the process of lateralization of the human body, teachers at the primary stage of education should make every effort to alleviate disorders of muscle activity and dysfunction of the skeletal system. This is particularly significant in the disciplines in which it is possible to use symmetrical exercises, as a stimulus for relaxation and to avoid monotony when training children and adolescents.

Key words: *diagnosing, activity muscle.*

Introduction

Recent development of modern technologies has led to new opportunities for studying regulation and control of movement. Widespread introduction of surface electromyography, in particular the telemetry application, enables precise assessment of teaching and perfecting the technique in the majority of sports disciplines (Snarr and Esco, 2013; Lim et al., 2014).

Teaching hurdling techniques increasingly requires the use of many innovative methods, replacement equipment, and research into new elements that might improve results. Apart from innovations in teaching and training, different solutions of analysing the technique are increasingly looked for. This is done through

analysing a sequence of frames of hurdling during competitions, but also in modern research laboratories where the structure of movement is accurately determined at the moment of clearing the hurdle (Li et al., 2011; Iskra and Coh, 2011; Balsalobre-Fernandez, 2013). Hurdling is a sport engaging asymmetrical movements of the upper and lower extremities; however, the movements alternate so they should be symmetrical reflections of one another. An additional difficulty is the necessity of being able to clear the hurdle with the right and left attacking leg (Iskra and Čoh, 2011).

The lateralisation process is regarded as one of the aspects of motor development manifesting, to a greater or lesser extent, as functional asymmetry. The majority of conducted studies have determined a degree of differentiation between organs such as: eyes, ears, hands, and legs as regards the frequency and precision of their movement. Specialists' opinions on the shaping of functional asymmetry can be divided into two groups. Some of them support endogenous factors, seeking lateralisation's etiology in differences between cerebral hemispheres, conditions of foetal development, and the asymmetrical arrangement of internal organs (Castiello and Stelmach, 1993; Annett, 1999). Babu and Roy (2013) indicate that asymmetrical structure of the human body is already visible in about the sixth week of prenatal life and this determines certain postural patterns. The second group of researchers, explaining lateralisation in terms of exogenous factors, is convinced that environmental factors resulting from everyday work and social upraising or from social pressure can be fundamental determinants of this phenomenon (Dirn-berger, 2012; Stöckel and Weigelt, 2012). Ballanger and Boulinguez (2009) have tried to explain lateralisation using surface electromyography on the basis that EMG offers a key tool enabling an explanation of the relationship between the laterality of upper extremities and interactions between cerebral hemispheres.

The electromyogram and the EMG video recording as well as many biomechanical methods aid the analysis of differences in asymmetry; moreover, they correlate with the description of errors in technically complex sports (Illyés and Kiss, 2005; Mastalerz et al., 2012). 400-m hurdling is such a technically complex sport and individual hurdlers' technique is rarely analysed.

Material and Methods

Participants

The analysis included 4 male and 4 female hurdlers with a minimum of five-years training in 400-m hurdling, representing the academic club AZS Politechnika Opolska. The hurdlers have all achieved successes at national level: seven of them were first-class hurdlers and one a champion-class hurdler. On average, the men were 23.30±1.47 years old, their average body weight was 72±4.47 kg, while the average body height was 176.63±3.69 cm. Whereas, women were 22.30±1.55years old, on average, while their average body weight was 58.25±3.03 kg, and the average body height was 168.50±3.35 cm.

Procedures

The hurdlers performed three elements of hurdling training related to clearing the hurdle with a set rhythm of steps and set distances between hurdlers. In the first element (marked I), they marched between hurdles arranged every 150 cm. In the second analysed element (marked II), they trotted at moderate pace between hurdles arranged every 500 cm. In the third element (marked III), they performed the exercise running, and hurdles were arranged every 700 cm. The above exercises (elements) complied with the rules of teaching and training 400-m hurdling (Iskra and Čoh 2006; Adashevskiy et al., 2014; Przednowek et al., 2014). The participants performed the task with three hurdles arranged in a row with the measurement taken at the middle hurdle. In each element (I, II, III), they performed three trials attacking the hurdle starting from the left, dominant leg, and then three trials with the right, alternate leg. In total, each hurdler performed 18 trials (9 for the left leg and 9 for the right leg).

The testing tool was the 16-channel EMG manufactured by NORAXON DTS, registering muscle activity in training with a sampling rate of 1500 Hz. Ten electrodes were placed in accordance to the SENIAM methodology - between the movement spot and the tendons' attachments along the long muscle's midline.

The video material was registered using the high-frequency Point Grey Gazelle camera and the CRI VIST synchronizer. Monochromatic imaging was registered using StreamPix 5 software, with 2048 x 1088 pixel resolution and 250 frames per second speed.

The analysis concerned recordings of five muscles working on both sides of the body (deltoideus, biceps brachii, triceps brachii, pectoralis major, latissimudorsi). The muscle work on the left side of the body was analysed when when attacking the hurdle with the right leg. Next, the participant changed the attacking leg and the upper extremity of the opposite side of the body was analysed. Such arrangement of the analysis (right leg - left hand) results from the natural movement in learning the hurdle clearing technique. Measuring was started when the trailing leg took off the ground and ended when the attacking leg's heel passed the barrier (Fig. 1).

According to the guidelines of the SENIAM project, the NORAXON MR-XP 1.07 Master Edition software was used to process and analyse EMG signals. In surface EMG recordings, the exercise duration was standardised to 100%. The sampling rate was 1000 Hz. The root mean square (RMS) values of EMG signals were calculated for consecutive segments of 50 ms. The average was calculated for signal durations between the start and end of recordings, that is start [1] - stop [2] (Fig. 1). Calculating the average for all the participants might seem an over simplification due to significant individual muscle activity amplitudes, while not using any standardisation might result in little deviations of the values - [mV] shows the average value in individual recordings. Moreover, pilot studies proved a statistically significant correlation between repetitions of each trial. As no logical differences were found between the surface EMG recordings for the examined male and female hurdlers, all of the results were analysed cumulatively. Other authors (Kielnar et al., 2012; Stöckel and Weigelt, 2012) also did not find differences between sexes, despite examining a large group of people.

Purpose of Research

Presenting muscle activity values was not the aim of this research. It aimed at finding a correlation between repeated trials in a certain element of training and the significance of differences between upper extremities in hurdles clearing the hurdle with the left and right leg.

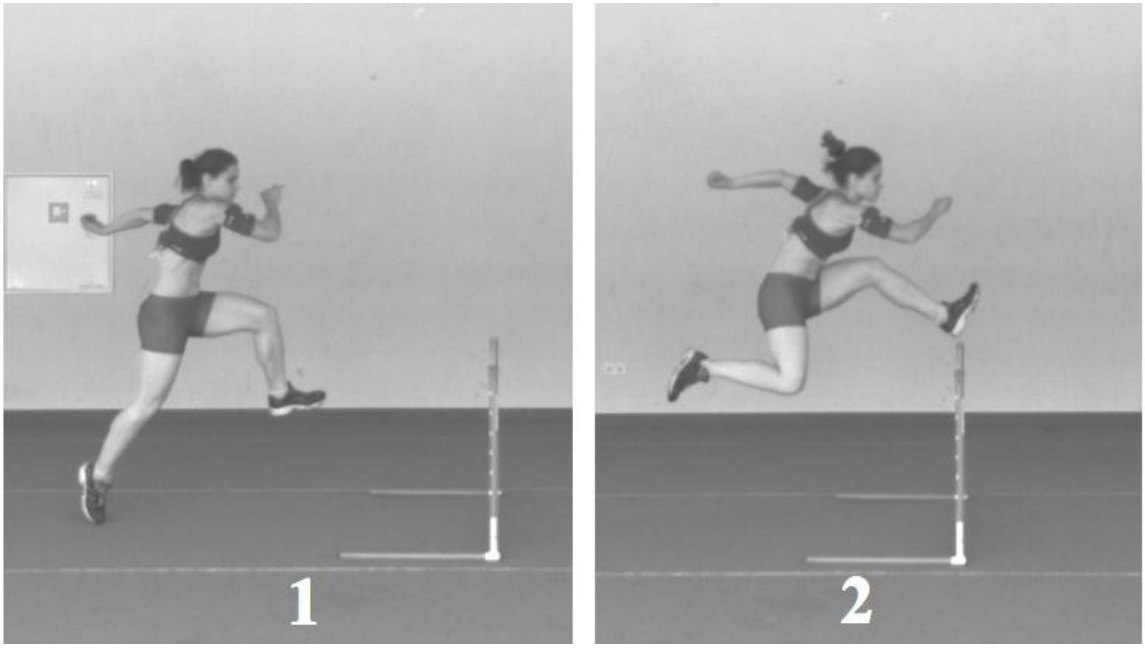

Fig.1. High-frequency camera image: [1] - recording start moment, [2] - recording end moment

Statistical Analysis

Statistical analysis was conducted using the Statistica 12 software (StatSoft). The Spearman's rank correlation coefficient was used to calculate correlation between three trials of each performed movement form (I, II, III). In order to determine the significance of differences between EMG recordings of muscle work of the left and right side of the body, the Wilcoxon signed-rank test was used. Descriptive statistics of the Statistica 12 software (StatSoft) were used to calculate somatic structure parameters.

Results

Regarding the muscle work on the right side of the body, the Spearman's rank correlation coefficient showed high correlation at $p \leq 0.05$ between three individual trials of each described element (I, II, III). The lowest correlation coefficient was shown for the element III in which the movement was the most similar to the natural hurdling. Figs. 2-3 present these correlations in graphs.

Muscle work on the left side of the body (right attacking leg) showed sparse and low correlations only in element I - movement performed when marching. With regard to the remaining movement forms, no correlation between the subsequent three trials were found. Graphical analysis of individual movement elements are presented in fig. 2.

Analysis of statistical differences between the right and left side of the body in individual movement elements (I, II, III) revealed significant differences only in elements I and II (Fig. 3). The analysis indicated that muscle activity of the right side of the body has more symmetrical pattern than the left side's muscle activity. Results concerning average muscle activity values [mV] of the selected hurdler and the entire group are shown in tabs. 1 and 2.

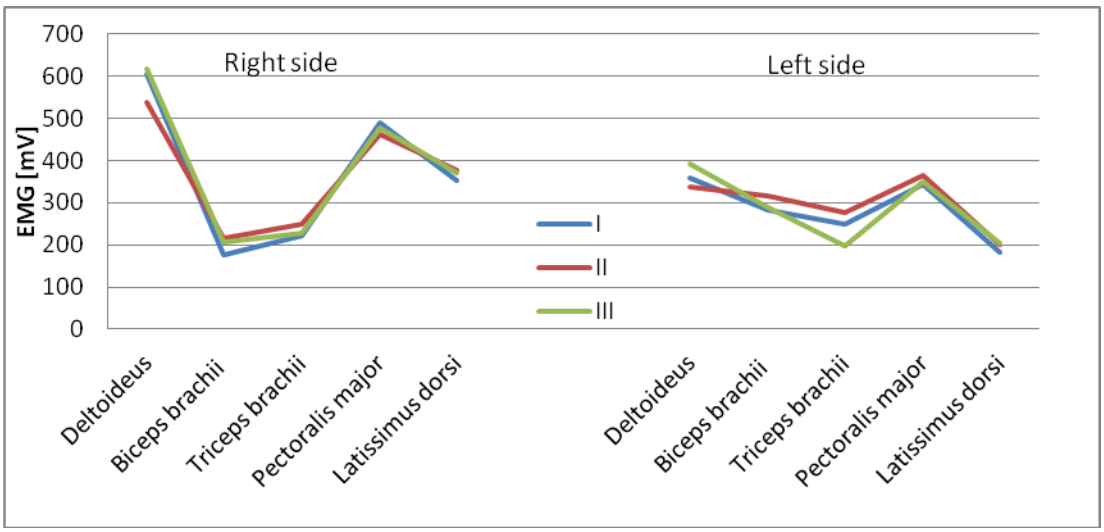

Fig. 2. Differences between EMG recordings of the right and left side of the body in individual movement schemes (I - marching, II - trotting, III - running)

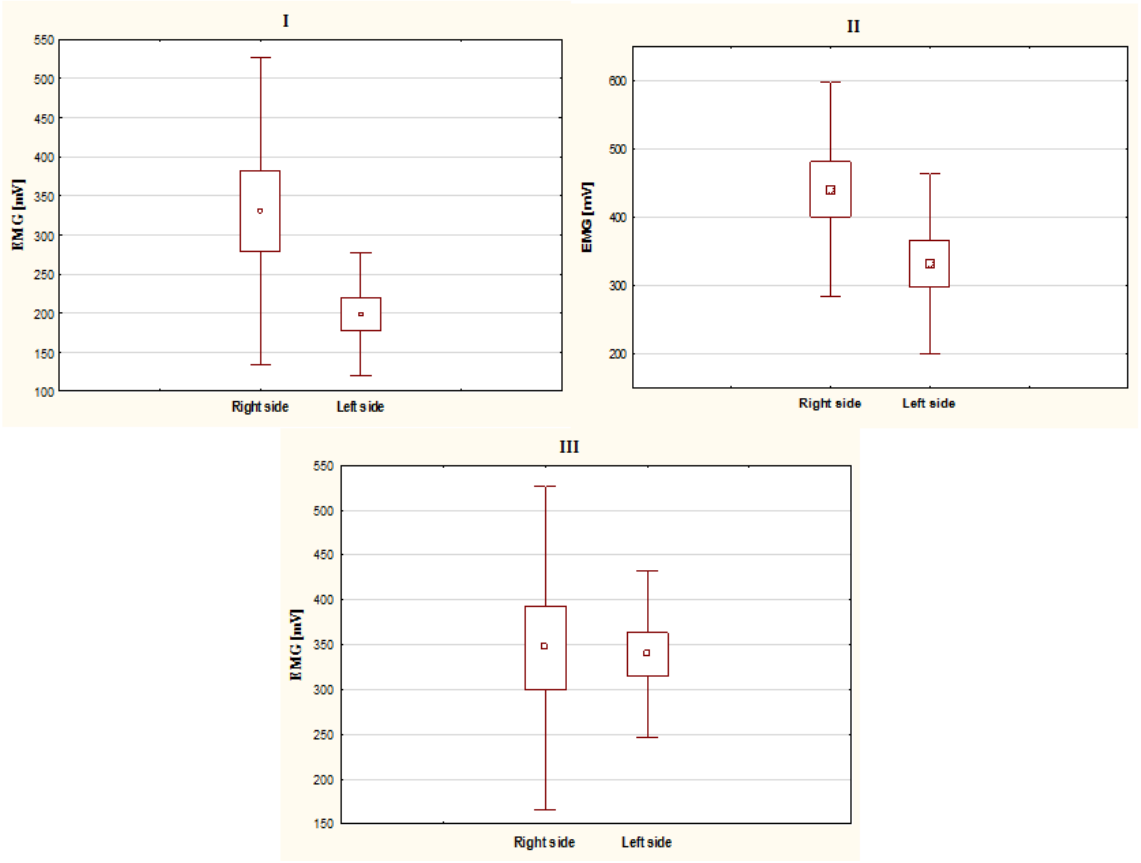

Fig. 3. Wilcoxon signed-rank test results regarding muscle activities of all the tested muscles on the right and left sides of the body in individual movement schemes (I - marching, II - trotting, III - running)

Table 1. Average values for individual muscles of all examined hurdlers in three trials of individual movement schemes [mV]

		Right side					Left side				
		Deltoideus	Biceps brachii	Triceps brachii	Pectoralis major	Latissimus dorsi	Deltoideus	Biceps brachii	Triceps brachii	Pectoralis major	Latissimus dorsi
I	I test	490	117	123	572	285	238	250	165	236	144
	II test	382	124	150	625	384	302	111	99	308	179
	III test	531	89	152	597	333	274	162	97	301	110
II	I test	548	204	297	609	499	323	250	318	489	165
	II test	651	262	327	568	442	337	369	342	562	146
	III test	634	270	253	564	474	434	324	223	535	162
III	I test	774	205	248	292	274	515	350	264	307	239
	II test	583	263	266	192	301	376	464	390	226	280
	III test	691	257	279	266	304	471	377	276	217	335

I - march, II - trot, III - run

Table 2. Average values for individual muscles of the selected hurdler examined in three trials of respective movement schemes [mV]

		Right side					Left side				
		Deltoideus	Biceps brachii	Triceps brachii	Pectoralis major	Latissimus dorsi	Deltoideus	Biceps brachii	Triceps brachii	Pectoralis major	Latissimus dorsi
I	I test	338	78	33	55	105	265	37	15	77	20
	II test	277	58	30	42	79	266	22	13	76	36
	III test	407	70	45	50	91	460	38	15	105	23
II	I test	338	78	33	55	105	265	37	15	77	20
	II test	277	58	30	42	79	266	22	13	76	36
	III test	407	70	45	50	91	460	38	15	105	23
III	I test	565	208	238	45	380	984	611	132	73	186
	II test	648	264	395	40	269	612	1075	394	71	273
	III test	607	236	317	43	324	798	843	263	72	230

I - march, II - trot, III - run

Discussion

Currently, researchers debate whether it is even reasonable to carry out studies on functional asymmetry considering the fact that the scientific world is already aware of the existence of morphological asymmetry of the human body (Niedzielski et. al., 2014). However, the dispute over how the functional asymmetry is shaped has not been settled nor proven yet. Thus, choosing the issue of significant differences in functional asymmetry of the presented complex athletic discipline seems justified. Literature reports a considerable number of studies analysing comparisons of muscle work techniques on the left and right sides of the body in sports activities. This type of studies includes not only individual sports but also team sports and shows significance of asymmetry in the training process and its influence on the playing technique (Parkin et al., 2001; Carpes et al., 2010; Diederichsen et al., 2007; Pakosz et al. 2014).

Studies examining a group of professional and amateur cyclists conducted by Carpes et al. (2010) present muscle activity and differences in asymmetry of surface EMG recordings of lower extremities' movement. In their conclusions, the authors emphasise that differences in muscle work asymmetry in cycling depends on the effort intensity level. Mastalerz et al. (2012), examining lower extremities' fatigue in runners underlines significant differences in fatigue percentage values between the right and left extremity. Studies of Ball and Scurr (2009) compared the relation between asymmetric work of the same muscles during drop jumps from a height of 40 cm. The authors noted statistically significant differences in surface electromyograms between the right and left extremities but only in the drop phase. Konieczny (2014) has shown application of EMG in determining the extent of muscle work asymmetry while throwing a ball with dominant and alternate extremities. Pakosz et al. (2014) while analysing the results of six examined ballers noted that voltages generated by the same muscle of dominant and alternate leg significantly differed as regards the muscle biceps femoris in the value of the EMG signal. Differentiation of the EMG activity concerning shoulder girdle asymmetry were also shown in the studies of Diederichsen et al. (2007). The authors analysed eight muscles of the shoulder girdle in twenty men practising sports during abduction and external rotation of both upper extremities. The results showed significant differences between dominant and alternate extremity, while the size of differences and dominance of a certain side to a large extent depended on the type of performed movement.

However, the authors of this work have not found studies concerning the analysis of upper extremities' muscle activity in hurdlers specialising in a distance of 400 m so it is not possible to compare the results of previously conducted studies. Sprint running is the sport most similar to hurdling; however, so far, EMG analysis of sprint disciplines have been limited to analysing lower extremities' muscle work (Alończyk et al., 2007; Coh et al., 2009). Low start was regarded as the most asymmetric movement structure performed during sprint running. In this type of studies, Wiemann and Tidow (1995), Rand and Ohtsuki (2000) determined the reaction time of individual muscles in certain running phases. The authors also showed differences in muscle activity between extremities.

In the case of hurdling, no studies included the bioelectrical signal created by muscles during running or during hurdle clearance. This was probably caused by the necessity of conducting complicated analysis in a highly dynamic movement form. The probable reason for that is the fact that hurdling is at the same time an asymmetric and acyclic activity. In a paper by Iskra and Coh (2006) hurdling was named a cyclic-acyclic discipline where individual rhythm units, i.e. parts connecting the cleared hurdles and the run to the next obstacle are cyclic. In the case of 400-m hurdling, the situation is more complicated as every next hurdle can be attacked with the right or the left leg. That is why a higher number of studies and analyses of upper and lower extremities during hurdle clearance are worth conducting. Several of the above-mentioned authors have focused their studies on biomechanical analysis of this issue while omitting the muscular apparatus driving this entire system. The conducted studies indicate considerable significant differences in bioelectrical signals generated by muscles and their repetition during hurdle clearance.

Conclusion

Although asymmetry is inevitable in the process of lateralization of the human body, teachers at the primary stage of education should make every effort to alleviate disorders of muscle activity and dysfunction of the skeletal system. This is particularly significant in the disciplines in which it is possible to use symmetrical exercises, as a stimulus to relaxation and avoiding monotony when training children and adolescents.

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Correspondence

Mariusz Konieczny
Opole University of Technology, Faculty of Physical Education and Physiotherapy
Prószkowska 76/9A, 45-758 Opole
E-mail: m.konieczny@po.opole.pl

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