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OBSAH

DESCRIPTION OF LOADS IN AN ANNUAL TRAINING CYCLE OF YOUNG FOOTBALL PLAYERS

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Submitted in May, 2003

The problem of training loads is still an area open for scientific penetration having direct practical implications. At the present stage of knowledge about training loads it becomes possible to rationally distribute training measures to adjust them to the adequate level of a sports group and the specificity of a given sport, as well as to modify the size of loads in consecutive stages of training so that they have a stimulating quality. This should lead to the development of model values of training loads in various sports. The problem of loading in sports games is more difficult to solve than in individual sport, since the performance of a team is the combined effort of many individuals. The aim of this study is to carry out a qualitative and quantitative analysis of training loads effected in an annual training cycle of young football players. The study was carried out among a group of 24 football players of Wielkopolski klub Piłkarski "Lech" (Wiełkopolska Football Club) aged 14–15.

Training loads were registered according to the methodology proposed by Sozański and co-authors, taking into account the identificatin of efforts in terms of type of performed exercises and their intensity. The process of training of the analysed team is characterised by the prevalence of special measures carried out in the third scope of intensity with some use of directed measures. The structure of training loads of the Lech Poznań under-15s in an annual training cycle (40 % – comprehensive and directed loads and 60 % special loads) is a proposition for a model solution to the problem of training loads in a group of young football players.

Keywords: Football, training loads, scopes of intensity.

INTRODUCTION

Irrespective of earlier cognitive achievements, the problem of training loads is still an area open for scientific penetration having direct practical implications. On this basis the concepts of training loads and their components are being improved more and more, which allows for departing from the somewhat obsolete approach to the problem of global loading in sport, understood either as load size (in the sense of the number of repetitions, distance covered, weight lifted) or only as intensity of exercise for a load perceived in both dimensions at the same time. A formula for its measurement, registration and means of analysis has been developed (Sozański & Śledziewski, 1995). At the present stage of knowledge about training loads it becomes possible to rationally distribute training measures to adjust them to the adequate level of a sports group and the specificity of a given sport, as well as to modify the size of loads at consecutive stages of training so that they have a stimulating quality. This should lead to the development of model values of training loads in various sports, where its basis should be the scope of maximal load in a match (Skrobański & Wieczorek, 1977). In this respect the problem of loading in sports games is more difficult to solve than in individual sports, since the performance of a team is the combined effort of many individuals. Thus certain methodological difficulties appear. In football the problem of training load is also still open. Two basic problems still need solutions, namely: the size of training loads in various phases of the training macrocycle of fully developed football players and the rationalisation of the training loads placed upon young players taking into consideration the requirements of training stages and accounting for their individual development.

The aim of this study, referring to the latter problem, is to carry out a qualitative and quantitative analysis of training loads effected in an annual training cycle of young football players.

MATERIAL AND METHODS

A group of 24 football players of Wielkopolski Klub Piłkarski "Lech" (Wielkopolska Football Club) aged 14–15, with an average training history of 5.3 years provided us with the material we needed for our research. The object of the analysis was the training macrocycle from 1.08.1998 to 23.06.1999 including two half-yearly training cycles (autumn and spring). During this time the team won the Polish edition of the world's largest

under-15s club tournament – Nike International Premier Cup, and then represented Poland in the middle-European edition played in Budapest in May 1999.

Training loads were registered according to the methodology proposed by Sozański and co-authors (1995), taking into account the identification of efforts in terms of type of performed exercises (the so called information area) and their intensity (the so called energetic area). In the information area there are comprehensive, directed, and special exercises. Each of them is based on so called means of effect, which are groups of exercises adequate for them. Training units were coded according to the register of groups of training measures in football (Zieliński & Śliwka, 1996), which is presented below in a simplified version. Comprehensive loads (W) are exercises which harmoniously develop the muscles, strengthen the body, improve the functioning of organs, and develop the motor potential of an athlete. They include the means of training effect according to the following codes: 1 – general warm-up, 2 – calming exercises, 3 – various forms of continuous run, 4 – general development exercises affecting several motor properties, 5 – tempo runs, 6 – fitness exercises in the form of games and plays, 7 – co-ordination exercises, 8 – suppleness exercises, 9 – complementary sports, 10 – exercises developing the general strength of large muscle groups, 11 – exercises of the dynamic strength of smaller muscle groups, 12 – exercises of strength endurance under difficult conditions. Directed loads (U) are exercises used to develop the intentionally profiled potential of skills characteristic for a given sport. They refer to means of effect according to the following codes: 13 – speed exercises, 14 – exercises of speed endurance, and 15 – exercises of jumping ability. Special loading (S) is achieved via exercises which develop a specific group of functional, fitness and motor properties adequate to a given sport. They include means of effect coded as: 16 – specialist warm-up, 17 – the technique of teaching exercises, 18 – the technique of mastering exercises, 19 – technical and tactical exercises, 20 – small games, 21 – tactical exercises in the form of simplified games and school games, 22 – control and master games, 23 – tests.

The energetic area includes the following loads: T_1 – supporting loads (exercises performed with a low or very low intensity, characterised by a heart rate of up to 130–140 beats/min after work); T_2 – aerobic loads (exercises performed at a moderate and high intensity with a direct heart rate of 160–180 beats/min after work, with the duration of the exercise lasting for above 5 minutes and even up to three and more hours of continuous work); T_3 – mixed aerobic and anaerobic loads (exercises performed at a high and submaximal intensity, heart rate directly after the effort over 180 beats/min and the duration of a series up to 5 minutes); T_4 – anaerobic lactic loads (exercises of a submaximal

TABLE 1
Global breakdown of training loads of under-15s "Lech" Poznań in an annual training

ENERGETIC AREA / INFORMATION AREA	SUPPORTING LOADS	EFFECTING LOADS					Σ1...5
		AEROBIC	MIXED	ANAEROBIC LACTIC LOADS	ANAEROBIC ALACTIC LOADS	ANABOLIC	
	SCOPES OF INTENSITY						
	1.	2.	3.	4.	5.	/6./	
W	1 2 6.1 8.3 6:47:30	3 7.1 4.1 8.1 5.1 9.1 6.2 23.1 36:02:17	4.2 8.2 5.2 9.2 6.3 10.3 7.2 11.3 21:06:51	4.3 11.2 6.4 5.3 12.1 7.3 23.3 10.2 3.3 0:31:27	10.1 6.5 11.1 12.2 23.2 0:29:59	10 11 12 0:53:25	64h 58m 04s
U				14.1 14.2 15.1 0:11:16	13.1 13.2 13.3 15.2 23.4 1:05:00		1h 16m 16s
S	17 19.1 23.5 10:02:00	16 18.1 19.2 20.1 16.1 18:53:00	18.2 16.2 19.3 20.2 21 22 23.6 67:08:28	18.3 19.4 20.3 16.3 1:25:50	18.4 19.5 0:30:45		98h 00m 03s
Σ W, U, S	16:49:30	54:55:17	88:15:19	2:08:33	2:05:44	0:53:25	164h 14m 23s

and close to maximal intensity, heart rate after work above 190 beats/min and duration of effort from 20 s to 2 minutes); T_5 – anaerobic alactic loads (exercises performed with the maximal and close to maximal intensity, and the duration of effort should not exceed 20 s of work); T_6 – exercises developing muscular strength (separated for methodological reasons).

Some of the used means from the information area may also be used in a few energetic areas and in this case coding has the form of 18.1, 18.2, 18.3 etc.

The collected data were worked on with the use of a TreOb 4 computer programme which was developed in the Department of Theory of Sport at the Academy of Physical Education in Warsaw.

RESULTS

Analysis of training loads

1. Total training load

The analysis of the data included in TABLE 1 allows for our conclusion that in the training macrocycle the team worked for 164 h 14 min 23 s, carrying out 165 training units (including matches). In the information area (TABLE 1) specialist loads (S) 98 h 03 s had the largest share and accounted for 59.67 %. Comprehensive means (W) included 64 h 58 min 04 s (39.56 %), and directed means (U) only 1 h 16 min 16 s (0.77 %). The ratio of W and U to S was 2:3. In the structure of loads by intensity of efforts (Fig. 1) loads in the 3rd and 2nd scope prevailed (T_3 – 53.74 %, T_2 – 33.44 %), followed by loads in the 1st, 4th and 5th scope (T_1 – 10.24 %, T_4 – 1.30 %, T_5 – 1.28 %).

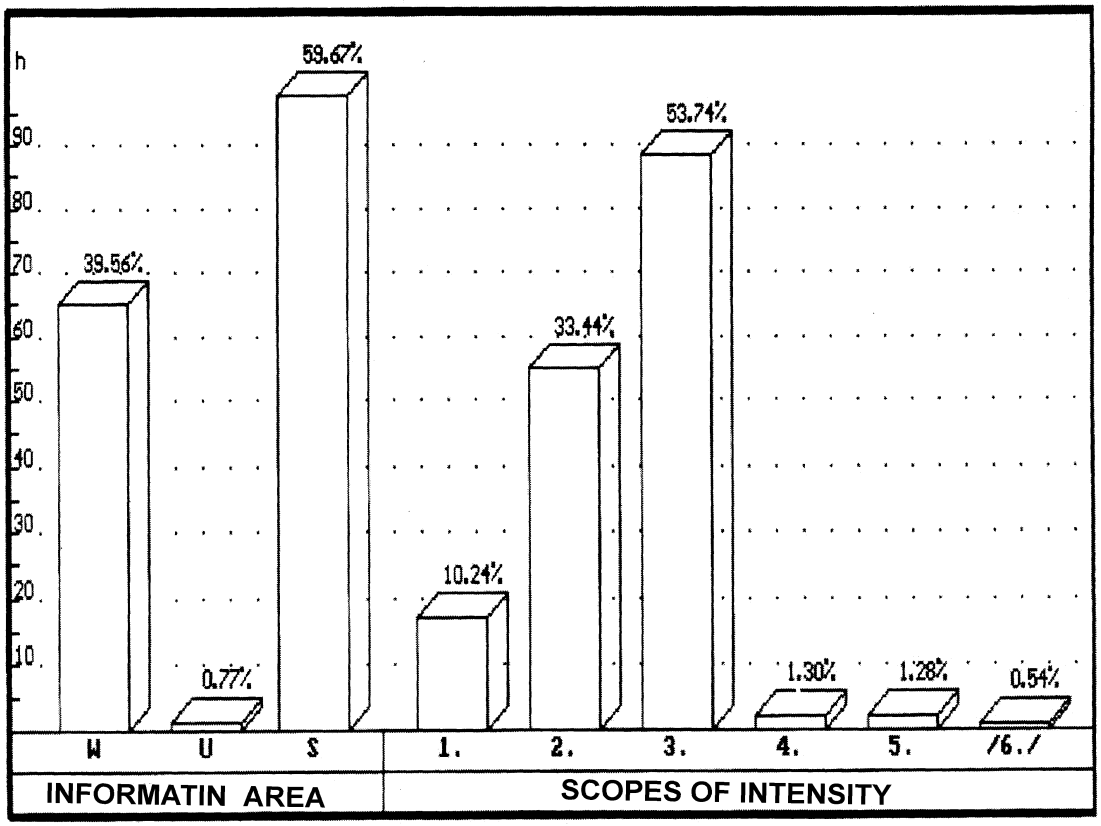
Macrocycle

Considering the share of individual energetic groups in information areas (Fig. 2) it should be stated that special preparation took place mainly at the 3rd and 2nd scope of intensity, and then consecutively in the 1st, 4th and 5th scope. In comprehensive preparation most work was performed in the 2nd, 3rd and 1st scope. A directed load was used only in the 5th and 4th scope of intensity.

1. Analysis of selection of training content (Fig. 3)

The most frequently used means of comprehensive preparation were general development warm-ups, various forms of continuous run, motor co-ordination and agility exercises, suppleness exercises, including stretching, games and plays, low intensity complementary sports. Apart from aerobic endurance, an important training element in the area of comprehensive preparation to which special attention was paid was motor co-ordination. A number of solutions applied to Ajax

Fig. 1
Structure of training loads (information and energetic areas) in an annual training cycle of under-15s WKP "Lech"



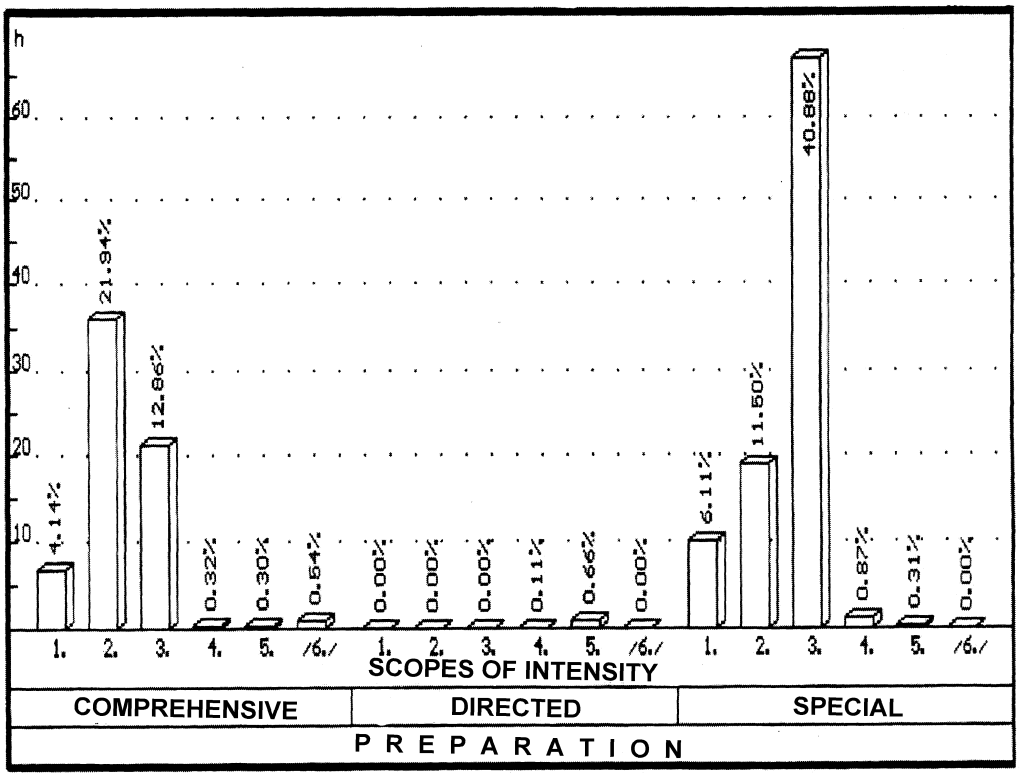
Amsterdam (a club with great traditions of youth training) were used. To a smaller extent general strength was developed, and some elements aimed to strengthen the trunk, arms, legs and abdominal muscles (exercises to overcome the resistance of one's own body and a teammate's body, elements of dynamic strength, exercises with the use of light medicine balls). In directed preparations anaerobic-alactic effort prevailed (speed and jumping ability exercises). Special emphasis was put on developing start speed and maximum acceleration to 20 m. The following were used: starts from various positions, starts after an additional exercise, "flying starts", runs with acceleration and loss of speed, combinations of various types of runs. Jumping ability exercises were woven into general development warm-ups, exercise circuits, and jumping ability games. In specialist preparation the main emphasis was on proper play and mastering and teaching technical skills. Forming technical skills in relation with motor co-ordination was treated as a primary task and it was present almost in all microcycles of the season. The priorities of the training were those elements which determine the modern style of playing: a variety of ball shots, receiving with a dummy, pass without receiving the ball, ability to play one-on-one (in attack and in defence), a range of dummies, dribbling, and constructive receiving of the ball. Also tactical exercises used in the form of simplified and auxiliary games had a distinct share. Simple tactical assumptions were confirmed by them – typical at this stage of training, and the so called applied technique was mastered (the ability to freely control the ball in a limited area in direct contact with an active opponent).

Theoretical preparation was carried out mainly during participation in distant training camps and included: showing training films, lectures on tactics of the game (current systems of play, tasks and responsibilities of players in individual positions and their co-operation in attack and defence), and discussions about hygiene and proper nutrition.

DISCUSSION

Drawing up of annual training plans (taking into account the size and character of the training loads used) involves specifying the level of difficulty, since so far no model values for individual stages of sports training have been developed. The recent attempt at unification of youth football training does not fully solve the problem. Also, there are large discrepancies between current theoretical views on the structure of training loads, applied particularly in youth categories. The views on the structure of loads, taking into consideration the intensity of exercise, are basically similar. Youth training should be consistent with the rhythm of biological and mental

Fig. 2
The structure of training loads of the team with joint consideration of the type of training and zones of intensity



development, adjusted to the current training status (Kapera & Śledziewski, 1997; Raczek, 1991; Sozański, 1994). Loads (both their capacity and intensity) should increase gradually in accordance with the requirements of consecutive stages of long-term training while maintaining proper care in the use of anaerobic measures. There are, however, basic differences concerning the information area of loads used.

The literature indicates that comprehensive and directed preparation is a load of from 25 % (Talaga, 1997) to even 80 % (Płatonow & Sozański, 1991) of the total load. Practical observations (Zieliński, 1997; Szwarc, 2002; Śledziewski, 1994) indicate that irrespective of the sports level of the footballers, specialist measures utilised at the third scope of intensity of exercise, so called mixed efforts, prevail in the training. This trend was also confirmed by studies of the team of the "Lech" Poznań under-15s.

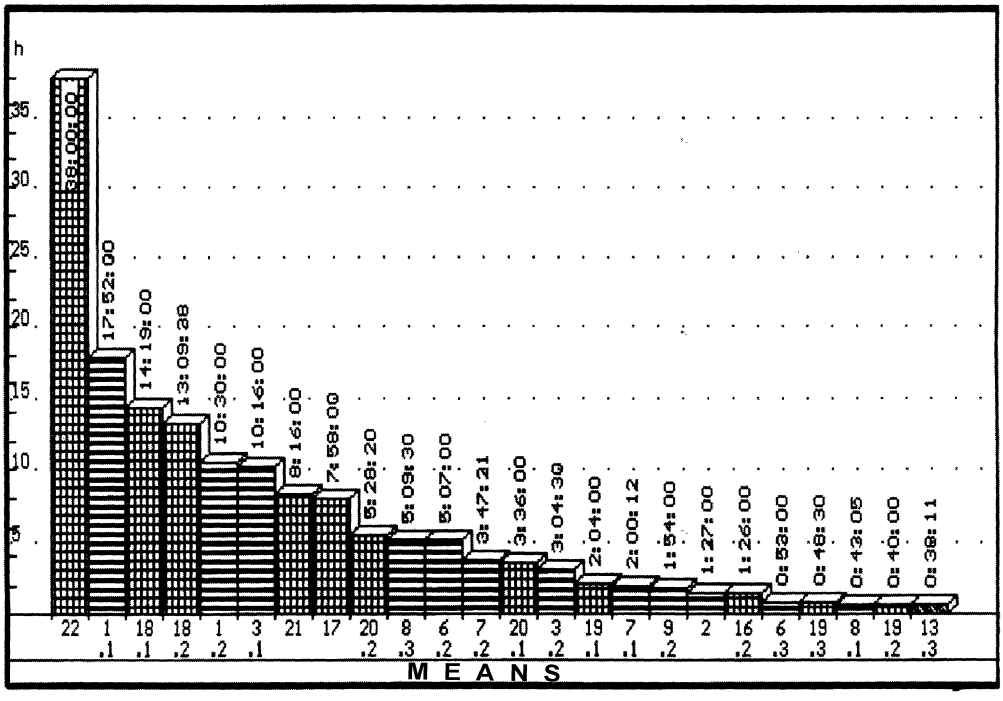
The reason for this is partly the adopted classification of training measures which includes teaching and mastering technical skills in the total pool of special loads, and perhaps partly these measures should be included in directed exercises. Defining these measures is waiting for a final solution. Also the number of played matches affects, to a large extent, the general picture of the training load structure. In the case of the discussed team, proper play accounted for 35 % of special loads in the information area and 39 % of loads of the T_3 scope in the energetic area. A similar structure of training loads was observed by Śledziewski et al. (1999) in the15-year old players of SEMPA Warszawa.

According to Śledziewski (1994) the large share of specialist preparation in the general balance of used loads reflects the specificity and technical and tactical requirements of the sport. Śledziewski (1994), supported by Przybylski (1997), considers the structure of loads, including approximately 50 % of special preparation measures, as the proper approach to this problem. Comprehensive preparation should reach about 30–40 % of the total load.

The quantitative structure of loads of the "Lech" Poznań team in an annual training cycle i.e. 40 % – – comprehensive and directed loads, and 60 % – specialist loads, does not differ from the data gathered by other authors and seems to be a justified compromise resulting from theoretical premises, requirements of the sport and organisational possibilities.

This study shows the scope and type of training loads in a certain strictly defined period of the training of boys playing football. It indicates the need to base the training more on lower scopes of intensity and to increase the percentage share of so called directed exercises. The studies seem to indicate that the training process in football is subject to modifications aiming to quickly achieve high effects of training, which, however, from the point of view of an individual full development of a player does not have to be a beneficial operation.

Fig. 3
Percentage use of individual groups of training means in the studied team



CONCLUSIONS

1. The process of training of the analysed team has been characterised by the prevalence of special measures carried out at the third scope of intensity with some use of directed measures. This is in compliance with a more general trend confirmed by studies on almost all stages of football training, however it is highly debatable.
2. The structure of training loads of the Lech Poznań under-15s in an annual training cycle (40 % – comprehensive and directed loads and 60 % special loads) is a proposition of a model solution of the problem of training loads in a group of young football players.
3. It seems necessary to develop a consistent system of registration and analysis, and then control of training loads which will make it possible to isolate model values in the information and energetic areas at individual stages of football training.

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POPIS TRÉNINKOVÉ ZÁTĚŽE V ROČNÍM TRÉNINKOVÉM CYKLU MLADÝCH HRÁČŮ FOTBALU

(Souhrn anglického textu)

Problematika tréninkové zátěže je stále otevřená oblast pro vědecké bádání, které nám poskytne výsledky použitelné v praxi. V současné době naše znalosti o tréninkové zátěži umožňují rozumně rozdělit tréninkovou zátěž tak, aby byla přizpůsobena adekvátní úrovni, a to jak pro určitou sportovní skupinu, tak pro daný sport a modifikovat množství zátěže v následujících úrovních tréninků takovým způsobem, aby bylo stimulující. Tento fakt by měl vést k vytvoření modelu hodnotícího tréninkovou zátěž v různých sportech. Vyřešit problematiku zátěže v kolektivních sportech je mnohem těžší než v individuálních sportech, protože výkon týmu je kombinací úsilí jednotlivých hráčů. Cílem této studie je přinést kvalitativní a kvantitativní analýzu tréninkové zátěže aplikované v ročním tréninkovém cyklu mladých hráčů fotbalu. Studie byla provedena u skupiny 24 fotbalových hráčů ve věku 14–15 let z fotbalového klubu Wielkopolski klub Piłkarski "Lech".

Tréninkové zátěže byly zaznamenány podle metodologie navržené Sozański a spoluautory, která bere v úvahu identifikaci úsilí ve vztahu k typu vykonávaného cvičení a jejich intenzitě. Tréninkový proces analyzované skupiny je charakterizován převahou speciální zátěže, která je vykonaná s třetinovou intenzitou a s menším užitím všeobecné zátěže. Struktura tréninkové zátěže u klubu Lech Poznań – hráči do 15 let v ročním tréninkovém cyklu (40 % – komplexní a přímá zátěž a 60 % – speciální zátěž) – je návrh modelového řešení problému tréninkové zátěže ve skupině mladých fotbalových hráčů.

Klíčová slova: fotbal, tréninková zátěž, intenzita záběru.

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THE USE OF SUPRA-MAXIMAL RUNNING SPEED MEANS IN SPRINTER TRAINING

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Submitted in June, 2003

In this article, the authors present results of long-term research aimed at maximal running speed development using supra-maximal speed means. They succeeded in establishing the optimal pulling force (20–40 N) that makes it possible to reach 105–108 % of maximal running speed. At this speed the kinematical parameters between maximal and supra-maximal speed do not differ considerably and this secures their optimal transfer into competition activity.

Keywords: Athletic sprints, supra-maximal speed, the development of maximal speed, kinematical parameters of maximal and supra-maximal speed running, pulling appliance, making optimal of pulling force.

INTRODUCTION

In short distance running the purpose is to overcome a given distance in the shortest possible time. The decisive factors of the sport performance structure are maximal running speed and the ability to keep it up for as long as possible (speed endurance). Even in many different sports and events the maximal running speed participates either directly or not at the level of sport performance and the successfulness of individual sporters.

During speed abilities development we must realise that "speed is mostly developed by speed". That's why the most effective and most frequent method for the development of speed ability is the repetitive method at maximal intensity. The long-term use of the same training methods and approximately the same training load leads to a stagnation of speed ability. Movements performed with the same speed and rhythm reach the stage, when there is no possible further maximal speed increase. The fixation of the nervous process in CNS is set, the dynamic movement stereotype is formed and this causes stride rate stagnation even when running technique is better. The speed barrier appears and sprinters' sport performance begins to stagnate.

One of the possibilities for speed barrier breaking is the use of the contrast method, the substance of which deals with the intentional change and combination (natural, easier, more difficult) of the performance of speed exercises.

The creation of easier conditions for motor activity makes possible such a change of several parameters which is manifested in reaching higher than maximal speed under natural conditions. We talk about over maximal, or, at present termed, supra-maximal speed. Easier conditions can be created, for example, in the use of natural conditions (running with the wind, down hill running) or outside force (various means of pulling) that influence the sporter.

Sport practice has confirmed the reliability and efficiency of the use of supra-maximal speed means, but at the same time it has demanded that we ask for more exact ways to apply it. Even in the training of short distance runners, various ways are used to prepare easier conditions for a higher speed reach than is the maximal running speed of the sprinter under natural conditions (Leierer, 1979; Viitasalo, Hirvonen, & Mero, 1982; Holland, 1984).

From the position of the use of supra-maximal speed means, the recommendation of Chomenkov (1974), Naglak (1974) and some others is valid, that easier conditions can be created only up to the level that makes it possible to reach such a speed which the runner is able to reproduce under natural conditions in a short period.

Chomenkov (1974), Bačvarov (1976), Kolodij, Lutkovskij, & Uchov (1985) and also Verchošanskij (1996) and others have focussed on the fact that the selection of supra-maximal speed means ought to be approached critically with responsibility, for the positive transfer of speed ability from one movement to another, which is possible only by making identical (similar) their kinematics as well as their dynamic structure and the character of the neuromuscular sports effort.

The biomechanics of supra-maximal speed has been paid attention to by, for example, Žukov & Šabanov (1983), Holland (1984), Bosco & Vittori (1986), Mero et al. (1987), Mero & Komi (1990), Dintiman et al.

(1997), and Vanderka (1998). All have confirmed the varying dynamism of their parameter changes during the increase of running speed. For example, during running, speed increases and stride lengths and rates are shared, but at higher velocities their relationship changes in an undesirable way. There is an increase of the portion of stride length, more important average forces in the vertical and horizontal contact reaction component and force extremes are achieved, that is we watch higher breaking effects in the passive part of the action angle of the contact extremity. Thus special co-ordination structures and the transfer into natural conditions is hardened.

Many researchers have confirmed the positive influence of the use of supra-maximal speed means for maximal running speed changes and, in this way, medially an increase in the level of sport performance in short distance runs as well. From the above-stated it is clear, that in order to reach a relatively similar positive effect several approaches were used, mostly based on empirical experience and partly even experimentally tested. But it can be said that sport practice has not till now been available according to the rounded-off, scientifically justified methodology of the supra-maximal application of speed means.

Analysis of the supra-maximal sprint problem has provided us with the following results:

- the effect of use means for the speed barrier break and thus even for an increase of the maximal running speed level has been confirmed,
- insufficient knowledge of the kinematics structure of the supra-maximal sprint has been revealed,
- possible negative changes in movement technique during the supra-maximal speed application have been indicated,
- possible ways for finding out the immediate and cumulative effects of supra-maximal speed means use have been demonstrated,
- great differences from the point of view of load, intensity, frequency, time duration and conditions occurring during application of impulses have manifested themselves and thus there is a need for the creation of scientifically explained methodology,
- the need for further, complex research on the problem, from the point of view of making optimal its use in sport practice has been revealed.

PURPOSE

The purpose of this research is, on the basis of the explanation of character and dynamism kinematics structural changes in running at different supra-maximal speed levels, to contribute to the creation of an optimal methodology of stimulus application and verify their use under training conditions.

HYPOTHESES

- we suppose that the kinematics structure of running motor activity will be changed by different levels of supra-maximal speed in positive as well as negative ways depending on the magnitude of the pulling force,
- we think that the interference of natural relations in the motor activity structure by the use of pulling appliances during supra-maximal speed running ought to by partly eliminated by making a model of stimulus conditions as well as by intentional effecting on sprinters,
- we suppose that an individually optimal pulling force exists that makes safe, specifically for each individual, the most suitable conditions for the active realisation of supra-maximal speed running.

TASKS

For the verification of our hypotheses we stated the following tasks:

- to find changes in the kinematics structure of supra-maximal speed running by the application of different pulling forces,
- to compare the development and dynamics of running kinematics structure changes under conditions of maximal speed and its further increase with the use of supra-maximal speed means,
- to model conditions for supra-maximal speed use with the aim to make optimal its transfer into sprinters' competitive activity under natural conditions.

METHODS

Regarding the variety, demands and logical link-up of the solution of these tasks, we had to work with two groups over a longer period of time.

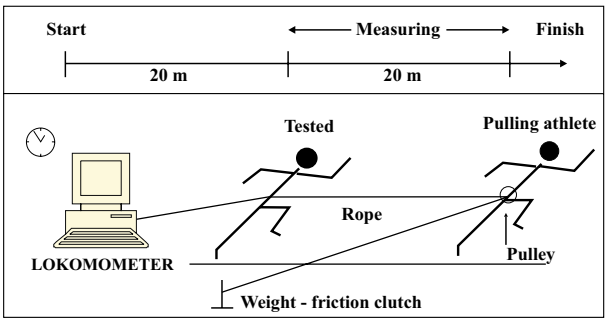
The first group was formed of 26 competitors from Bratislava (Slovakia) and Maribor (Slovenia), aged 17–31 years who had a level of sport performance in 100 m of 10.90–11.67 s.

In the second group there were 26 young sprinters aged 14–18 years with a performance level of 11.00–11.90 s in the 100 m event.

Tests were performed under the relatively stable conditions of the Bratislava indoor stadium in the preparation period (November–March) in the years 1990–1994.

The maximal running speed was learned in the run with a 20 m flying start and a 20 m approach. Over the same distance, sprinters passed a supra-maximal speed run. The reaching of it was made possible with the help of a pulling appliance known as SPEEDY (Fig. 1). The runner performing as the "pulling athlete", by the force of his pull and by the means of a single pulley, quickens the other partner, who reaches double the velocity of

Fig. 1
Running methodology and supra-maximal speed's measuring



the pulling athlete. The substitution of a fixed anchor by a mobile enabled us later to regulate the pulling force. The pulling forces of 20, 30, 40 and 50 N were applied.

During testing sprinters performed mostly runs as follows:

- 2 × 20 m with a flying start (the better of the two results served as the criterion for the maximal running speed),
- 2–8 × 20 m at the supra-maximal speed with a different pulling force (in the analysis results of all measurements were taken).

For detecting and processing basic kinematics characteristics of sprinters' motor activity during maximal and supra-maximal speed running we employed the measuring instrument "Locomometer" (Kampmiller, Holček, & Šelinger, 1993; Šelinger & Holček, 1993). The system works on-line, and basic parameter processing is available 1 min. after finishing the tested run.

We worked with the following parameters:

- average and immediate running speed,
- stride rate and length,
- time periods of single steps, their contact and flying time.

PROCEDURE

During processing of the parameters we used logical methods as well as methods of mathematical statistics. All variables are described by arithmetical average and standard deviation. In the mathematical-statistical analysis we applied non-parametric methods of data evaluation. For the testing of the statistical meaning of central values and differences of pair character data, the Wilcox test was used. Relations between variables are estimated by the Spearman pair correlation coefficient and regression analysis.

The reached empirical research results in confrontation with other authors' results as well as practical experience are confronted by logical evaluation of gained facts (analytic, synthetic and inductive–deductive methods), on the basis of which we have formulated items of knowledge and research conclusions.

RESULTS AND DISCUSSION

1. Changes of kinematics parameters of sprinter motor activity during supra-maximal speed running

During the first task solution of our research we focussed on a comparison of the kinematical parameters of maximal speed (running under natural conditions) and supra-maximal speed (running under easier conditions).

In the first group (26 sprinters aged 17–31 years, sport performance level 10.90–11.67 s) we performed 143 measurements under natural and 85 under easier conditions. The use of the pulling appliance with a fixed anchor did not enable us to define and stabilise the pulling force. That is why runners were reaching different levels of supra-maximal speed.

The average time of maximal speed running was 2.167 s and the supra-maximal speed 1.936 s. That means that sprinters reached, in the flying 20 m run, under easier conditions, on an average, a better time by 0.231 s. That is they were faster by 10.66 % than in maximal speed running.

The statistical characteristics of kinematics parameters of running under natural and easier conditions are presented in TABLE 1. At supra-maximal speed conditions, considerably statistically highly significant changes of all parameters apart from a practically unchanged stride rate could be seen. It means that higher speed was reached with runners only by stride length increase.

TABLE 1
Statistical characteristics of kinematics parameters of maximal and supra-maximal speed running

PARAMETERS		Maximal		Supra-maximal		x1 – x2
		x1	s1	x2	s2	
Speed	[m.s^{-1}]	9.23	0.27	10.33	0.39	– 1.100**
Contact time	[s]	0.113	0.008	0.105	0.008	+ 0.008**
Flying time	[s]	0.114	0.008	0.121	0.007	– 0.007**
Stride length	[m]	2.10	0.10	2.34	0.11	– 0.240**
Stride rate	[Hz]	4.41	0.18	4.43	0.17	– 0.020

** $p < 0.01$ * $p < 0.05$

TABLE 2
Changes of running strides' parameters in maximal and supra-maximal speed condition

PARAMETERS		x	s	xMS – xSMS	sMS – sSMS
xSSMS	[m.s^{-1}]	8.32	0.378	– 0.63	0.170
xSSSMS	[m.s^{-1}]	8.95	0.208	**	**
xSLMS	[m]	1.98	0.142	– 0.14	0.040
xSLSMS	[m]	2.12	0.102	**	**
xSRMS	[Hz]	4.22	0.177	– 0.02	0.008
xSRSMS	[Hz]	4.24	0.169		**

Legend: MS – maximal speed; SMS – supra-maximal speed; SS – stride speed; SL – stride length; SR – stride rate; ** 1% level of statistical significance; ** 5% level of statistical significance

Fig. 2
Dependence of running speed and flying phase of stride at maximal and supra-maximal running speed

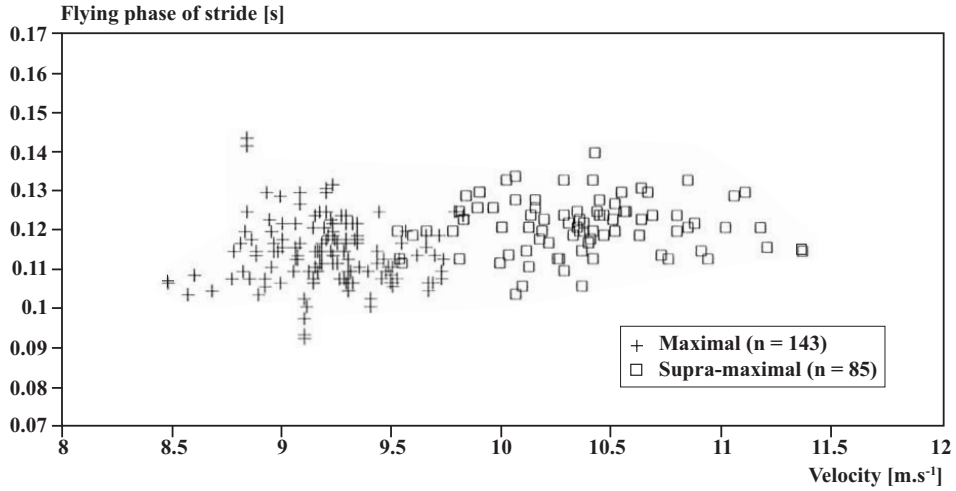


Fig. 3
Dependence of running speed and contact phase of stride at maximal and supra-maximal running speed

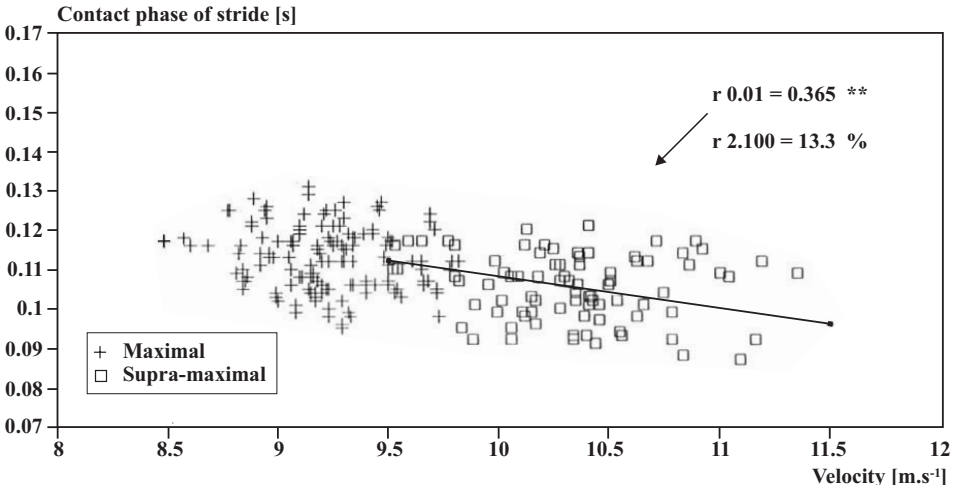
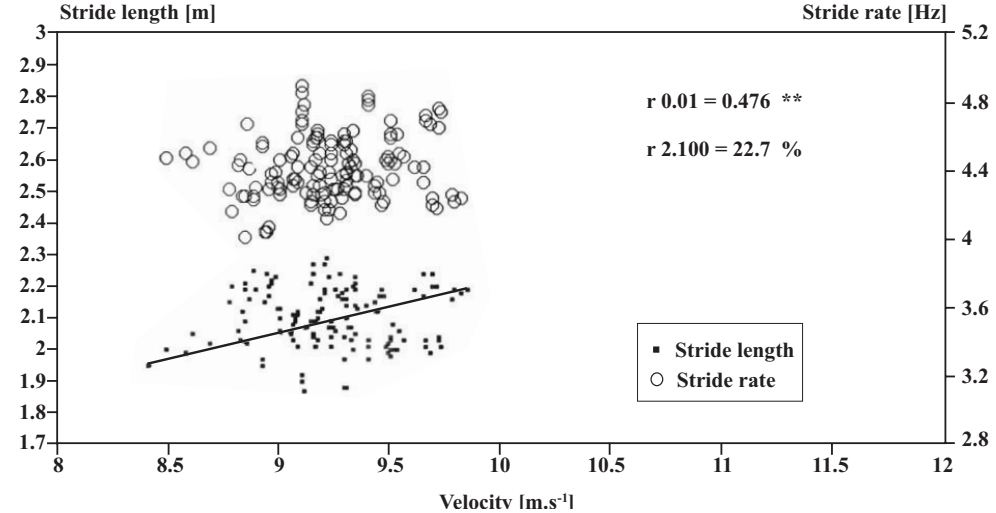


Fig. 4
Dependence of speed, stride length and rate at maximal speed running



Further by means of pair correlation analysis, we looked for the coherence between running speed and other parameters – length, frequency, contact and flight time of the running stride. Under natural conditions we did not confirm significant relations of running speed with the lasting of contact or flying phases, nor even with stride rate (Fig. 2, 3). Under easier conditions there is a clear tendency that faster sportsmen have shorter contact time (Fig. 3) and the closest relationship can be seen between the velocity and stride length (Fig. 4). The relationship of the velocity with the time of duration of flying phases did not reach statistical significance (Fig. 2).

On the basis of positive changes of contact and flying times and stride length and vice versa, a practically unchanged stride rate, as well as on the basis of a relatively high correlation between supra-maximal speed and stride length, we suppose that under easier conditions runners were passive. The reaching of higher quality in several parameters we explain mainly by the activity of outer force: A pulling apparatus.

The pulling appliance on one side makes possible a considerable increase of running speed, but the kinematics structure of running is changed from the point of view of a higher level of speed – strength co-ordination ability in an undesirable way. So called "live pulling" with the help of a fixed anchor indicates various pulling forces and at the same time, with the supra-maximal level speed increase (higher than optimal), the negative character of the changes of several parameters of movement activity (for example stride length) is deepened.

On figures 5 and 6 trends of changes to the kinematics parameters of maximal and supra-maximal speed running can be seen. On axis x there is an expressed running speed of sprinters during the 20 m flying run, on axis y stride length and rate (Fig. 5) and duration of their contact and flying phases (Fig. 6).

Fig. 5
Regrssion of kinematics parameters' changes at maximal and supra-maximal running speed

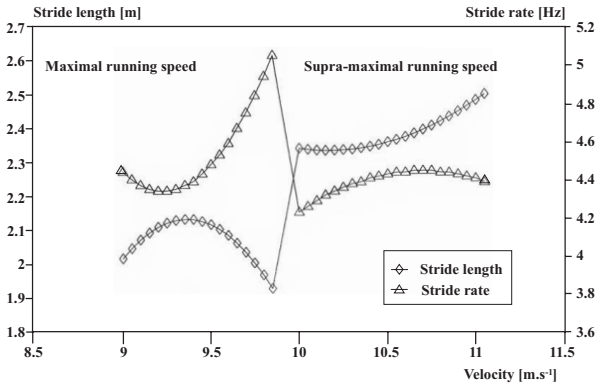
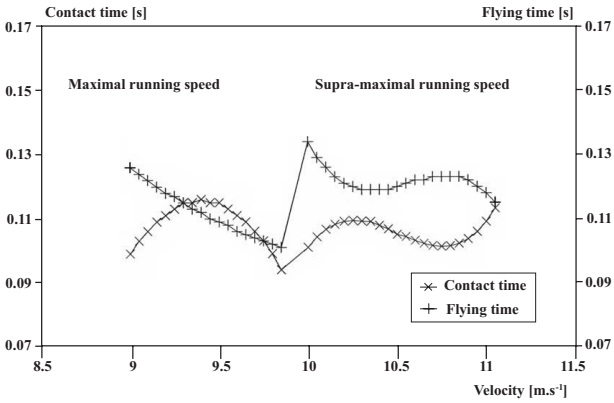


Fig. 6
Regression of kinematics parameters' changes at maximal and supra-maximal running speed



Under natural conditions, the running speed is increased from 9 to 10 m.s^{-1} in such a way that stride rate manifests, from the start, a mild decrease and than sharply rises. The stride length has the opposite tendency (first to increase and then to decrease), the contact phase shortens and the flying phase has an increasing and then a decreasing course.

Under conditions of running with a pulling apparatus, when runners get into the zone of the supra-maximal speed 10–11 m.s^{-1}, a significant change takes place – a stride length increase, and the tendency is permanently graduating. The stride rate does not change at all, it has a stable character. The duration of the contact phase indirectly decreases and the flying phase rises in the same way.

From the levels and tendencies of single kinematics parameters and changes of running, by their mutual comparison under natural and easier conditions, comes their controversial character. We have confirmed again that supra-maximal running speed with a pulling apparatus can be reached by means of a substantial stride increase while simultaneously keeping the stride rate which presents a controversial tendency in comparison with running under natural conditions. This fact gives rise to the question: If, from the point of view of motor learning and the theory of motor abilities development, applied methodology of supra-maximal speed running is effective or not.

2. Optimisation of the pulling force by supra-maximal speed running application

In the second half of the course of the solving of this problem, we started to regulate the magnitude of pulling force by the use of a frictional mechanism with the help of a weight in the pulley "Speedy" appliance. Members of the second group (26 sprinters aged 14–18 years with a performance level of 11.00–11.90 s in the 100 m

run) passed, with some exceptions, 6–8 runs of 20 m in length from a flying start at supra-maximal speed with four increased pulling forces (20, 30, 40, 50 N).

The condition of making the pulling force optimal is connected with the parallel creation of conditions for stride rate increase. From the methodical point of view we consider as decisive not to pull the sprinter by a too high force in order to be able to do movements actively with higher frequency over the whole covered distance. In this way it is possible to improve co-ordination at a higher speed level of single extremities and the centre of gravity. According to performed measurements it seems to us that such an active choice in pulling conditions can be performed by sprinters at a pulling force magnitude of 20, 30 and sometimes 40 N. Higher force application negatively influences the required stride rate increase. It causes a disproportionate lengthening of the stride and a passive tread-down. It forces runners to keep their attention on safety during movement activity.

We feel that, under easier conditions, the velocity of 5–8 % higher than the maximal running speed is adequate. The aim of this training is, even with help of a relatively small pulling force, to create a faster co-ordination connection of the neuromuscular apparatus and thus create dispositions for overcoming the speed barrier. But even in optimising the pulling force we found inter-individual differences. As significant we consider the discovered fact that a further stride rate increase under supra-maximal conditions can be carried out only by those sprinters who have its high starting value at their disposal as well as a shorter stride contact phase time. The stated problem is probably closely connected with the level of special co-ordination abilities. It manifests itself for example in the case of the two following runners. L. B. (Fig. 7) had, under natural conditions, a running stride rate of 4.66 Hz and, under supra-maximal speed conditions, while individually making an optimal pulling force of 30 N, was able to reach it by 5.07 Hz. A further pulling force increase (40 N) led also in the case of this sprinter to a negative phenomenon in running structure that is expressed by frequency decrease. On the other hand, in the case of K. S. (Fig. 8) with a higher pulling force, the stride rate mildly but fluently decreased – from 4.14 Hz to 3.96 Hz with a pulling force of 50 N.

Fig. 7
Trends of running speed changes and stride rate at different pulling forces (runner L. B.)

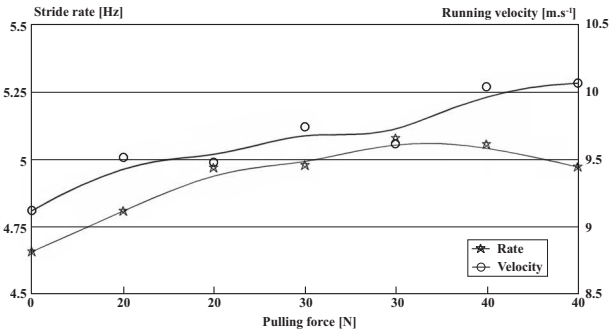
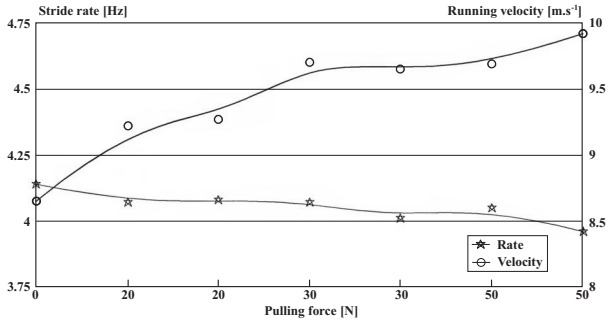
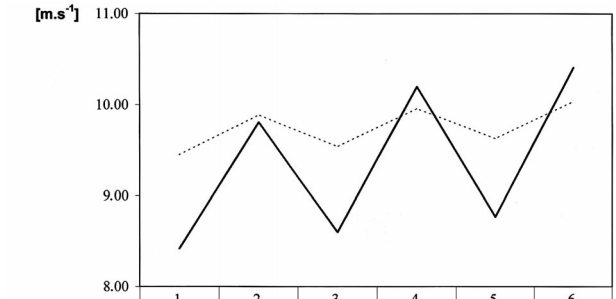


Fig. 8
Trends of running speed changes and stridevrate at different pulling forces (runner K. S.)



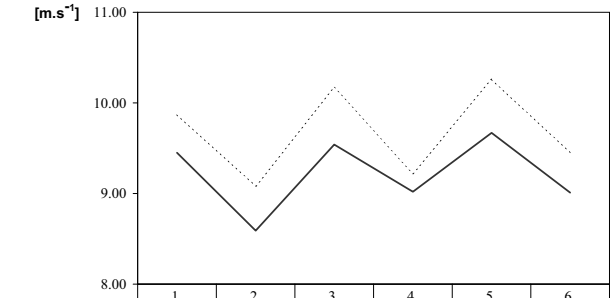
On the basis of the above stated facts we consider as rightful the demand to respect, in supra-maximal speed application, also the individual specificity of each sports participant. We suppose that for the sprinter with lower frequency abilities, the application of this method can have even a negative influence on their technique. This is only a hypothesis that ought to be verified in future research.

Fig. 9
Speed changes of single running strides (runner I. J.)



	1.	2.	3.	4.	5.	6.
Maximal speed	8.42	9.81	8.60	10.20	8.77	10.41
Supra-maximal speed	9.45	9.89	9.54	9.96	9.63	10.04

Fig. 10
Speed changes of single running strides (runner J. L.)



	1.	2.	3.	4.	5.	6.
Maximal speed	9.45	8.59	9.54	9.02	9.67	9.01
Supra-maximal speed	9.87	9.08	10.17	9.22	10.26	9.45

CONCLUSIONS

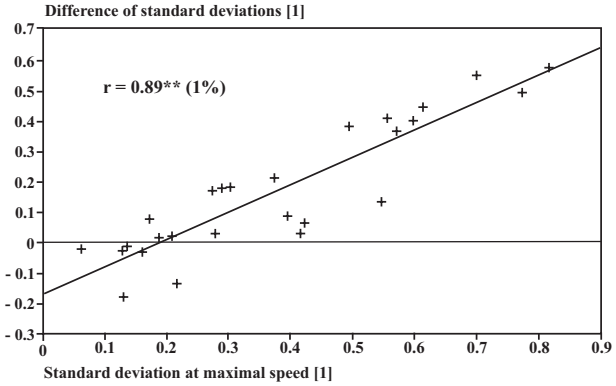
1. Kinematics characteristics of supra-maximal speed with inadequate pulling force undergo various changes of character when compared under natural conditions. Sprinters under easier conditions act passively, relying on the outer pulling force's function. Higher velocity is reached by a practically unchanged stride rate, while the length of the stride is increased. The negative trend of changes in selected movement activity parameters deepens with supra-maximal speed increase.

The above-mentioned facts indicate that there is a need for making optimal stimulation from the point of view of motor ability development, especially in speed, strength and co-ordination.

2. Making more effective the application methodology of supra-maximal speed requires us to optimise the pulling force magnitude with the parallel creation of conditions for runner activity increase in order to be able to perform movements with higher frequency during the whole run.

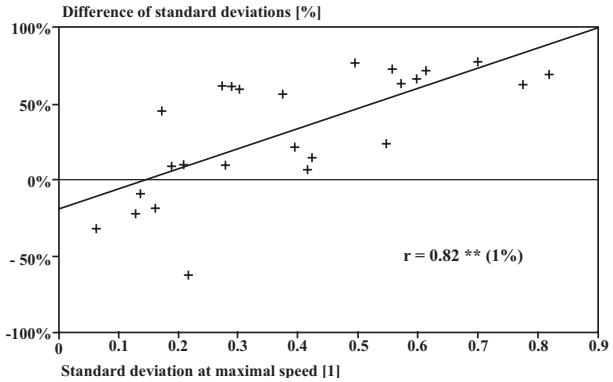
The optimisation of function is contributed to significantly by the possibility of stimulus intensity regulation (magnitude of the pulling force) of supra-maximal speed that is made possible by use of a friction mechanism with the help of weight in a pulley appliance of the accelerator "Speedy". Regarding the character of movement activity structural changes and the individual sprinters' specialities (mainly stride rate magnitude under natural conditions) we consider as optimum a pulling force of 20–30 N, sometimes even 40 N, that is manifested by reaching 105–108 % of maximal running speed. A higher force influence negatively required a stride rate increase, causing passive step down and inaccurate lengthening of stride. It also takes runners' attention away from the safety of movement activity performance from the point of view of the possibility of injury.

Fig. 11
Dependency of standard deviation and standard deviations' changes at maximal and supra-maximal speed running [1]



3. In the application of supra-maximal speed stimulus in sprinters training it is important to respect individual peculiarities of movement activity performance. A higher adaptable effect can be seen in sprinters that even under natural conditions of maximal speed running dispose of a shorter contact time and higher stride rate.

Fig. 12
Dependency of standard deviation and standard deviations' changes at maximal and supra-maximal speed running [%]



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VYUŽITÍ PROSTŘEDKŮ SUPRAMAXIMÁLNÍ RYCHLOSTI V TRÉNINKU SPRINTERŮ

(Souhrn anglického textu)

Autoři v příspěvku uvádějí výsledky dlouhodobého výzkumu zaměřeného na rozvoj maximální běžecké rychlosti s využitím prostředků supramaximální rychlosti. Podařilo se určit optimální sílu tahu (20–40 N), která umožňuje dosáhnout 105–108 % maximální běžecké rychlosti. Při této rychlosti se kinematické charakteristiky běhu maximální a supermaximální rychlostí výrazně neliší, což zabezpečuje jejich optimální transfer do závodní činnosti.

Klíčová slova: atletické sprinty, supramaximální rychlost, rozvoj maximální rychlosti, kinematické charakteristiky běhu maximální a supramaximální rychlostí, tažné zařízení, optimalizace síly tahu.

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First-line publication

Until now published over 120 articles, research studies and books in Slovakia as well as in abroad.

AN ANALYSIS OF HOW TO SOLVE CONFLICTS OF PHYSICAL EDUCATION CLASSES

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Submitted in May, 2003

The purpose of this research is to gather information on solving conflicts that emerge in classes of physical education, and to find out how Slovene teachers of physical education approach the solution of these conflicts. The aim of this research is to ascertain what ways of solving conflicts Slovene teachers of physical education decide to use.

For this purpose, a questionnaire has been developed, including a couple of conflict behavior situations, occuring during physical education classes. From randomly chosen primary schools in Slovenia 34 teachers were questioned. Since the sample has been randomly chosen, it does not imply any generalization. Teachers have been asked to provide answers to hypothetical pedagogical situations, grouped into several classes (for example, conflicts which could result in potential injuries; conflicts, which could disturb the process of physical education, and the like).

Data was processed at the computer data processing department at the Faculty of Sport, Ljubljana. For this purpose, the SPSS software package was used (subpackage FREQUENCIES).

This research supports one hypothesis: PE teachers use a variety of methods for solving conflicts. When solving conflicts, teachers use different approaches; the first and most frequently used approach is the authoritative approach – "the teacher's way", and the second most frequently used approach is the democratic approach – "cooperation with a student". Experts in this field most widely support the latter approach. Teachers rarely decide for a "compromise" approach, and there is practically no method of indulgent allowance used.

The results of this research can be useful for teachers of physical education in order to be able to compare the methods they use with the methods presented in this research. At the same time, these findings could be considered when trying to determine the suitability and efficiency of individual approaches for solving conflicts.

Keywords: Primary school, physical education, communication, conflict, solving conflicts.

INTRODUCTION

Communication represents one of the principle processes in any society. By communicating, we fulfill our needs to express our thoughts, ideas, feelings, and desires.

With the lack of professional implementation of communication in school as an educational institution, there would be no quality education. Communication in classes of physical education has, as opposed to other types of classes in school, its advantages and disadvantages. A relaxed and informal atmosphere has a positive effect on the quality of interpersonal relationships; teachers exert an educational influence upon their students, who are required to participate maturely and responsibly in the pedagogical process. Physical education namely involves situations, which may become risky when rules are not being followed and a relaxed atmosphere may easily turn into an unmanageable chaos.

Each time people interact, their opinions and interest may be different and interpersonal problems may emerge. As far as conflicts are concerned, school as an educational institution is no exception. Conflicts emerge in interpersonal relationships as well as in contextual areas – among teachers, among students and between teachers and students. Communication can also be one of the causes of conflicts. Nevertheless, communication is the only tool to successfully solve conflicts.

When solving conflicts in physical education classes, we must pay particular attention to situations caused by inappropriate behavior and representing a potential risk. Situations like these are lower in number in other types of classes. However, a relaxed atmosphere and children's emotional engagement during physical education classes contribute to a higher motivation for solving problems, and thus to more qualitative solutions of conflict situations.

SUBJECT, PROBLEM, AND PURPOSE

Communication

Communication is the fundamental tool of education. The contemporary science dealing with communication is called interpersonal communicology. It focusses on the following type of communication: any kind of information exchange via communication channels between two or more subjects who are physically located near each other.

The process of communication is combined of four fundamental elements: the sender of the message, the message, the recipient of the message, and the context. Communication can be carried out either verbally or non-verbally.

The so called "Palo Alto" school (Watzlawick, 1967) classifies interpersonal communication into verbal, non-verbal, contextual, and relational. The communication is harmonic and sincere when the spoken context is in harmony with the non-verbal behavior, and when the spoken context confirms the speaker's attitude towards the context and its recipient. The communication is disproportional and insincere when the verbal and non-verbal contexts are out of sync, and when the spoken context is degraded and negated through the speaker's attitude towards the context and its recipient.

The Hamburg School of Communicology (Schulz von Thun, 1984) distinguishes the following integral parts of interpersonal communication: message (context) transfer, identifying the attitude of the speaker towards the context and the message recipient, uncovering one's own personality, and influencing the message recipient. Therefore we could talk about the contextual, relational, personal, and influential aspects of communication. The process is reciprocal – we send and receive messages, reciprocally we try to identify interpersonal relationships and attitudes towards the message (context). We both uncover our own personalities and influence each other. This process is either conscious or subconscious and is mostly carried out by means of non-verbal communication. In each conversation we have with a student, we transfer a certain context to him/her, we define relationships (with the context, or the student), we reveal our own personality and influence the student. All of the above-mentioned is known as the "theory of four aspects of communication".

According to the interpersonal communication flow, we distinguish among four types of interpersonal relationships:

- "ME OR YOU" is interpersonal rivalry, or so called symmetric communication. It is a "battle" for hegemony and power during the communication flow. Both speakers are convinced of their infallibility. In such a situation, the process of education is very difficult.
- "ME AND YOU" is positionally fixed communication. Both the roles and the positions are fixed and the co-speaker must follow these rules. It is very obvious who is first and who is second, who is speaking and who is to listen. In such a situation, the teacher is always, and the student is never right.
- Hidden communication "ME ABOVE YOU" represents communication controlled from the background. The one who seems to be first is in fact second and vice versa. The virtual democratic relationship between the teacher and the student is in fact controlled by the teacher. The relationship is insincere and students gradually begin to lose trust and they themselves start using the same methods of manipulation.
- "ME AS WELL AS YOU" is communication where partners freely and interchangably supplement each other. The prevailing component is the topic of the conversation. The relationship between partners is flexible, depending on the topic and the context. All parties involved contribute to the process of education in such interpersonal communication relationships.

Communication in physical education classes

When compared to other types of classes, a physical education class is carried out under different and specific conditions. Its specific character is that verbal communication can be aggravated due to noise and the students being spread around the "classroom". However, this specific character can be beneficial for the physical education teacher. Namely, a relaxed and informal atmosphere has a positive effect on the quality of interpersonal relationships, which to a great extent contributes to a successful educational process.

Non-verbal communication is of greater importance physical education classes than in other types of classes. The students must be motivated to perform sport activity primarily through our own example and attitude towards the class – the relationship that shows through non-verbal communication. In sport, there are certain activities, which cannot be explained merely in words and it is easier for the students to learn certain movements by imitation.

It should be mentioned that students generally like physical education. According to some sources of information, it represents the favorite school subject of students in Slovene schools. The student's emotional engagement in physical education classes is higher than in other types of classes. On one hand, this is very welcome since a higher motivation level can be used in achieving the goals of the physical education process. On the other hand however, a high emotional engagement represents the potential occurrence of a conflict and thus more occurrences of inappropriate behavior.

Conflict

Fischalek (1987) describes conflicts as interpersonal contradictions of different needs, desires, interests, emotions, and acts. We distinguish among internal, external, latent, false, and mixed conflicts, and conflicts arising from accepting or avoiding a confrontation. Internal conflicts can arise because of two different and repulsive contexts (trap), two different and attractive contexts (difficult choice), or one context, which is both repul-

sive and attractive (two sides of a story). The external conflicts involve two or more individuals with different non-concordant desires and activities. The latent, hidden and subconscious conflicts occur when individuals are not aware of their own disagreement. Mixed conflicts are a combination of internal and external conflicts (Fischalek, 1987).

Deutch (according to a resumé by Brajša, 1993) describes a conflict as a battle of incompatible tendencies and effects within an individual, within a group and a nation, or among individuals, groups and nations in situations characterized either as rivalry, or cooperation. As such, we distinguish interpersonal and intrapersonal conflicts, conflicts within and among groups, as well as international and intranational conflicts.

This author stated that an analysis of all the components of a conflict is necessary in order to understand the conflict situation: the partners´ past relationships, the behavior patterns in a given conflict situation, the core of the problem, social environment, observers, solution strategy, and consequences.

Most authors agree that a conflict as such means nothing bad. The key is how we approach the solution of such a conflict. To a certain extent, a conflict represents an optimal method of interpersonal relationship (Luthans, 1989). Deutsch (1973) describes a number of positive characteristics of a conflict. Conflicts help us to learn about problems, to seek new solutions, to prevent inactivity and to stimulate curiosity. Conflicts alleviate self awareness, stimulate activity (changes), and strengthen the identity of an individual or a group.

Conflicts play an important role in everyday relationships (Bach & Goldberg, 1975). They enable us to achieve an optimal distance to which we can be near a partner. Conflicts represent a part of a battle for the primary role in a relationship; they emerge in a struggle for security and certainty in a relationship. Conflicts are actively present in the process of establishing a personal identity and they help us eliminate romantic illusions about relationships with other people. Also, the problem of a third person's involvment in a relationship is correlated with conflicts.

Dealing with a problem

It is important to distinguish between two concepts, dealing with a problem on one hand, and conflict solution on the other hand. How we deal with a conflict essentially influences its solution, and above all, the applicability and realization of the solution. According to Gordon (1996), we distinguish between the following methods of solving problems (conflicts):

1. "I win you lose". This is a solution to my problem, not ours. A one-way solution, which is the result of the authoritative decision-making of the leader. The partner in this case is left discontented.
2. "You win I lose". Our behavior is permissive. The leadership and decision-making is left to others, not the leader. In this case, only the partner is satisfied.
3. "All win". The solution to a problem has been achieved in cooperation with all parties involved, satisfying all.

The first two methods could be characterized as "win – lose" situations, where dealing with conflicts provokes an even more intense antagonism and hatred, and where the possibility to reach a compromise or solve a problem is smaller and smaller. Within a group, the win – lose method strengthens the oligarchy and gradually renders the group's activities impossible.

The above method of solving conflicts causes a depraved perception with partners. Gradually they see and hear more and more of what they want or have to see or hear, and less and less of what they actually do see and hear. This causes wrong opinions, blind loyalty, hostile tempers, and preconceived ideas, and tends to depreciate the opponen's personality. Their judgment becomes highly subjective and biased.

According to Gordon (1996), the use of force, power, and repression when solving conflicts causes dependence, fear, and anxiety. The communication is restricted upwards, the coworkers are pushed into flattering, and the relationship among the coworkers provokes rivalry and competition. Conformity, inferiority, refusal, and dislike develop. In some cases, introversion and escape. This method creates alliance and coalition among the coworkers. Among the management, the use of force when solving conflicts requires a lot of time, makes management decisions difficult, causes estrangement, stress, and weakens their influence on their coworkers. In general, this method is short term and is the most expensive one.

The authoritative method of solving problems can be very effective in situations requiring urgent, swift action. In physical education classes, these are potentially dangerous situations. The consequences of not following the rules can lead to falls, impacts, collisions, troubles when chewing gum, ...

At the same time, the authoritative approach can represent the only possible method when dealing with a large number of people and when a thorough and long conversation is not possible.

The third method, with no loser, requires cooperation, mutual respect and consideration instead of competition. It makes possible mutual creativity and satisfaction.

Robins (1989) modifies Gordon and distinguishes four methods of solving conflicts. These methods are similar to the previously mentioned ones, with an added method, where both parties involved in a conflict are satisfied even though neither finds the result as an ideal solution.

1. persistency ("we win, the partner loses")
2. adapting ("we lose, the partner wins")
3. compromise (we and the partner lose and win)
4. cooperation (both win)

With the help of this research and a questionnaire, we wanted to ascertain how Slovene teachers of physical education react to defined hypothetical conflict situations, which were classified into several pedagogical situations.

The aim was to find out how teachers solve those conflicts, which could potentially cause injuries and are thus dangerous, conflicts, which make the process of education difficult or impossible, and how they solve such conflicts, which arise due to differences in students' interests. We wanted to ascertain which methods are most widely used among Slovene physical education teachers.

GOALS

Conflicts in school emerge on a daily basis. There are fewer conflicts in certain classes and with certain teachers, and more in others. Teachers are more or less successful in solving conflicts. Based on the many approaches of solving conflicts, the goal of this research is to:

1. Establish whether there is a most commonly used or most effective method for solving conflicts in physical education classes.

For this purpose, some typical pedagogical situations that emerge physical education classes have been selected. The situations are presented in the form of a questionnaire, and the questioned teacher could choose the method he/she would use to solve a hypothetical conflict situation.

HYPOTHESES

Based on the subject, problem and goals, the following hypothesis can be set:
H1: Teachers of physical education use different methods when solving conflicts.

METHODS

PROFILE OF SUBJECTS

Professors of physical education (34 total, both male and female) from randomly selected primary schools in Slovenia were questioned.

SAMPLE OF VARIABLES

The sample of variables in the questionnaire supports the thesis by Robins (1989) – four classes of methods for solving conflicts:

1. PERSISTENCE (We persist in ascertaining our needs. We are convinced that our opinion is the only correct one and that our solutions are the only acceptable ones.)
2. ADAPTING (We adapt to the desires and needs of the students without ascertaining our needs.)
3. COMPROMISE (Such as voting; one way today – another way tomorrow; indulgent allowance is used by both, teachers and students.)
4. COOPERATION (Representing one's own opinion and listening to the opposite one; mutual agreement with which all parties involved are satisfied.)

Regarding the method used for solving conflicts, the following answers to individual questions are possible: persistence, adapting, compromise, cooperation and consistency. Teachers have circled the answer that corresponds to the method they would use to solve the hypothetical conflict situation presented by an individual question. The hypothetical pedagogical conflicts have been grouped into several classes. For example, conflicts, which could result in potential injuries, conflicts, which make the process of education difficult; conflicts, which arise due to differences in students' interests, and other similar types of conflicts (detailed descriptions of the conflicts studied here are available and can be obtained from the authors of this research).

DATA PROCESSING METHODS

Data has been processed at the computer data processing department of the Faculty of Sport, Ljubljana. For this purpose, the SPSS software package, version 10.0 has been used (subpackage FREQUENCIES).

EMPIRICAL DATA AND DISCUSSION

Answers to some questions have been incorporated into specific pedagogical situations. The following conflict situations have been analyzed in more detail:

- conflicts, which can be dangerous (potential injury),
- conflict, which make the education process difficult.

We have analyzed the methods of solving different conflict situations.

How teachers of physical education react to critical situations in physical education classes

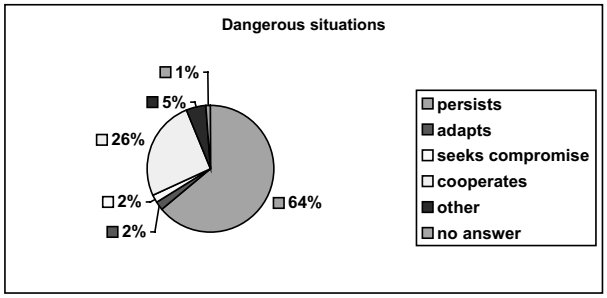
This section includes responses to the following situations c:

- Situation no. 5: The student intentionally moves to a place or position where there is the possibility of impact with another student.
- Situation no. 8: The student insists to practice using inappropriate, slippery shoes.
- Situation no. 11: The student climbs and jumps unprotected and beyond control, or throws different objects at other students...

TABLE 1

Teacher's response to dangerous situations	Number of answers (n)	Percentage (%)
Teacher persists	65	64
Teacher adapts	2	2
Teacher seeks compromise	2	2
Teacher cooperates with student	27	26
Other	5	5
No answer	1	1
Total	102	100

Fig. 1



In situations, which are potentially dangerous (TABLE 1, Fig. 1), teachers most commonly choose the method of persistence. Students often overestimate their abilities and they have a drive to show off. The perception of danger is put behind and teachers can judge such situations more objectively. Whether the teachers will take some time to talk to the students or not, is up to their judgment (depending on how serious the situation is, depending on the student, and other circumstances).

The majority of authors are of the opinion that the most appropriate approach to solving conflicts is when the teacher and student cooperate. Mutual respect and considering other people's opinions, needs, and desires leads to a more stable and qualitative solution. The content in such a case is mutual.

One of the principles of communication pleasure is the right to be active and passive during a conversation. Every person has a right either to cooperate in or to withdraw from a conversation. In this context, it is worth mentioning the driving force for solving a conflict. Students sometimes do not have the desire to solve a conflict together with the teacher. On the other hand however, their acting can harm themselves as well as other students. The teacher, who is responsible for safety in the classroom, is thus forced to use the method of "power". Gordon (1996) states that when a swift and energetic action is required, or when we have to deal with a large group of people, the method of power (teacher persists) is the only successful one. The absence of conflict behavior does not indicate that the conflict has been solved. Inappropriate behavior can re-occur, and it is worth thinking of cooperation with the student, but at a suitable time.

How teachers of physical education react to situations that disturb the process of physical education

Some questions are related to hypothetical situations, which can lead to potential injuries and are thus dangerous. This section includes answers to questions posed by such situations as presented in our questionnaire:

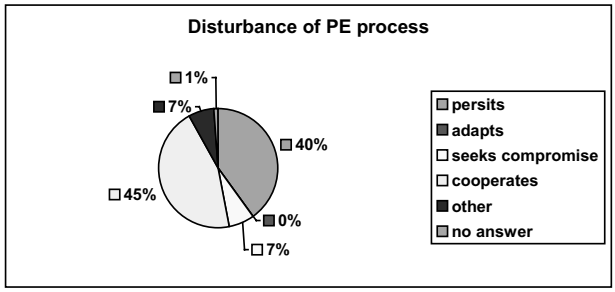
- Situation no. 6: Student does not listen to instructions.
- Situation no. 9: Student does not follow instructions.
- Situation no. 12: Student refuses to be in a physical education class.
- Situation no. 13: Student refuses to perform a certain exercise.
- Situation no. 14: Student keeps talking and makes remarks during an explanation.
- Situation no. 15: Student disturbs other students.

In situations, which disturb the educational process, taking up a lot of time and thus making the lesson less effective, teachers most commonly choose the following two methods: persistence and cooperation (see TABLE 2, Fig. 2). The authoritative approach (the teacher persists) is probably less time consuming; however, the inappropriate behavior is likely to re-occur because we may have

TABLE 2

Teacher's response to situations which disturb the process of physical education	Number of answers (n)	Percentage (%)
Teacher persists	82	40
Teacher adapts	0	0
Teacher seeks compromise	15	7
Teacher cooperates with student	89	45
Other	15	7
No answer	3	1
Total	204	100

Fig. 2



not solved the conflict entirely. Also, the authoritative approach in such cases is successful because children in fact are aware of their inappropriate behavior. The atmosphere in physical education classes is by nature playful, the teacher-student relationship is far more relaxed and children may momentarily be tempted. A warning in such situations can be sufficient to wake the students up and get them back to cooperating. There are no strong conflicts in such cases. However, when the conflict is not solved or when it is very critical, the majority of authors agree that a more successful method would be cooperation. In this way, we would save a lot of time in the long term. There is also a greater possibility that the conflict will be solved and that the educational aspects of a democratic approach will be fulfilled.

Due to the nature of questions six, nine, twelve, thirteen, fourteen, and fifteen, we expected that the chosen methods "teacher persists" and "teacher cooperates with student" would be equally frequent. These assumptions were generally right.

Ways of solving conflicts in physical education classes

Based on the answers obtained from the questionnaire, we analyzed the most frequently used methods of solving conflicts.

TABLE 3 and Fig. 3 show how frequently methods for solving conflicts in physical education classes are used. Teachers most frequently decide to use the authoritative approach, that is "teacher persists". The second most frequently used approach is democracy, that is "teacher cooperates with student". "Compromise" is less frequently used.

Experts in this field most widely support the cooperation method. Such a method offers a more stable and qualitative solution. Besides, we can take advantage of this method to educationally influence a student, since this method is based on mutual respect and consideration.

During physical education classes, there are situations when students may get injured. In such cases, an effective and authoritative approach is required.

The results presented in TABLE 3 and Fig. 3 indicate that there is practically no teacher who would use one single approach for solving conflicts. Teachers most commonly decide for the "persistence" and "cooperation" approaches. Some tend to use one method more, others some other. In specific situations, some teachers also decide for a "compromise", while there is hardly any "adapting" method used. Of all the answers, 5 % are classified under "other". The review of these answers has shown that some answers could be classified as "persistence" and some as "cooperation". Other answers indicate that teachers have decided for a combination of methods. These teachers first persist in their opinion and if not successful, they then decide for "cooperation" and vice versa.

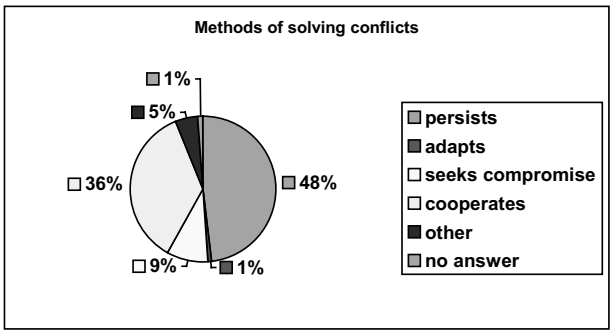
Based on the obtained answers as presented in TABLE 3 and Fig. 3, we can confirm hypothesis number 1. Teachers of physical education use different methods when solving conflicts. Our assumption is that the main reasons are that conflicts differ by nature, or that there are potential consequences of any given conflict situation.

To further investigate the causes, a more thorough classification of pedagogical situations would be required in the future, and at the same time, the use of other statistical methods. The current situation could be explained by parameters, which have not been used in this research, such as, the teacher's sex, age, years of experience, specialization, the influences of a curriculum, work conditions, group relationships, society, ... In research projects to follow, the series of instruments used will have to be expanded in order to obtain more accurate information.

TABLE 3

Methods of solving	Number of answers (n)	Percentage (%)
Teacher persists	176	48
Teacher adapts	4	1
Teacher seeks compromise	35	9
Teacher cooperates with student	135	36
Other	20	5
No answer	4	1

Fig. 3



CONCLUSION

The aim of this research has been to ascertain how Slovene teachers of physical education approach solving conflicts. For this purpose, the questionnaire included a couple of conflict behavior situations, which occur during classes of physical education. To simplify the analysis, questions have been grouped into three classes (dangerous situations; situations where the educational process is disturbed and are not dangerous; situations

where different interests are present and do not disturb the educational process). Teachers have been asked to choose among answers representing different approaches to solving conflicts. The approaches chosen are based on the Robbins (1989) classification of methods for resolving conflict situations.

From randomly selected primary schools in Slovenia, 34 professors of physical education have been questioned. Data has been processed at the computer data processing department at the Faculty of Sport, Ljubljana. For this purpose, the SPSS software package, version 10.0 has been used (subpackage FREQUENCIES).

The results indicate that in order to be efficient in solving conflicts during physical education classes, different approaches are required. Teachers most frequently use the authoritative approach – "the teacher's way". The second most frequently used approach is the democratic approach – "cooperation with the student". In some situations, teachers are forced to use the "compromise" as well. Based on the obtained results, the hypothesis H1 has been confirmed – none of the teachers uses solely only one single approach.

How a teacher approaches the resolution of conflicts is very often dependent on differences among students. An approach, which is successful with one student, does not necessarily lead to a successful solution with another student. There is no all-purpose recipe. On one hand, this means extra hard work for the teacher, whereas on the other hand, it offers an enormous number of possibilities in finding the appropriate solutions. The work of a good teacher, who continuously seeks new solutions, can thus never become boring – even though in identical situations it does re-occur. Intuition, and the so called "touch for working with children" are the capabilities of every good teacher.

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ANALÝZA ŘEŠENÍ KONFLIKTŮ V HODINÁCH TĚLESNÉ VÝCHOVY

(Souhrn anglického textu)

Účelem výzkumu je shromáždit informace o řešeních konfliktů, které se objevují v hodinách tělesné výchovy, a nalézt způsob, jak slovinští učitelé tělesné výchovy přistupují k řešení těchto konfliktů.

Pro tento účel byl vytvořen dotazník, který obsahuje několik případů konfliktních situací v chování žáků, které se objevují v hodinách tělesné výchovy. Dotazník jsme zadali 34 učitelům ze základních škol ve Slovinsku. Vzorek byl náhodně vybrán a nezahrnuje v sobě žádná zobecňování. Požádali jsme učitele, aby nám poskytli odpovědi na hypotetické pedagogické situace, které jsme uspořádali do několika skupin (např. konflikty, které by potenciálně mohly skončit úrazem; konflikty, které by mohly rušit průběh hodiny tělesné výchovy apod.).

Hodnoty byly zpracovány na oddělení zpracovávání dat na Fakultě sportu v Lublani. Pro tento účel byl použit program SPSS (soubor četností).

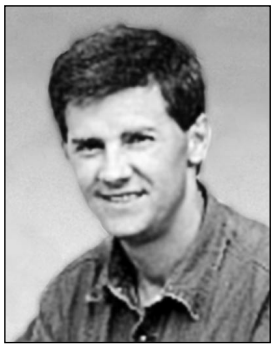
Výsledky výzkumu potvrdily hypotézu: učitelé tělesné výchovy užívají celou škálu způsobů řešení konfliktů. Během řešení konfliktů učitelé používali různé přístupy: na prvním místě a nejčastěji byl použitý autoritativní přístup – „učitelův způsob řešení", druhý nejčastější způsob byl demokratický přístup – „spolupráce se studentem". Odborníci v tomto oboru podporují druhý zmiňovaný přístup. Učitelé se jen zřídka rozhodují pro

„kompromisní“ přístup, prakticky zde nebyla použita žádná metoda, která by byla benevolentní.

Výsledky tohoto výzkumu mohou být užitečné pro učitele tělesné výchovy a ti pak mohou být schopni srovnat si zmiňované metody s metodami, které používají jiní učitelé. Zároveň mohou výsledky zkoumání přispět k ověření vhodnosti a efektivity použitého učitelova individuálního přístupu při řešení konfliktů.

Klíčová slova: základní škola, tělesná výchova, komunikace, konflikt, řešení konfliktů.

Dr. Jože Štihec, Ph.D.



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ENVIRONMENT ANALYSIS IN THE DOMAIN OF COMMUNAL SPORT ACTIVITIES

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It is possible to state that the organisation and way of functioning of the State administration has gone and will be going through an incessant development process, which has responded and will be responding to the changes and needs of society.

"The basic philosophy of local authorities, who are willing to build up new and well functioning organisation models, is their orientation towards 'public services'. It means that services offered by local authorities should be designed not only for people, but also in cooperation with them" (Welsh, 1994, 195).

It is thus necessary for the municipality to stay in contact with its inhabitants and to evaluate their needs and attitudes. According to Welsh (1994), the task of local authorities is to analyse the impact of services offered to particular segments of the community, who should be served by the authorities. This analysis, which can be considered as an audit made for certain client groups, is, besides being other things, also a starting point for the elaboration of an overall municipality strategy. This analysis can be carried out by means of primary or secondary research.

The present state of our society and developmental tendencies taken under consideration, it is clear that the existence of leisure activities systems will be a significant element in the decision-making processes of State employees at all levels of State (public) administration.

The relationship between those who can influence outer forces and those who occupy positions in leisure-time organisations defines the dynamics of future development.

The role of municipalities in the domain of public services cannot be replaced. That's why it is necessary to study the opinions and attitudes of employees responsible on a local scale. It is also important for the information transfer and communication to be carried out rapidly.

Keywords: Municipality, citizen, leisure activities, organisations, conditions.

INTRODUCTION

Within the framework of the creation of a new "Conception of Sport and Physical Culture Development in the Liberec Region", the Liberec regional council has asked the Faculty of Physical Culture to work out a study describing and evaluating the opinions and attitudes of local authorities' employees toward communal recreation. The stress was put on educational activities of a sport character.

The study comprised three parts:

1. Representatives' attitudes toward leisure activities of a sport character, seen within the framework of local politics.
2. The present-day situation in the financing of communal recreation from local budgets.
3. The present day situation in the domain of ownership (in the sphere of sport and physical education).

The size of the region and the diversity of studied subjects made the realisation of the study very difficult. Due to the volume of information gathered, we will restrict this article to the first part of the problem: Representatives' attitudes toward leisure activities within the framework of local politics.

From the etymological point of view, the word "citta", "cité", "ciudad" (originating from Latin, "civitas") contains two basic concepts: the town as a material, archeological and topographic unit and, at the same time, the town as a place for the congregation of people, or, as the Italian encyclopedia Treccani puts it, "a historical and legal phenomenon, which represents the characteristic and inevitable nucleus of society's life" (European Urban Charter, 1992).

In sociological terms, municipality is defined as a local community, within the framework of which exchanges and interactions between local inhabitants and institutions leading to the achievement of economic, social and cultural goals are realized. From the administrative point of view, a municipality is seen as the lowest administrative and geographical unit of urban or rural character (Velký sociologický slovník, 1996, 667, 669).

The Act N° 128/2000 on municipalities says that municipality is defined as a basic self-governing (autonomous) community of citizens, clearly defined by a geographical border (Public administration, 31).

At present, towns are more and more often referred to as municipalities ("commune", "municipio", "Gemeinde", "comune") or "autonomous territorial bodies assembling inhabitants with particular interests", and as inhabited areas "with organized urban and public services development, having their own administration" (European Urban Charter, 1992).

The town is viewed not only as a local unit but also as an integral part of the development of mass consumption. Residential houses, schools, transport services and all kinds of entertainment facilities represent a form of modern industry product "consumption" (Castells, 1983).

Harvey (1973) states that local authorities' decisions have a significant impact on the image of the town and on its developmental tendencies. It is important, for example, what kind of tax alleviations are accorded to the construction companies as well as to the subjects interested in buying real estate.

The government (executive power) is another element influencing directly the town's life in many domains. It plays an important role in road and municipal flat construction, plans the localization of green areas in the town, building cultural and social centers, etc. The face of a town depends thus on the interaction between the market forces and the governing power, and it is a symbolic and spatial expression of the processes ongoing in the entire society (Castells, 1983).

The European Urban Charter (1992) defines the present and future conditions of urban development. It makes this statement, among others, that the enforcement of individual rights should be based on solidarity and responsible citizenship. The citizens of European towns have, according to the above mentioned Chart, the following rights:

Health – the right to live in an environment promoting human physical and psychological health;

Sport and leisure – the right to use a large variety of sport and leisure facilities, irrespective of age, abilities or income;

Culture – the right to use facilities and take part in a variety of creative activities;

Participation – the right to participate in pluralistic democratic structures and in the municipal management, this participation being characterized by cooperation among different partners, by the principle of subsidiarity, by the right to information and by protection against excessive regulation;

Personal development – the right to live under urban conditions that help individuals to acquire personal richness and to insure the individual's social, cultural, moral and spiritual development;

Financial mechanisms and structures – should enable local authorities to find the financial backing necessary for putting into practice the rights defined in the Declaration.

When defining the "public administration", it is necessary to reflect on its functional and organizational aspects and its overall structure, specific to the context of the Czech Republic.

The definition of this term is not easy: until recently, the State had been the only vehicle of public administration and had made it clear that no other bodies were eligible to act in favour of public interest. That is why the term "public administration" was often replaced by the term "State administration".

To be able to redefine and set up the characteristics of the above-mentioned terms, we take as a basis the Act N°128 from April 12, 2000 on municipalities.

The characteristic feature of today's society is that its management is no longer insured exclusively by the State organs. Other subjects (mainly the so-called self-governing public corporations) are playing an increasing role in society's management and in decision-making processes.

In a society organized into a State, public administration refers, in general, to administration of public affaires realized by the state's executive organs. The State and self-governing public corporations carry out the duties of their positions in public administration through so called administrative bodies.

Each group sets up its own procedures and structures of power. It needs to be stressed that power and leadership are not identical notions. Power is viewed as the ability to make others behave in the desired way. Leadership means the ability to make (persuade) the group to behave (and act) voluntarily in a certain way. When we take into consideration what has been said above, we see that the power holders in a particular society will always be involved in setting up new tendencies and will be the ones who take the lead.

Wideman (1999) states that the Czech Republic's adhesion to the European Union presumes that the Republic meets certain requirements concerning the functioning of public administration. It must be decentralized, controlled, financed properly and so-called public service must be implemented. The administration has to be flexible, effective and managed by qualified professionals who consider municipal and regional planning to be the basis for their activity.

Urban planning is, according to the European Urban Chart (1992), a science which has the professional and analytical potential for assessing projects, programs and strategies, which serve as a basis for physical, social, economic and ecological structures. And these define if the presumptions and decisions have been legitimate from the point of view of feasibility, political plausibil-

ity and in accordance with a higher level of political decision-making.

Urban planning is becoming a crucial component of successful work on all municipality levels. It is therefore necessary to take this fact under consideration when creating any conceptions of systematic solutions to the problems of leisure activities, which are an integral part of human life. According to the European Chart of Sports (1994), all the inhabitants of a municipality have the right to participate in sport activities, irrespective of their social origins, age, sex, economic situation or ethnic background.

In the table below, we list the means municipalities use to enforce this decision (paraphrase of the European Urban Charter, 1992):

Adopting active policies in the domain of sports for all age, social, ethnic and handicapped inhabitants of a particular municipality;

Removing psychological, social and economic constraints which might prevent the inhabitants from taking part in sport activities;

Providing a network of basic sport facilities covering the whole of each municipality or the surrounding area;

Insuring organization of the facilities in such a way that local populations can identify with them, encouraging a sense of ownership and thus reducing vandalism and delinquency;

Insuring that publicly-provided sport facilities complement those organized by the voluntary and commercial sectors;

Insuring that proposed sport facilities meet the present as well as the future needs of the inhabitants and that they become an integral part of those parts of municipalities, in which they will be constructed, and that they fit into the overall urban plan of the community.

When planning freely accessible playgrounds, wooded areas, bicycle paths and playgrounds, the politicians have to bear in mind one crucial goal: to foster and stimulate the recreational activity of the citizens. The Act N° 564/1990 defines that the domain of education will be put under the agenda of the newly created, independent school boards.

One of the recommended measures is to create conditions for the establishment of specific work positions that would be in charge in the domain of leisure on the municipal, local and regional level.

Their task will be, among others, the following:

To insure the functioning of the state administration in the given domain;

To treat the proposals of local conceptions, plans and recommendations concerning the programs of state support and protection of youth;

To participate in the planning and budgeting of the particular domain and in the field of use of state subventions;

To coordinate and control the management of the tasks connected with social issues, health, leisure time and life style;

To create an information system and provide counseling services;

To cooperate with other departments and other partners.

METHODOLOGY AND CHARACTERISTIC OF THE SAMPLE

The client has agreed to the realization of the survey, which would include 23 questions and 8 demographic indicators. In two rounds, 228 questionnaires were distributed and 97 communities were sent the questionnaires by post. After a logic control, all 97 of them were used for statistical processing – this means that the return rate was 100 %. The results of the survey are described in this article. In the second round, the researchers spoke with 131 local authorities representatives in the remaining communities of the Liberecký kraj. After a logic control, all 131 questionnaires were used for statistical processing. The results are being processed.

Note: the authors of the survey use the terminology as defined by the client and they are aware of the fact that objections of technical character could be raised.

REPRESENTATIVES' ATTITUDES TOWARD LEISURE ACTIVITIES OF SPORT CHARACTER ON THE LEVEL OF COMMUNAL POLITICS

Having taken into consideration the needs of the article, we will state several findings of the research carried out in 1999 by the Institute of Children and Youth of the Ministry of Education, Youth and Sport, in cooperation with the Department of Recreology of the Palacký University in Olomouc and departments N°73 and K3 of the Ministry of Education, Youth and Sport.

This research analyzed the opinions and attitudes of those regional and local authorities' employees who have already been working in the field of youth and physical education.

Respondents submitted that their work does not comply with the initial objectives. It is evident that the classification of particular work positions is not clear: one third of the employees said that they use only 10 % of their time working on the original objectives of the particular position.

There are significant contrasts among the respondents when it comes to the nature of their work (what they think it should be) and the reality:

The respondents consider as **important** the following items:

A/ Protection of society against negative influences;
B/ Use of State subventions;
C/ Support of NGO's, counseling activities;
D/ Information;
E/ Coordination of the activities of all participating subjects;
F/ Participation in creation of plans and budgets;
G/ Participation in material, economic and personal backing of activities;
H/ Working out proposals of local conceptions.

On the other hand, they consider as **less important**:

I/ Creating conditions for good functioning of corporations;
J/ Working out communications for higher administration units.

The **level of education** and professional training is unsatisfactory. The respondents' opinion concerning their own readiness for the function corresponds with their opinion concerning the methodical leadership of higher structures. Employees want to express that they themselves are not "to blame".

The **central** system of financing leisure activities within regions is inconvenient. Decentralized financing of individual bodies (finance distribution by a particular local administration) is clearer and more "fair".

In respect for the need for the creation of a clear concept in this domain, we consider as **very important** the following opinions:

A/ The issue of leisure time is very important for the public;
B/ It is necessary that decision making concerning certain conceptional issues be transferred to the competence of lower administration units;
C/ There is an urgent need to resolve the issue as a systematic solution;
D/ It is beneficial and necessary to solve the issue of leisure activities as a whole ("from one point"), given that it is possible to coordinate the process with other departments – social dept., dept. of construction, etc.

It is interesting to compare the conclusions of the analysis of opinions and attitudes of the employees already "active" in this sphere (made in the entire Czech Republic) with the results of the survey in the Liberecký kraj: see TABLE 1.

We state that the methodology of the two surveys was identical, the only difference being the partition of the communities. We made a more detailed partition in the case of Liberec, according to the number of inhabitants.

CONCLUSION

On the basis of the data gathered in the survey, we can state that:

The present state of affaires is very similar to the one described in the research project done in 1999. We can therefore say that the development rate does not correspond with the needs and developmental trends of today's society.

In general, it is not true that the communities have created specific work positions that would insure functioning of this domain.

Education of responsible employees is higher in the communities with a higher population.

The number of employees with proper education is on the increase in accordance with the population growth but still does not correspond with trends.

Only one community has an independent department which is fully focused on the issue.

Of the communities, 4/5 are not even considering the creation of such departments.

The bigger the community, the more likely it is to have sport **committees**. However, 1/2 of the communities are not even considering creating such committees.

It is positive that only one community considers the issue of communal recreation as unimportant, and only two as less important.

This issue is considered by 94 communities to be important for all age and social groups**.**

Communal recreation is considered to be, together with tourism, to be important and beneficial by **67 communities and** only 3 communities with a population smaller than 500 inhabitants think that these issues are not connected.

NGOs are supported in **41 communities** by lending them communal sport facilities for free or for a symbolic price.

The majority of communities support their NGO's by combining several approaches.

Grant policies are also often used to encourage material and personal development.

Our results have shown that the issue of communal recreation – and not only in the domain of sport and physical culture – is becoming an subject of interest of State employees on all levels of State administration. It is necessary to add that in most cases, these employees do not have the capacity to leave the traditional point of view and that they do not conceive the domain as a space for influencing and forming the modern life style.

TABLE 1
Summary of opinions of executive representatives of the municipalities of the Liberecký kraj

Total number of communities in the region who participted	97							
	1–500 inhabit.	**501–1000**	**1001–1500**	**1501–2000**	**2001–5000**	**5001–10000**	**10001–50000**	**50001–100000**
Number of employees who are, in your office, in charge of the organization and management of communal physical education and recreation:								
	3	2	0	0	1	2	1	3
Their education level (in numbers)								
University of sport character	0	0	0	0	1	0	1	0
University	1	0	0	0	0	1	0	2
Secondary school	2	1	0	1	0	1	0	1
Elementary school	0	1	0	0	0	0	0	0
Do you have a department in charge of this sphere?								
Yes	0	0	0	0	0	0	1	0
No, but we are considering its creation	3	0	0	0	1	1	0	0
No, and we are not considering its creation	36	28	9	7	3	4	1	1
Do you have a special commission who deals with this issue?								
Yes	7	7	0	1	1	3	2	1
No, but we are considering its creation	4	2	2	2	2	1	0	0
No, and we are not considering its creation	28	18	7	4	1	1	0	0
You consider the sport and communal recreation								
Important for inhabitants of all age and social groups	19	17	6	5	2	5	2	0
Important mainly for children and young people	21	12	2	4	2	0	0	1
Less important for the life of the municipality (town) and its inhabitants	2	1	0	0	0	0	0	0
It is not at all important for the town's (municipality's) life and the life of its inhabitants	1	0	0	0	0	0	0	0
The problems of communal sport and recreation and the problems of regional tourism								
Are closely related and should be considered as a whole	23	20	7	6	4	5	2	1
Are not related too closely and it is not necessary to consider them as a whole	12	8	2	1	0	0	0	0
Are not related at all	3	0	0	0	0	0	0	0
Economic support for the NGO's in your community is realized								
As financial support of activities (the contents and personnel side), as grant policy	6	9	3	3	1	4	1	1
By means of financial support of investments and reconstruction of facilities	9	8	3	3	1	1	2	1
By advantageous leasing of the sport facilities that belong to the municipality	3	5	2	1	1	2	1	1
By lending the municipal sport facilities for free or for a symbolic charge	14	14	4	3	3	3	0	0
By other means	8	4	3	1	1	0	0	0

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ENVIRONMENTÁLNÍ ANALÝZA AKTIVIT KOMUNÁLNÍHO SPORTU

(Souhrn anglického textu)

Můžeme konstatovat, že organizace a řízení státní správy procházelo, prochází a bude procházet neustálým vývojem, který reagoval, reaguje a bude reagovat na změny uvnitř společnosti a na její potřeby.

„Základní filozofií místní správy, která je ochotna vytvářet nové a akceschopné modely organizace, je orientace na ‚služby veřejnosti' – to znamená, že místní správa by měla poskytovat služby pro lidi a s lidmi, nikoliv pouze lidem" (Welsh, 1994).

V této souvislosti je potřebné zdůraznit naléhavou nutnost komunikace obce se svými obyvateli, poznávat a analyzovat jejich potřeby a postoje. Welsh (1994) uvádí, že úlohou místní správy je vyhodnotit, jak různé služby, které poskytuje odpovídají různým segmentům obce, kterým musí obec sloužit.Tato hodnotící analýza, kterou lze pojmout jako audit služeb pro určité skupiny zákazníků, je kromě jiného východiskem při zpracování celkové strategie obce. Nástrojem této analýzy může být primární či sekundární výzkum.

Vzhledem ke stavu a tendencím vývoje bude mít existence systému volnočasových služeb v životě naší společnosti stále vzrůstající význam a bude hrát významnou roli i v rozhodovacích procesech odpovědných pracovníků na všech úrovních státní (veřejné) správy.

V rámci zpracování „Koncepce rozvoje tělovýchovy a sportu v Libereckém kraji" byl dán zadavatelem (Radou Libereckého kraje) požadavek zhodnotit současný stav názorů a postojů pracovníků veřejné správy na úrovni obcí v rámci celého kraje na oblast komunální rekreace s akcentováním aktivit sportovního (tělovýchovného) charakteru.

Úkol byl realizován v následujících oblastech:

1. Postoj zastupitelstva k problematice sportovních volnočasových aktivit na úrovni komunální politiky.
2. Současný stav v oblasti financování komunální rekreace z obecních rozpočtů.
3. Současný stav v oblasti majetkové (chápáno v oblasti sportovní a tělovýchovné).

Složitost a rozsah zadání v rámci kraje představuje velmi komplikovaný úkol a to jak velikostí regionu, tak i různorodostí šetřených subjektů.

Vzhledem k rozsahu se příspěvek zabývá pouze první oblastí zadaného úkolu, tedy postoji zastupitelstev obcí k dané problematice.

Klíčová slova: obec, občan, volnočasové aktivity, organizace, podmínky.

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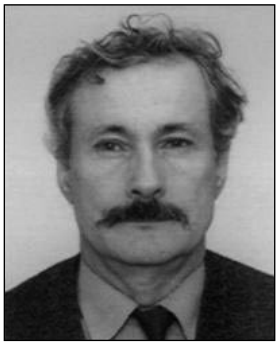

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ENVIRONMENTAL FACTORS AND THE ELEMENT OF THEIR STYLE OF LIFE AS PREDICTORS OF THE MORPHOFUNCTIONAL GROWTH OF THE CHILDREN IN POLAND

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In our work we touched on the problem of factors modifying children's somatic and functional traits. We tried to prove that living conditions like the number of children in a family (social-economic factor), the level of lead in the blood (connected with pollution) and physical activity (life style element) influence the somatic and functional development of the children in Poland. Besides we would like to estimate hierarchy, directions and strength of these factors' influence on body dimensions, condition and co-ordination abilities. We chose 154 boys of 11 years of age from the small town Polkowice for our research.

The results were received in 1996. We examined basic somatic traits: body height and weight; motor trials: hand grip, standing jump, medical ball throw, tapping test, and the flamingo balance test. Additionally we received questionnaire information about physical activity as well as results regarding the level of lead in the blood. We used multiple regression and canonical analysis as a statistical method in pursuing the aim of our work. The results showed that factors analysed in elaboration are only partial modifiers affecting somatic and functional traits. The social-economic factor is stronger than the rest of the factors and affects somatic traits, both of the rest affect functional traits.

Keywords: Social-economic factors, environmental conditions of growth, children's development, morphofunctional traits, lead in the blood.

INTRODUCTION

The problem of the effect of environmental conditions on the biological development of children and of young people has a sound base in many works of scientific literature (Bláha & Vignerová, 2002; Charzewski & Bielicki, 1990; Eiben et al., 1991; Hulanicka et al., 1994; Ignasiak et al., 1997; Lindgren, 1976; Sławińska, 2000; Strzelczyk, 1995). The authors show us the general directions of influences of both kinds of modifiers: social-economic as well as those associated with the pollution of the natural environment. The first of these can stimulate development either negatively or positively, often compensating even for the unprofitable influence of the latter (Bouchard & Malina 1983; Kovar, 1980; Malina, 1984). The estimation of the influence of physical activity on children's organisms is rather seldom undertaken. The fact that it plays a stimulating role is well-known, especially with reference to spheres of the function of the human organism, but it is not very well recognised in its interactions with other factors.

A minority of the reports suggest that social-economic factors are stronger, in comparison to that of the pollution of the natural environment, as they modify development. Hulanicka (1994) says factors connected with the quality of the social environment act more strongly on the tempo of pubescence and the level of the somatic development of the children than factors of the chemical and physical pollution of the environment. Our own research suggests that social-economic factors have a stronger influence on the sphere of structure, but pollution interacts with some functional features of children (Domaradzki & Ignasiak, 2002; Domaradzki et al., 2001).

In the elaboration regarding the subject of the conditioning of the biological development of children and youth, the influence of the above factors was often examined separately. Fewer works took into account the influence of several factors simultaneously.

THE AIM OF OUR WORK

1. Estimation of the influence of the level of lead in the blood, the number of children in each family and physical activity, connected together, on the level of the development of somatic and functional features. In our analysis we concentrated on the settlement on a hierarchy of factors of definite magnitude of standardised beta coefficients and the spheres of their influences.
2. Qualification of the range and strength of the relationships of the level of lead in the blood, the number of children in each family and physical activ-

ity, seen together, on the level of the development of somatic and functional features treated complexly.

RESEARCH MATERIAL AND METHODS

The results were received in 1996 during complex research carried out in the town of Polkowice in south-west Poland. We selected only 11-year-old boys for this work, treating the pre-puberty period as better for our purposes than the puberty period. There were 154 boys between the ages of 10.50–11.49 years who were included in this group. In our work we used the following data:

A) Information contained in our questionnaire: the number of children in each family (1.2 – a lower number of children, 3 and over – a greater number of children in each family) and physical activity (high, middle, less activity);
B) The level of lead in the blood (Pb-B) [µg/dl];
C) Somatic features: body height and weight;
D) Tests diagnosing motor abilities: hand strength, standing jump, medical ball throw;
E) Tests diagnosing co-ordination traits: tapping test (speed of movement), "flamingo balance test" (balance).

We used the following statistical methods:

1) Multiple regression: this method serves to investigate relationships between many independent variables (explanatory) and dependent variables (explained), it permits an expectation of the value of each parameter on the basis of independent variables. It is used both in testing of hypotheses as well as with methods of exploration;
2) Canonical analysis: this method serves the investigation of relationships among many independent variables (explanatory), and many dependent variables (explained), and it can also be used as a method of exploration.

As a foundation for our methods, the results of the "flamingo test", because of a lack of a normal distribution of data, were changed into logarithm and then used in analyses.

ANALYSIS

Basic statistical characteristics are shown in TABLE 1.

Prediction of the level of somatic and motor development in multiple regression

Investigations of relationships between different parameters using a simple Pearson's correlation give us an image of connections between pairs of features, showing power and directions of dependence. They serve, however, most often for the purpose of initial, simplified analysis, not giving us the possibility of a deeper estimation of occurrences.

TABLE 1
Mean values and standard deviations of analysed parameters

Parameter	Mean	sd
body height (cm)	138.61	5.64
body weight (kg)	32.84	7.13
hand grip (kG)	14.06	4.53
ball throw (cm)	517.20	82.14
standing jump (cm)	134.38	18.72
tapping test (s)	14.90	1.59
balance (s)	0.68	0.23
Pb-b (µg/dl)	3.93	2.20

The complexity of biological apparitions causes us to pay attention to many different factors rather than one. So we undertook an attempt to answer a question: Which factor, from among such modifiers as: the level of lead in the blood – a threat factor connected with the pollution of the environment, the number of children in each family – a social-economic factor, physical activity – a factor connected with life style, have a stronger influence and on which sphere of the organism (somatic and functional).

Having in view a settlement of the hierarchy and of the directions of influence, in the case of three of the above mentioned factors we focused only on a comparison of the magnitude of coefficients and the directions of their effects, resigning from a wider analysis of partial correlation, semicorrelations or a model of prognosis.

Analysis is divided into three parts. Discussed relationships of parameters with somatic features and functional traits based on the energetic efficiency of the activity of the nervous system are rated separately.

Values of standardised beta coefficients and coefficients of regression and levels of their statistical significance for each parameter are shown in TABLE 2.

Somatic traits

From between both somatic features a greater power of conditioning is shown by body weight than body height. With regard to greater genetic stability, this second feature is then waiting to occur. Of all the analysed factors, this modifier has a very strong and even statistically significant influence. It confirms the values of standardised beta coefficients. The value of the coefficient of regression shows that families enlarging themselves for an additional child is accompanied by a decrease in body weight of the new offspring by about 2 kilograms. The above realization corresponds with the research of other authors, who have also observed a greater negative influence of social-economic factors, than that of the pollution of environment, on somatic features (Hulanicka et al., 1994).

TABLE 2
The values of standardised beta coefficients and regression coefficients and their levels of statistical significance

Parameter/test	Factor	Standar. BETA	Regression coef.B	p≤
body height	lead in blood	–0.08	–0.26	0.29
	number of children in family	–0.15	–1.12	0.07
	physical activity	0.05	0.47	0.51
body weight	lead in blood	–0.13	–0.53	0.10
	number of children in family	**–0.19**	**–1.91**	**0.02**
	physical activity	–0.01	–0.14	0.88
hand grip	lead in blood	–0.15	–0.34	0.06
	number of children in family	0.00	0.00	1.00
	physical activity	0.04	0.27	0.61
ball throw	lead in blood	–0.06	–0.56	0.44
	number of children in family	0.07	1.65	0.36
	physical activity	**0.35**	**9.73**	**0.00**
standing jump	lead in blood	–0.11	–5.59	0.15
	number of children in family	–0.11	–13.94	0.15
	physical activity	**0.27**	**38.98**	**0.00**
tapping test	**lead in blood**	**0.22**	**1.68**	**0.01**
	number of children in family	0.09	1.76	0.24
	physical activity	**–0.16**	**–3.64**	**0.04**
balance	lead in blood	0.00	0.00	0.99
	number of children in family	0.07	0.02	0.41
	physical activity	**0.18**	**0.06**	**0.03**

Condition abilities

Condition abilities based on, among other things, energetic transformations, are connected strongly enough with somatic features to also determine their important predispositions. It is not surprising that there is in fact a lack of significant relationships between environmental factors and the static strength of the hand, which is, as we can read in Ignasiak's sentence (1988), strongly related to the general dimensions of the body and especially to body height (this feature in our investigations did not show connections with the analysed modifiers). Otherwise there remains explosive strength of both the upper and lower limbs (legs), the increment of which is statistically significantly connected with physical activity. It is important that the remaining two other factors, and especially the level of lead in the blood, have a negative influence on the level of explosive strength. The foregoing observation has significant practical implications pointing out this, that in an environment which is ecologically endangered, which certainly does not favour a profitable biological development, it is possible to stimulate the development of children by applying movement. Coefficients of regress show that an increase in activity improved results in the long jump by about 10 centimetres, and in the throw with a medical ball by about 40 centimetres – it is an increase in the explosive strength of the upper and lower limbs.

Co-ordination ability

The basis for co-ordination ability is the efficiency of the activity of the nervous system. It is probably a reason for greater, in comparison to earlier analysed parameters, relationships of the speed of movements to the level of lead in the blood. Increasing the level of lead in the blood by about 1 μg accompanies the extension of the time of executing tests by about over 1.5 seconds. This factor influences the speed of movements most strongly, which is confirmed by standardised beta coefficients. However the influence of physical activity on this predisposition also statistically significant, but the influence is less. It proves that properly dosed physical activity can stimulate the development of co-ordination predisposition, healing the unprofitable influence of environmental modifiers.

Multidimensional relationships between analysed groups of parameters in the light of canonical correlations

The above analysis is somewhat broader than simple correlations and sheds light upon the problem of relationships between different parameters, but this method makes possible only the estimation of the influence of several factors on a single parameter. However, the human organism is not a straight sum of single parameters, but a complicated complex, linking each parameter to

TABLE 3
Canonical weights for somatic features

body weight	0.88
body height	0.16
PB-b	0.32
number of children in family	0.97
physical activity	0.18

TABLE 4
Canonical weights of condition abilities

hand grip	0.86
standing jump	0.16
ball throw	0.88
PB-b	0.16
number of children in family	0.58
physical activity	0.70

TABLE 5
Canonical weight for co-ordination abilities

tapping test	0.90
balance	0.42
PB-b	0.80
number of children in family	0.01
physical activity	0.78

Fig. 1
Canonical correlations

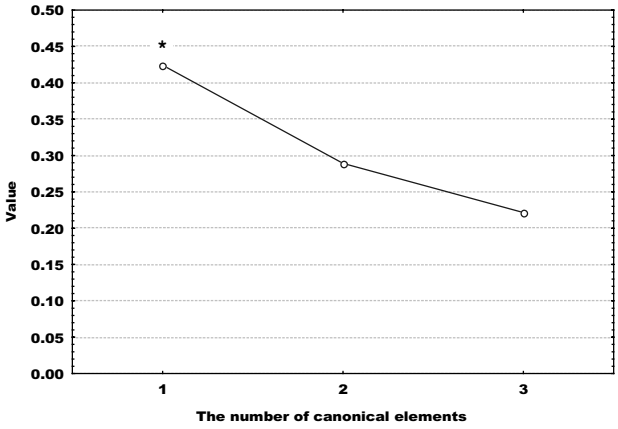
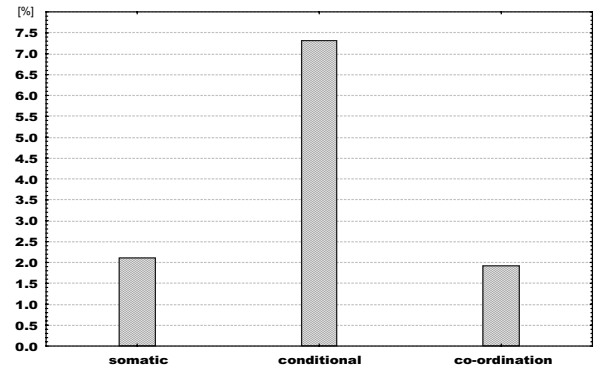


Fig. 2
Values of redundancies for each groups of parameters



another, entering in intricate interactions a conglomeration of components. So it is suggested to supplement the usage of the above methods by using canonical correlation. It permits us to show relationships between groups of parameters with regard to individual contributions carried in by a single factor in all correlations (canonical weight) and to qualify redundancies.

In analysis we concentrated only on comparisons of the magnitude of redundancies of canonical variables of groups of three factors with a group of somatic features, motor abilities and co-ordination predisposition and indicate the variables most related in every model.

The analysis of entire redundancies between the first and most essential canonical variables in every accumulation for the first separated canonical element in groups of examined parameters (Fig. 1) shows a generally low percentage of explained variability of groups of parameters by the analysed factors (Fig. 2). It testifies that factors selected for analysis are not only unique, having an influence on the analysed somatic and functional features, but their influence is perceptible.

The level of lead in the blood, the number of children in each family and physical activity treated together influence, to the greatest degree, conditional abilities. To a lesser degree they are related to the group of co-ordination predisposition, although the range of this account is little different from the range of connections with somatic features. The obtained results can show a greater ecosensitivity of functional features creating conditional abilities in comparison to structural features such as body height and weight or co-ordination traits which are conspicuous with greater genetic stability.

To rate the influence of single variables on the formation of a model of connections in all groups for further analysis, we surrendered canonical weights in 3 groups of parameters (TABLE 3–5, Fig. 3–5).

In a model of connections between analysed factors with somatic parameters, the greatest influence on the formation of relationships was had by body weight and the number of children in each family (TABLE 3, Fig. 3). It shows the imminent connections of these somatic features and the social-economic factor. Considerably less significant was the participation of body height and the remaining factors. A similar result was obtained by us in preceding investigations (Domaradzki et al., 2001). There were greater relationships of social-economic factors, than the pollution of the natural environment, with somatic features also being observed Hulanicka et al. (1994).

Fig. 3
Canonical weights for somatic features

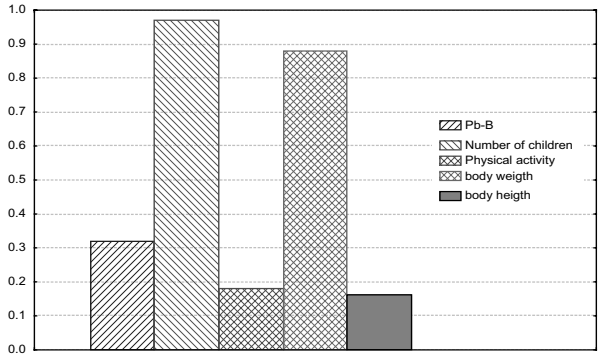
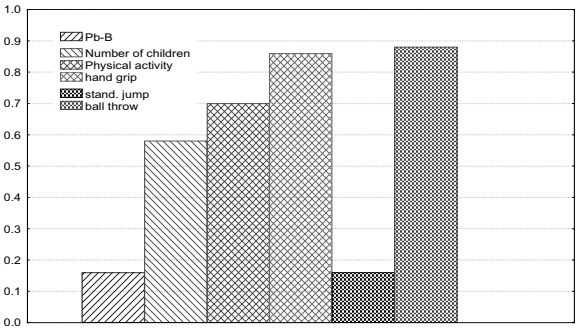


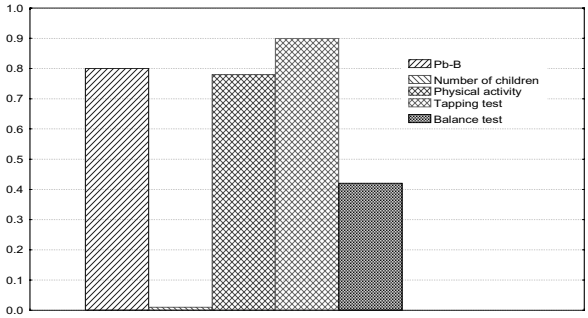
Fig. 4
Canonical weights of conditional abilities



In models constructed for conditional abilities the greatest accounts refer to the static and explosive strength of the upper limbs and physical activity (TABLE 4, Fig. 4). Weaker connections were shown with the number of children in each family. Conditional abilities are determined by a team of functional features mostly on an energetic basis. The efficiency of processes of the releasing of indispensable energy for muscular work is possible to train. Stronger relationships between these abilities and the factor of physical activity are rather intelligible.

Environmental pollution is a factor which, more strongly than remaining factors, influences co-ordination abilities (TABLE 5, Fig. 5). Stronger connections refer to the speeds of movements than to co-ordination balance. The reason for, in comparison to both earlier analyses, greater relationships of the level of lead in the blood, could be the fact that the basis of co-ordination ability is the efficiency of the activity of the nervous system. Lead being a neuro-toxin, it strongly attacks the most important and most sensitive system in the human organism – the nervous system. The second factor connected with both co-ordination predispositions is physical activity. Its considerable participation suggests that by surrendering the organism to physical effort we can

Fig. 5
Canonical weight for co-ordination abilities



stimulate the development of co-ordination abilities and in this manner we can weaken the unprofitable influence of other factors.

RESULTS AND CONCLUSIONS

1. Acceptance to the analysis group of factors determines a narrow scale of modifiers of formative structural and functional components of the organism. We should search for more factors explaining more biological variability of the organism in further investigations.

2. The social-economic factor showed itself to be stronger than the remaining factors, connections with the sphere of somatic structure, confirming reports by other authors about the greater part played by social-economic factors, greater than the pollution of the natural environment, in the formation of directions of somatic development of children.

3. The remaining two factors create stronger accounts with the sphere of the function of the organism. Physical activity stimulates the level of development of functional features based on energetic transformations. The level of lead in the blood is more strongly connected with functional features dependent on the efficiency of the activity of nervous system.

4. However the negative influence of the level of lead in the blood can be softened by suitable supplementary physical fitness.

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FAKTORY PROSTŘEDÍ A STRÁNKY ZDRAVÉHO ŽIVOTNÍHO STYLU JAKO PREDIKÁTORY MORFOLOGICKO-FUNKČNÍHO ROZVOJE DĚTÍ V POLSKU

(Souhrn anglického textu)

V předložené stati je řešena problematika modifikátorů, které ovlivňují rozvoj dětí v oblasti somatické a funkční. Pokusili jsme se dokázat, že činitelé jako je pořadí dítěte v rodině (činitel společensko-ekonomický), hladina olova v krvi (činitel spojený se znečistěním místa bydliště) a pohybová aktivita (element životního stylu) k těmto determinátorům patří.

Cílem práce je hodnocení hierarchie, směrů a síly vlivů těchto činitelů na morfologickou stavbu, kondiční a koordinační schopnosti. Měření bylo provedeno v roce 1996 v Polkovicích, v malém městě východního Polska. V předložené stati prezentujeme výsledky měření u skupiny 154 11-letých chlapců: výška a hmotnost těla, síla stisku ruky, skok do dálky z místa, hod plným míčem, tapping-test a flamingo-balanční test. Anketou byl zjišťován počet dětí v rodině a míra pohybové aktivity. Empirický materiál byl doplněn výsledky zkoumání hladiny olova v krvi. Výsledky analýzy ukazují na úzkou souhru modifikátorů, podílejících se na strukturálních a funkčních komponentech organismu. Činitel společensko-ekonomický působí zejména v oblasti somatické, úroveň kondičních schopností koreluje s mírou pohybové aktivity a úroveň koordinačních schopností s hladinou olova v krvi.

Klíčová slova: společensko-ekonomické činitele, podmínky místa bydliště, rozvoj dětí a mládeže, oblast morfologicko-funkční, hladina olova v krvi.

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RESPIRATION FREQUENCY AND SPECTRAL ANALYSIS OF HEART RATE VARIABILITY

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The results of the short-term recording of the spectral analysis (SA) of heart rate variability (HRV) in 20 healthy volunteers (aged 32.55 ± 12.75; 8 male and 12 female) with additional vagal stimulation by controlled breathing are presented in this article. A fourth position (supine with controlled non-deep breathing with a frequency of 0.2 Hz) was added to a standard orthoclinostatic test in three positions (supine-standing-supine).

The influence of breathing frequency on SA HRV was identified partly by comparing standard parameters in the third and the fourth supine position, partly by comparing complex parameters (Stejskal et al., 2002) obtained from standing and supine positions during spontaneous breathing (positions 2 and 3) and from standing and supine positions with controlled breathing (positions 2 and 4).

Via means of individual standard parameters of SA HRV evaluation the increase in vagal activity with controlled breathing was not clearly confirmed. On the contrary, comparison of complex parameters (vagal activity, sympathovagal balance and total score) during spontaneous and controlled breathing clearly demonstrated increased vagal activity.

Keywords: Spectral analysis of heart rate variability, respiration frequency.

INTRODUCTION

The spectral analysis (SA) of heart rate variability (HRV) is a non-invasive method enabling us to quantify the activity of the autonomous nervous system (ANS).

There are three main spectral components in the spectrum of short-term HRV recording: VLF (very low frequency, in our modification – 0.02 to 0.05 Hz) – its output is related to the thermoregulatory sympathetic activity of blood vessels, to the level of circulating catecholamines or to oscillations in the rennin-angiotensin system; LF (low frequency – 0.05 to 0.15 Hz) – reflects baroreflex activity in which sympathetic and parasympathetic activity participate; HF (high frequency – 0.15 to 0.50 Hz) – is influenced by efferent vagal activity only.

The spectral power of heart rate variability is influenced by many external (physical activity, daytime, season, quantity and quality of sleep, medication, fluid/food intake, alcohol, smoking, altitude, temperature etc.) and internal factors (age, health, gender, fitness, and body position). Respiration also significantly influences SA HRV results because it induces periodical oscillations of the heart rate (HR) – respiratory sinusoidal arrhythmia (RSA). Slower respiratory frequency (RF) produces bigger RSA and the power of the HF component increases as well (proof of increased vagal activity); on the contrary, with faster respiration the HF component is reduced (Malik & Camm, 1995; Stejskal & Salinger, 1996; Šiška, 2000; Šlachta, 1999).

In the case of respiration frequency slower than 0.15 Hz (less than 9 breaths/min), the HF component is not only reflecting vagal activity, it also reflects sympathetic activity (Aguirre et al., 1990; Pitzalis et al., 1998). According to Barron and Hemli (2000), with deep breathing approaching the frequency of 0.1 Hz, the spectrum of HRV is created partly by components related by respiration (parasympathetic) and partly by non-respiratory components, which are at least partly of sympathetic origin.

The aim of this study was to compare SA HRV under conditions of spontaneous and controlled breathing with the use of a new SA HRV evaluation method (Stejskal et al., 2002).

METHOD

SA HRV evaluation by complex parameters

SA HRV evaluation by means of individual indexes is relatively difficult and very often less conclusive and even antagonistic results can be found. These discrepancies led authors to creating a new evaluation method of SA HRV (Stejskal et al., 2002).

The authors worked with the assumption that the most important external factors influencing ANS function are aging and some diseases. Exercise intensity significantly influences the HRV spectral power as well: gradually descending vagal activity is presented by gradually descending total spectral power and the power of individual components. The gradual transfer

of spectral power to slower fluctuations is proved by an increase in the VLF percentage and its ratio to LF and HF components (VLF/LF a VLF/HF) (Stejskal et al., 2000).

Due to the previous findings for the new evaluation of SA HRV the authors used all age dependent parameters obtained from the orthoclinostatic manoeuvre from 216 healthy volunteers aged 12 to 70 years (35.05 ± 14.30) (Šlachta et al., 2002). Parameters decreasing with age, disease and exercise intensity are combined in the complex index of vagal activity (VA). Parameters increasing with age, disease and exercise intensity are joined in the complex index of sympatho-vagal balance (SVB) (Stejskal et al., 2000). By combining these two parameters, we acquire a so-called total score (TS) of SA HRV (which reflects all of the combined age dependent parameters). By relating the total score to calendar age we get a so-called functional age of ANS (Stejskal et al., 2002).

All complex indices are represented by point values from +5.0 to –5.0 points. Positive values mean high vagal activity and shift of the sympatho-vagal balance towards the vagus; negative values have the opposite meaning.

The new SA HRV evaluation method leads to a more unambiguous identification of less noticeable changes in the power spectrum; orientation in the complex indices of SA HRV is, in comparison to the standard parameters, easier and the interpretation of results less complicated.

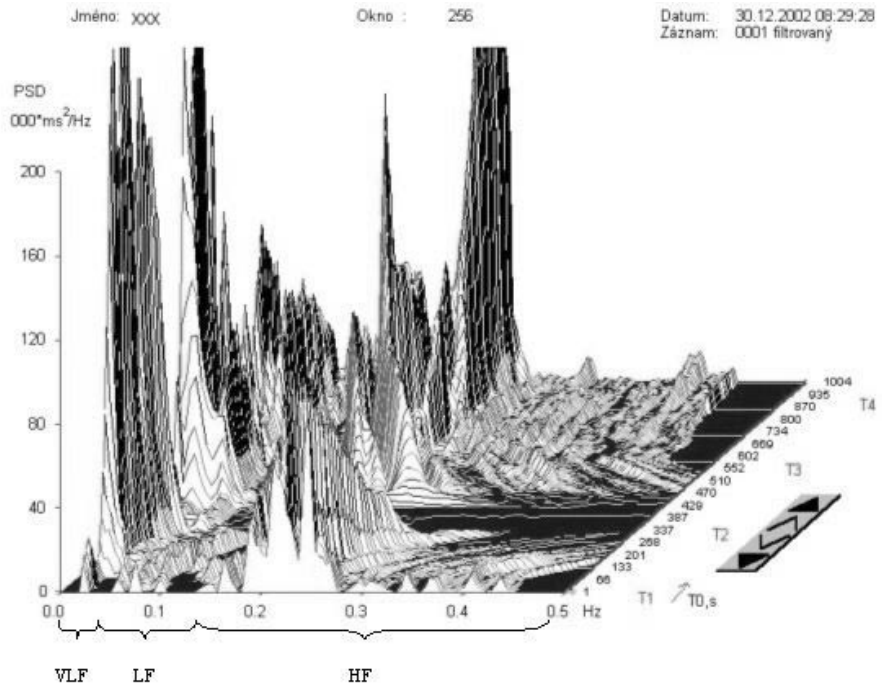
Methodology

We tested 20 volunteers aged 32.55 ± 12.72 years (8 male and 12 female). All subjects were healthy and free of medication except for women taking hormonal contraceptives. Nobody carried out regular aerobic physical activity; two subjects smoked not more than five cigarettes a day, the others were non-smokers.

We measured HRV by means of the original hardware and software VarCor PF5 (Salinger et al., 2003). The number of recordings of cardiac cycles was increased from 300 to 330 (Stejskal & Salinger, 2003) because of the time data stacionarity and the possibility of improving the filtration of multiple arrhythmias and artifacts. For SA HRV calculation the standard number of 256 R-R intervals was used.

The fasting subjects were examined by the means of an orthoclinostatic test in the morning. Subjects lay in a quiet room with closed eyes during the whole test. After 330 heart contractions the subjects stood up and stayed in this position until 330 heart contractions had been recorded; than the subjects reclined again and 330 further heart contractions were recorded. ECG registration started 45 seconds after changing each position. Thus all periods of measurements were carried on in a steady-state. To this standard orthoclinostatic test

Fig. 1
Three-dimensional graph of SA HRV measured in four positions (supine-standing-supine-supine)



VLF = 0.02–0.05 Hz; LF = 0.05–0.15 Hz; HF = 0.15– 0.50 Hz; T1 = supine position (spontaneous breathing); T2 = = standing position (spontaneous breathing); T3 = supine positron (spontaneous breathing); T4 = supine position (controlled breathing)

(supine-standing-supine), a fourth position was added (Fig. 1) (supine with controlled non-deep breathing). One breathing cycle was 5 seconds long (2 s inspiration, 3 s expiration), thus breathing frequency was 12 breath/min (0.2 Hz). Breathing was directed by verbal instructions "breathe in, two, breathe out, two, three" from a tape recording. The ECG record from the first position was not evaluated; this was only used for measurement standardization. The second and the third position (ANS reaction to orthostatic and clinostatic tests during spontaneous breathing) or the second and fourth position (ANS reaction to orthostatic and clinostatic tests during controlled breathing) were evaluated.

We chose the following individual SA HRV parameters for statistical processing: total spectral power (P_T), spectral power of individual components (P_{VLF}, P_{LF}, P_{HF}), percentage of the individual components (% VLF, % LF, % HF), and ratios between individual components (VLF/HF, LF/HF, VLF/LF). In addition to these parameters, complex indices of SA HRV (TS, VA, and SVB) were also calculated.

Basic statistical characteristics (average and standard deviation) and the paired Wilcoxon test were calculated by means of the software programs SPSS and Microsoft Excel.

RESULTS

HR, P_T a P_{HF} did not change during spontaneous and controlled breathing significantly. P_{VLF}, P_{LF}, % VLF a % LF were significantly lower within controlled breathing whereas % HF significantly increased (TABLE 1). That is why the VLF/HF and LF/HF ratios were significantly lower during controlled breathing while the VLF/LF ratio did not change significantly (TABLE 1).

All complex parameters (TS, VA a SVB) significantly increased during controlled breathing (TABLE 1).

TABLE 1
Comparison of heart rate and SA HRV parameters during spontaneous and controlled breathing

		spontaneous breathing	controlled breathing
HR	$\bar{x}$	60.52	60.94NS
	SD	6.79	7.32
P_T	$\bar{x}$	2867.84	2238.81NS
	SD	2476.76	1446.77
P_{VLF}	$\bar{x}$	217.11	157.52*
	SD	248.83	189.74
P_{LF}	$\bar{x}$	991.79	290.11**
	SD	1312.96	283.20
P_{HF}	$\bar{x}$	1658.94	1791.19NS
	SD	1517.90	1269.22
%VLF	$\bar{x}$	13.63	9.22*
	SD	12.14	7.93
%LF	$\bar{x}$	29.25	15.09*
	SD	15.49	13.83
%HF	$\bar{x}$	57.12	75.69**
	SD	18.12	18.96
VLF/HF	$\bar{x}$	0.33	0.17**
	SD	0.46	0.20
LF/HF	$\bar{x}$	0.67	0.30**
	SD	0.58	0.45
VLF/LF	$\bar{x}$	0.65	0.83NS
	SD	0.61	0.77
VA	$\bar{x}$	–0.13	0.33*
	SD	1.67	1.50
SVB	$\bar{x}$	0.59	1.80**
	SD	1.56	1.84
TS	$\bar{x}$	–0.03	0.84**
	SD	1.58	1.32

$\bar{x}$ = average value; SD = standard deviation; HR = heart rate; VLF = very low frequency; LF = low frequency; HF = high frequency; P_T = total spectral power; P_{VLF} = VLF power; P_{LF} = LF power; P_{HF} = HF power; % = relative part of individual component in total power; VA = complex index of vagal activity; SVB = complex index of sympatho-vagal balance; TS = total score of SA HRV; NS = = no significant difference; * = $p < 0.05$; ** = $p < 0.01$

DISCUSSION

A high degree of standardization is necessary for SA HRV measuring due to many external and internal factors, which can influence HRV considerably (Malik & Camm, 1995; Stejskal & Salinger, 1996; Šiška, 2000); that is why we tried measuring conditions in a maximally standardized manner (measuring approximately at the same times of day and minimizing sensual stimulations).

Controlled breathing with a frequency of 0.2 Hz, did not change the value of P_T and rather than absolute changes of the HRV spectrum, a shift of spectral power towards faster fluctuations took place.

An insignificant decrease in P_T in association with a significant decrease in P_{VLF} and P_{LF} and an insignificant increase in P_{HF} can be caused by sympathetic activity reduction which contributes to the performance of both of the slower components (Stejskal & Salinger, 1996; Šiška, 2000). However, we do not have clear evidence, because SA HRV does not actually measure sympathetic activity. We can only claim that within controlled breathing with a frequency of 0.2 Hz, the spectral power shifts from the bands influenced by both branches of ANS to the band influenced by vagus only (significant increase in % HF). However, the change in P_{HF} is not significant; therefore we were not able to unambiguously

qualify the influence of controlled breathing on vagal activity by means of the P_{HF} only.

These unclear conclusions are in contrast with the unambiguous results of evaluation by means of complex SA HRV indices: differences in all complex indices are significant and show evidence of the increase in vagal activity within controlled breathing and shift of sympathovagal balance towards vagus. Thus this result confirms the results found by Malik and Camm (1995), that controlled breathing with a frequency between 0.20 and 0.30 Hz is characterized by the movement of sympathovagal balance towards the vagus.

Another factor influencing RSA is ratio of the duration of expiration/inspiration – within fast inspiration and slow expiration, RSA is bigger than with slow inspiration and fast expiration (Strauss-Blasche et al., 2000). That is why in research projects to come it will be necessary to investigate the influence not only of various breathing frequencies, but also investigate in detail the influence of different lengths of inspiration/expiration and possibly of breathing depth on HRV.

CONCLUSION

During controlled breathing frequency (0.2 Hz) P_T did not change; spectral power shifted from an LF to an HF band. SA HRV evaluation by complex indices seems to be more sensitive and unambiguously shows an increase in vagal activity during controlled breathing.

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RESPIRAČNÍ FREKVENCE A SPEKTRÁLNÍ ANALÝZA VARIABILITY SRDEČNÍ FREKVENCE

(Souhrn anglického textu)

V práci jsou prezentovány výsledky vyšetření krátkodobého záznamu spektrální analýzy (SA) variability srdeční frekvence (HRV) u skupiny 20 probandů ve věku 32,55 ± 12,75 let (8 mužů a 12 žen), u kterých byla měřena SA HRV při dodatečné stimulaci vagu řízeným dýcháním. Ke klasickému ortoklinostatickému testu ve třech polohách těla (leh-stoj-leh) byla přidána čtvrtá poloha (leh s řízeným neprohloubeným dýcháním s frekvencí 0,2 Hz).

Vliv frekvence dýchání na SA HRV byl identifikován jednak na základě srovnání standardních ukazatelů ve třetí a čtvrté poloze vleže, jednak na základě srovnání komplexních ukazatelů (Stejskal et al., 2002) získaných z polohy ve stoje a vleže při spontánním dýchání (po-

lohy 2 a 3), resp. ve stoje a vleže při řízeném dýchání (polohy 2 a 4).

Pomocí jednotlivých ukazatelů standardně používaných pro hodnocení SA HRV se při řízeném dýchání jednoznačně nepodařilo potvrdit vzestup vagové aktivity. Naopak srovnáním komplexních ukazatelů (vagové aktivity, sympatovagové rovnováhy a celkového skóre) při spontánním a řízeném dýchání bylo zvýšení vagové aktivity prokázáno jednoznačně.

Klíčová slova: spektrální analýza variability srdeční frekvence, frekvence dýchání.

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THE EVALUATION OF MORPHOLOGY AND FOOT FUNCTION

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The foot as a basal element of the human body does not only provide for locomotor movement but it is a substantial responsive sensor and its condition is radically reflected in postural activity demonstration.

We acquired the footprints (static and dynamic plantograms using the FootScan method) from students studying in the first class of The Physical Education and Recreation program at FTK UP in 2002 (55 male students and 65 female students). Plantograms formed on the basis of individual methods were mutually compared.

The evaluation of the longitudinal foot vault in males and females by means of a foot index by classical plantograph illustrates that it is evident that a high percentage (78.5– 90.9 %) thereof is present in the normal foot category. The flat foot category is represented only rarely. The frequency of occurrence of the cavus foot category is about 20 %. The results of foot type evaluation via the FootScan method appear to be different. The category of cavus foot occurred most frequently and that is, in more than 80 % of cases, in both feet. Categories of flat foot are not present at all.

We found valgose hallux with a significantly higher frequency in both genders in static podograms of both feet and its like in the dynamic podogram, with the exception of the dynamic podogram in males on the right foot (a higher frequency of varose hallux – 55 %). The frequency ratio of plus-rate and minus-rate of hallux angle is equalled in women when estimating its occurrence on the right and left foot. The negative average values of hallux misalignment in males are higher on the right foot than on the left foot in the static podogram and higher than on the dynamic podogram.

The average values of the plus-rate of the hallux angle, determined in accordance with individual methods do not differ significantly, varying from 3°–5° on both feet and for both genders. The average values of plus-rate misalignment of the little toe differ from 13° to 21°.

The Valgus heel position has reached more then 90 % occurence in both genders. The Varus position has been noticed only sporadically.

It appeared from our previous figures that the high frequency of collapsed longitudinal foot vault is not the primary problem, but forefoot deformities relating to collapsed transversal foot vault and to ache seem to be very serious.

Keywords: Static and dynamic plantogram, vault foot, normal, cavus and flat foot, hallux angle, little toe angle, foot angle, valgosity, varosity heel, FootScan, foot type, forces in plantar areas.

INTRODUCTION

The foot as a basal element of the human body does not only provide locomotor movement but it is a substantial responsive sensor and its condition is radically reflected in postural activity demonstration. Regarding the fact that each human being walks 4 times around the equator in the course of life, we suppose that feet well deserve thorough attention and that foot care deserves greater education of the public. The formation of the foot vault is completed around the age of 6.

The condition and the function of longitudinal and transversal foot vault is influenced:

- by genetic predispositions,
- by adequate physical strain (chronic overexertion and strain without adequate compensation),
- and last not least by anthropometricly appropriate and good quality footwear.

We can already observe foot deformities, particularly forefoot ones, in the age group of pre-school children.

It appeared from our previous figures that a high frequency of collapsed longitudinal foot vault is not the primary problem, but rather forefoot deformities relating to a collapsed transversal foot vault and to pain seem very serious. Deformities of the forefoot concern hallux misalignment (valgosity, varosity) and relate to a pronated forefoot position as well as to little toe misalignment, dilatation of the front foot (an uneven width of the left and right foot), toe deformities and metatarsalgy. The pronation position of the forefoot manifests itself in the loading the medial part of the foot and the overloading of the longitudinal foot vault. It is evident that alterations in the area of the forefoot affect the position of vertical forces in individual parts of the foot, manifesting themselves in a longitudinal foot vault condition and in the reactivity and elasticity of the foot.

For as much as the foot has kinetic functions (static and dynamic) it can consecutively come to changes of step and stereotypes of the gait of an individual and to modification of its motoric conditions.

Consequently those alterations will be reflected in the condition of the support-movement apparatus of the lower limbs, in the pelvic area and the lower part of the trunk. This relationship is also valid vice versa.

Fig. 1
FootScan

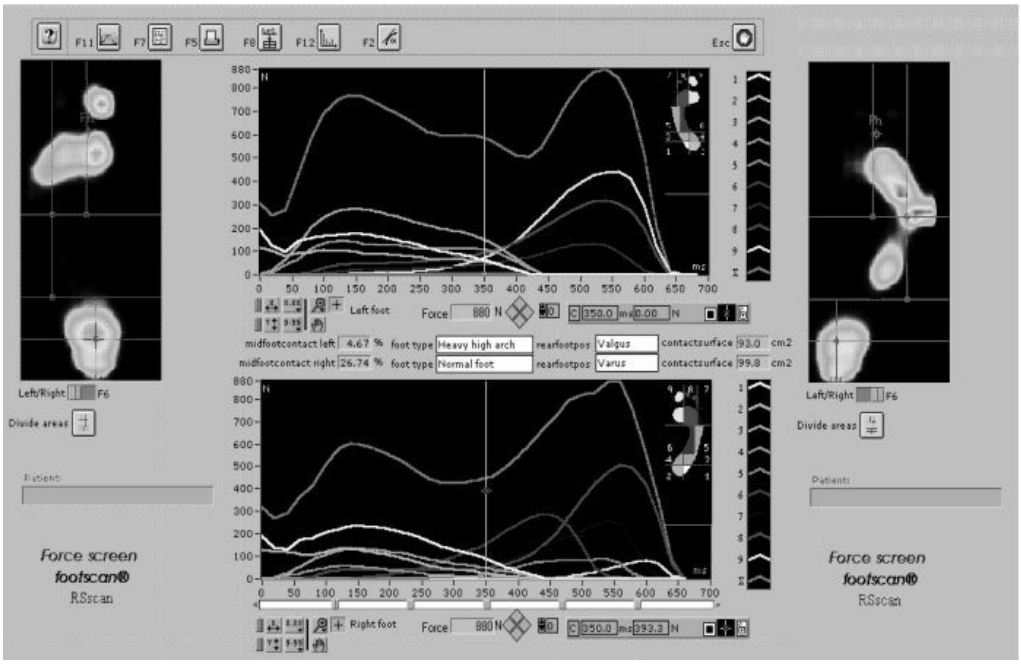
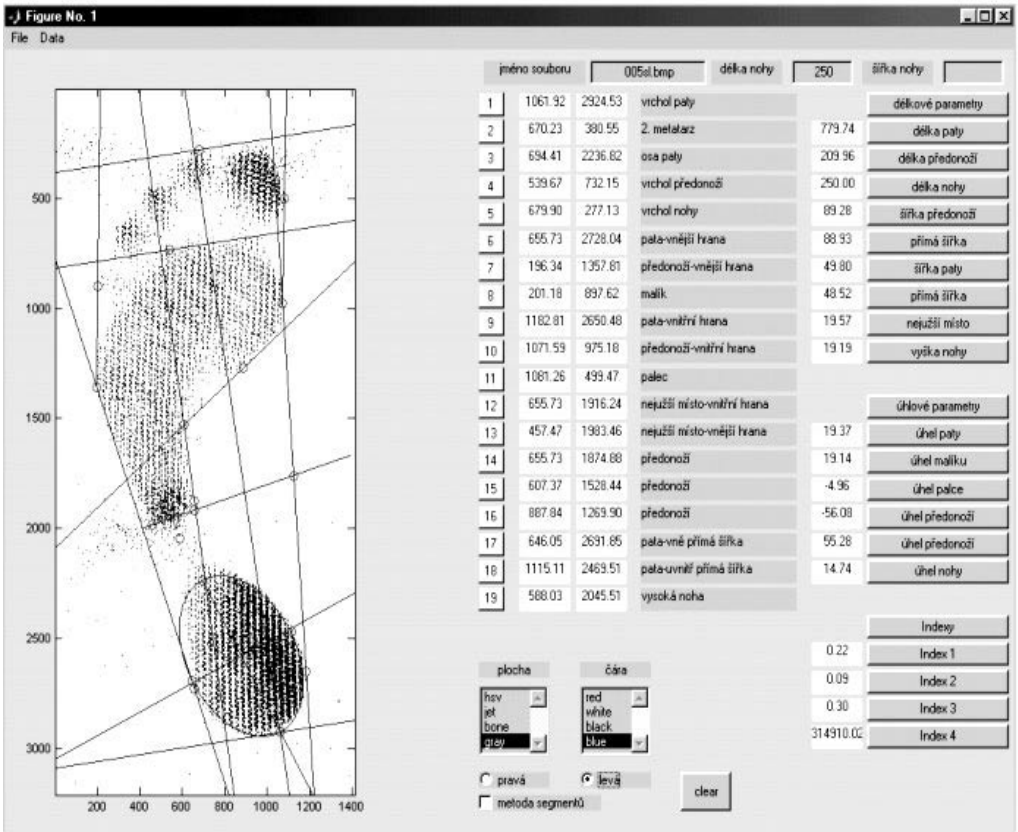


Fig. 2
Plantogram



METHODOLOGY

We acquired footprints from students studying the first class of The Physical Education and Recreation program at FTK UP in 2002 (age: 19–21 years). It concerns the population affected by a greater intensity and volume of physical activity. On the other hand we can assume that those probands wear better quality footwear. We made out static and dynamic plantograms on a French made podograph in 55 male students (height: $\bar{x}$ = 182.1 cm, s = 8.2 cm, weight: $\bar{x}$ = 75.0 kg, s = 5.8 kg) and 65 female students (height: $\bar{x}$ = 167.9 cm, s = 5.8 cm, weight: $\bar{x}$ = 62.0 kg, s = 5.2 kg).

State and foot function analysis can be done using various methods, such as the plantograph method (Dungl, 1989; Klementa, 1987; Kopecký, Hřivnová, & Zemánek, 2002; Kučera et al., 1994; Pražáková, 1985; Ledvinková, 2000; Přidalová & Riegerová, 2002; Přidalová et al., 2003; Urban, Vařeka, & Svajčíková, 2000; Šťastná, 2002), X-ray method, aspection, anthropometrical measurement (Klementa, 1987; Kučera et al., 1994), or by more sophisticated methods (Meyring, Diehl, Milani, Hennig, & Berlit, 1997; Razeghi & Batt, 2000; Rosenbaum, Hautmann, Gold, & Claes, 1994; Virmavirta & Komi, 1993; Virmavirta, Perttunen, & Komi, 2001).

Further, we analysed the footprint as part of the stride as acquired by the FootScan method. The FootScan method works with pressure force analyses in the area of the planta and on its basis it determines the type of the foot: heavy high vault foot (HHVF), high vault foot (HVF), light high vault foot (LHVF), normal foot (NF), light flat foot (LFF), flat foot (FF) (Fig. 1).

We appointed selected anthropometrical parameters in a footprint - foot index (Chippaux-Šmiřák, In Klementa, 1987), hallux angle, little toe angle (Pražáková et al., 1985; Hegrová, 1999; Ledvinková, 1999), foot angle (Klementa, 1987) and valgosity and varosity of the foot (Dungl, 1989). We worked with the help of the software program "Foot" (Elfmark & Přidalová, 2002), whose anthropometric points and individual parameters are precisely defined (Fig. 2).

The statistical relevancy of differences between foot parameters was assessed with the use of Wilcoxon's and Mann-Whitney's tests.

RESULTS

The evaluation of the longitudinal foot vault in males by means of a foot index by classical plantograph illustrates that it is evident that a high percentage is present in the normal foot category. The flat foot category is represented only rarely. The frequency of occurrence of the cavus foot category is about 20 % (TABLE 1).

The results of foot type evaluation by FootScan method appear to be different, where there is the most frequent occurrence of the cavus foot category and that is in more than 80 % of cases on the left and right foot. The flat foot categories are not present at all (TABLE 2).

The occurrence of flat foot in females is similar to that in males – thus rare. The evaluation of longitudinal foot vault by foot plantograph appears to be identical to that of males, highest frequency being in the normal foot category. We encounter a high frequency of cavus foot occurrence surpassing the 80 % limit in the FootScan method (TABLE 2).

TABLE 1
Frequency of foot index evaluation (plantograms) and foot type (FootScan)

		PLRD		PLRS		FOOTR		PLLS		PLLD		FOOTL	
		n	%	n	%	n	%	n	%	n	%	n	%
0	M	5	9.1	3	5.4	46	83.6	4	7.2	6	10.9	50	90.9
	W	12	18.5	12	18.5	53	81.5	13	21.5	11	16.9	57	87.7
1	M	50	90.9	49	89.1	9	16.4	50	90.9	47	85.5	5	9.1
	W	52	80.0	52	80.0	11	16.9	51	78.5	51	78.5	8	12.3
2	M	0	0	2	3.6	0	0	1	1.8	2	3.6	0	0
	W	1	1.5	1	1.5	1	1.5	1	1.5	1	1.5	0	0
3	M	0	0	1	1.8	0	0	0	0	0	0	0	0
	W	0	0	0	0	0	0	0	0	1	1.5	0	0
4	M	0	0	0	0	0	0	0	0	0	0	0	0
	W	0	0	0	0	0	0	0	0	1	1.5	0	0

PLRD – plantogram of right foot – dynamic, PLRS – plantogram of right foot – static
FOOTR – FootScan of right foot, PLLS – plantogram of left foot – static, PLLD – plantogram of left foot – dynamic, FOOTL – FootScan of left foot, 0 – hight vault foot, 1 – normal foot, 2 – 4 – flat foot, M – men, W – women

TABLE 2
Frequency of cavus foot (FootScan)

		LHVF		HVF		HHVF		NF		LFF	
		L	R	L	R	L	R	L	R	L	R
Men	**n**	17	19	18	14	15	13	5	9	0	0
(1 = 1.8 %)	%	30.9	34.5	32.7	25.5	27.3	23.6	9.1	16.4	0	0
Women	**n**	20	24	18	13	19	16	8	11	0	1
(1 = 1.5 %)	%	30.8	36.9	27.7	20.0	29.2	24.6	12.3	16.9	0	1.5

LHVF – light high vault foot, HVF – hight vault foot, HHVF – heavy hight vault foot, NF – normal foot, LFF – light flat foot, L – left, R – right

The average values of foot index in males are 32.1 % in static right podograph and 28.4 % in the left one. We found the average value of 32 % in the dynamic podogram with a minimal side difference. Average values of the foot index in the female in static and dynamic podograms differ on the left and right foot from 27.0 % to 29.6 % (TABLE 3).

TABLE 3
Average values of index foot

	PLRS		PLRD		PLLS		PLLD	
	M	W	M	W	M	W	M	W
n	55	65	55	65	55	65	55	65
$\bar{x}$	32.0	28.0	30.4	29.0	28.4	28.0	31.0	27.4
s	0.9	1.0	0.8	3.2	0.8	0.9	1.0	1.1

PLRD – plantogram of right foot – dynamic, PLRS – plantogram of right foot – static, PLLS – plantogram of left foot – static, PLLD – plantogram of left foot – dynamic, M – men, W – women

The average values of the plus-rate of the hallux angle, determined according to individual methods do not differ significantly, they vary from 2.9°–5.4° on both feet and both genders (TABLE 4, 5).

The average value of the plus-rate of hallux misalignment in females is significantly higher than in males (within the framework of individual methods). We found valgose hallux with a significantly higher frequency in both genders in the static podogram in both feet (in more than 50 % of students) and its like in the dynamic podogram, with the exception of the dynamic podogram in males on the right foot (higher frequency of varose hallux – 55 %). According to the FootScan method, hallux varosity prevails on both feet in both genders.

The frequency ratio of plus-rate and minus-rate of the hallux angle is equalled in women when estimating its occurrence on the right and left foot. The negative values of hallux misalignment in males are higher on the right foot than on the left foot in both the static and dynamic podogram. The negative values of hallux misalignment in females are higher on the left foot than on the right foot in both the static and dynamic podogram.

We monitored small toe misalignment in its positive as well as negative values. Only some individuals are found in the category of negative misalignment. The average values of plus-rate misalignment of the little toe differ from 13.1° to 20.8°. We haven't found any foot without small toe misalignment. The lowest values of small toe angle were determined on the dynamic podogram. The values of the little toe angle significantly differed on both feet in both genders on the footprint of the static and dynamic podogram. Lower small toe misalignment was observed in female feet (TABLE 6, 7).

Foot angle in males reached average values from 16.1° to 16.6° on both feet, within the framework of individual methods, without prominent side differences. The values in females varied from 15.7° to 16.3°. The foot angle illustrates a valgosity of about ≧18° and a varosity of the heel of ≦15°. The quantity of the foot angle determines the normal position of the heel, which does not correspond regarding the visual rating of the heel's position. We suppose that the foot angle does not have the appropriate characteristics for monitoring the heel's valgosity and varosity (TABLE 8).

TABLE 4
Average values and frequency of hallux misalignment in men

	Static plantogram								Dynamic plantogram							
	Right				Left				Right				Left			
	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s
(°, +)	30	54.5	3.4	2.9	35	63.6	4.6	3.9	25	45.5	4.4	2.9	32	58.2	4.1	2.9
(°, –)	25	45.5	–5.1	5.1	20	36.4	–4.2	3.5	30	54.5	–4.5	3.8	23	41.8	–3.1	–2.9

TABLE 5
Average values and frequency of hallux misalignment in women

	Static plantogram								Dynamic plantogram							
	Right				Left				Right				Left			
	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s
(°, +)	47	72.3	4.7	3.1	51	78.5	4.8	3.5	42	64.6	4.9	2.7	47	72.3	5.4	3.8
(°, –)	18	27.7	–2.9	2.8	14	21.5	–5.4	4.2	23	35.4	–2.9	2.3	18	27.7	–4.6	4.2

< 0 – hallux varosity (–), > 0 – hallux valgosity (+)

TABLE 6
Average values and frequency of small toe misalignment in men

	Static plantogram								Dynamic plantogram							
	Right				Left				Right				Left			
	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s
(°, +)	53	90.4	20.8	5.1	54	98.2	20.2	5.4	54	98.2	14.3	3.8	55	100	15.8	5.4
(°, –)	2	3.6	–28.6	0.22	1	1.8	–20.7	0	1	1.8	–23.3	0	0	0	0	0

TABLE 7
Average values and frequency of small toe misalignment in women

	Static plantogram								Dynamic plantogram							
	Right				Left				Right				Left			
	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s
(°, +)	64	98.5	16.9	6.1	65	100	17.2	5.7	64	98.5	13.1	6.3	62	95.4	13.9	5.1
(°, –)	1	1.5	–21.7	0	0	0	0	0	1	1.5	–0.8	0	3	4.6	–2.1	1.9

< 0 – little toe varosity (–), > 0 – little toe valgosity (+)

TABLE 8
Average values and frequency of foot angle in men and women

	Static plantogram								Dynamic plantogram							
	Right				Left				Right				Left			
	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s	n	%	$\bar{x}$	s
Men	55	100	16.3	1.7	55	100	16.1	1.8	55	100	16.6	1.8	55	100	16.1	1.7
Women	65	100	15.9	2.0	65	100	15.7	2.0	65	100	16.3	1.9	65	100	16.0	1.8

TABLE 9
The frequency of various positions of the rear-foot (FootScan method)

Heel		Valgozity		Varozity		Neutral	
		L	R	L	R	L	R
Men	n	38	42	11	9	6	3
	%	69.1	76.4	20.0	16.4	10.9	5.4
Women	n	44	52	16	11	5	2
	%	67.7	80.0	24.6	16.9	7.7	3.1

The order of frequency of the rear-foot position occurrence is about the same in both sexes. The rear-foot position is most numerously present in the valgoze position, in women it is on the right side in 80 % of cases. The least numerous is the occurrence of the neutral position. Both valgozity and varozity influence and are influenced by the state and function of the muscle groups, particularly in lower limbs and in the trunk area (TABLE 9).

From observed foot parameters between men and women, there were significant differences in the static plantogram of the angle of the little toe on both feet, in

TABLE 10
Significant differences of foot parameters in men and women

M – W	Static plantogram		Dynamic plantogram	
	Right	Left	Right	Left
F1	0.002	0.011	0.304	0.053
F2	0.003	0.112	0.012	0.082
F3	0.459	0.439	0.289	0.968
Ch-S	0.049	0.734	0.787	0.073

F1 – little toe angle, F2 – hallux angle, F3 – foot angle, Ch-S – foot index Chippauxe-Šmiřák, M – men, W – women

TABLE 11
Significant differences of foot parameters in men and women on static and dynamic plantograms

Dynamic – static	Men		Women	
	Right	Left	Right	Left
F1	<0.001	<0.001	<0.001	<0.001
F2	1	1	0.619	1
F3	0.177	0.787	0.082	0.804
Ch-S	0.074	0.061	0.322	0.775

F1 – little toe angle, F2 – hallux angle, F3 – foot angle, Ch-S – foot index Chippauxe-Šmiřák, M – men, W – women

the angle of the big toe in both the static and dynamic plantograms on the right foot and in the static plantogram of the right foot – the foot index (Ch-S) (TABLE 10).

Significant differences were found in the static and dynamic plantograms among foot parameters – in both sexes only in the angle of the little toe and that is on the left and right foot. The lateral beam of the foot appears to be more flexible. On the basis of our outcome in this population of students it is possible to claim that there is no great difference in the performance of the footprint on the basis of the static or dynamic plantogram (TABLE 11).

Significant differences between left and right foot were found in the big toe angle in men in the static plantogram and in the foot index (Ch-S). The borderline of significance is the big toe angle and foot angle in the dynamic plantogram. So it is obvious that from the point of view of laterality, the position of the big toe and the foot in the male student population is different, which is probably connected to the dominant limb. These differences were not determined in women (TABLE 12).

On the basis of the functional parameters of the evaluation of the foot using the FootScan method we

TABLE 12
Significant diferences of parameters on the right and left foot in men and women

Right – left	Men		Women	
	Static	Dynamic	Static	Dynamic
F1	0.281	0.281	1	0.457
F2	0.003	0.059	0.804	0.619
F3	0.418	0.059	1	0.457
Ch-S	0.002	0.461	0.885	0.193

F1 – little toe angle, F2 – hallux angle, F3 – foot angle, Ch-S – foot index Chippauxe-Šmiřák, M – men, W – women

found out that the highest average force displays itself in the area of the middle part of the forefoot in both genders, on both feet. It is followed by the heel part, where force distribution differs laterally in individual areas in accordance with the dominant lower limb. The exterior part of the heel on the left foot is notably loaded in both genders. On the contrary, on the right foot it is the interior side of the heel. The average force acting on the heel zone is considerably higher in men than in women, but there are no significant differences between genders in the area of the middle part of the forefoot. So it is evident that the heel is apparently more loaded in men, where the heel strike is vigorous. The middle part of the forefoot is overloaded in both genders and it does not differ by force dimension (TABLE 13).

CONCLUSION

- A collapse of the longitudinal foot vault is not the problem of students of Physical Education belonging to the sportive population. We believe that flat foot evaluation according to the foot index of Chippaux-Šmiřák is very vague and the range of evaluation within the framework of individual categories is relatively broad. We observed the occurrence of cavus foot in students of Physical Education, in which we find irregular distribution of forces in the planta area. The centre of the forefoot and heel are greatly overloaded in the cavus foot, which is accompanied by the sole of the foot aching in its front part.
- The FootScan method evaluates the longitudinal foot vault in a dissimilar way and shows a higher frequency of the cavus foot in both genders.
- A collapse of the transversal foot vault or its long term overloading is accompanied by front foot area deformities, thus hallux misalignment, little toe misalignment and other toe deformities.
- It is essential to monitor valgosity or varosity and also hallux misalignment into its plus-rate or minus rate figures. Hallux varosity relates to a pronated

TABLE 13
Basic statistical characteristics of the average force in the sole areas

Areas	Men						Women					
	x̄	med	s	min	max	n	x̄	med	s	min	max	n
1L	135.2	139.9	44.22	69.6	272.2	55	113.8	116.4	44.77	35.7	240.7	65
1R	113.7	113.2	38.16	56.8	240.4	55	85.42	78.9	28.63	28.5	167.3	65
2L	96.66	92.5	38.8	36.1	252.2	55	81.26	78.6	28.99	25.9	147.7	65
2R	131.9	124.1	37.28	71.1	228.8	55	106.2	104.1	32.26	31.5	202.1	65
3L	99.93	105.3	38.65	19.8	213.7	55	75.57	73.7	29.73	12.2	135.7	65
3R	87.26	87.8	37.26	10.7	155.3	55	68.19	69	26.1	19.6	126.4	65
4L	61.31	57.1	28.63	2	137.9	55	46.69	40.4	23.58	1.3	108.4	65
4R	77.71	76.3	36.43	1.5	174.9	55	64.61	61.4	27.49	10.4	139.1	65
5L	24.9	18.4	24.21	0	107.3	51	16.15	11.25	19.72	0	117.3	62
5R	22.73	16.4	23.44	0	94.7	52	13.77	12	11.61	0	43.2	59
6L	8.99	1.4	12.97	0	49.4	45	8.45	1.6	12.18	0	51.9	59
6R	23.38	13.85	29.57	0	139.6	46	21.24	13.7	24.23	0	91.9	58
7L	105.2	108.1	38.24	29.9	185.7	55	63.37	61.6	27.01	18.5	129.3	65
7R	81.22	71.1	44.87	26.8	202.8	55	51.49	45.2	26.82	10.1	118.6	65
8L	170.1	178.4	35.59	84.4	245.9	55	165.2	164.4	37.56	84.4	284.4	65
8R	167.3	166.6	46.3	77.1	277.5	55	160.5	157.1	37.64	78.1	258.1	65
9L	127.1	111.4	60.01	27	261.7	55	107.9	96.8	43.05	27.7	256	65
9R	136	124.6	64.07	46.2	297.1	55	123.4	125.8	39.64	50	242.2	65

R – right, L – left, 1–9 – the area of sole (figure)

forefoot position, concurrently to the declination of the longitudinal foot vault, even though according to the foot index it is often not estimated as being a flat foot. In relation to the pronated position of the forefoot, we observed feet depivoting, thus walking with points of the feet pointing towards each other.

- Small toe misalignment illustrates relatively positive values, which are related as well to forefoot deformation.
- The quantity of foot angle determines the normal position of the heel, which does not correspond regarding the visual rating of the heel position. We suppose that the foot angle is not the appropriate characteristic for monitoring heel valgosity and varosity. The Valgus heel position has reached more than 90 % occurence in both genders.
- A dynamic podogram informs us about the foot while it is taking off and introduces the foot as a more "physiological" formation, nevertheless it is necessary to judge the quality of the tread and further expand the footprint selection.
- The FootScan method serves for the evaluation and distribution of pressure forces in the plantar area. The highest average force was recorded in the middle part of the forefoot both in men and women, followed by the heel. The heel load in the individual spheres differed in accordance with the dominant lower limb.
- One of the most interesting results is the fact that the most loaded part of the foot is the middle part of the rear foot. Another interesting result is that the point of ground contact of the left foot is its lateral part, while on the right foot it is its medial part – with no influence of the foot type, rear foot position or sex. Significant differences between the foot types and types of rear foot positions were also found. For example with increasing height of the foot arch and increasing tendecy to varosity, the share of the load is higher on the midfoot – especially in the male foot. A Particularly heavy high vault foot (HHAF) in the whole midfoot and a high vault foot (HAF) in its medium part are in contact with the ground significantly longer than other foot types. Relating to these results is the fact, that the higher foot arch is, the later it loses contact, in the midfoot and earlier in the forefoot.
- The foot condition must be monitored simultaneously with the evaluation of the support-movement system in the lower part of the trunk and with a lower limb condition.

- A significant relationship exists between shortened lower limb muscles (especially the flexors and extensors of the hip joint) and foot parameters (Přidalová, Riegerová, & Rýznarová, 2002)

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HODNOCENÍ MORFOLOGIE A FUNKCE NOHY

(Souhrn anglického textu)

Noha jako bazální článek lidského těla neslouží pouze k lokomočnímu pohybu, ale je významným senzitivním čidlem a její stav se výrazně odráží v demonstraci posturální aktivity. Stav a funkce nohy je ovlivněna různými činiteli: genetickými predispozicemi, adekvátní fyzickou zátěží, následnou kompenzací a antropometricky vhodnou a kvalitní obuví.

Stav nohou jsme hodnotili různými metodami plantografie a metodou rozložení tlakových sil v oblasti chodidla u studentů 1. ročníků oborů rekreologie a tělesné výchovy FTK UP (v r. 2002). Zaměřili jsme se na determinaci morfologických a funkčních parametrů nohy: index nohy, úhel palce, malíku, nohy, paty, typ nohy, maximální sílu v jednotlivých částech chodidla. V plantografii jsme využívali statický a dynamický otisk nohy.

Dospěli jsme k následujícím závěrům: u studentů TV a rekreologie je podélně plochá noha výjimkou. Hodnocení plochonoží dle indexu Chipauxe a Šmiřáka se nám jeví jako vágní, meze jednotlivých kategorií jsou velmi široké. Typické pro tuto sportovní populaci jsou deformity v oblasti předonoží, na něž poukazují vysoké hodnoty úhlu palce a malíku. Je zřejmé, že při hodnocení vyosení palce je nutné brát v úvahu valgozitu i varozitu. Typické je rovněž vyosení paty ve smyslu valgozity, méně varozity (metoda FootScan). S přímým postavením pat se setkáváme pouze ojediněle. Na základě i předchozích výsledků je možno konstatovat, že vyosení pat souvisí rovněž s postavením pánve, kyčelních a kolenních kloubů a stavem svalů na dolních končetinách.

Dynamický podogram představuje nohu jako „fyziologičtější“ útvar, ve smyslu laterálního paprsku. Na základě testování stavu podélné klenby nožní dle indexu nohy a úhlu palce a nohy nehraje roli, zda využijeme dynamického či statického otisku.

Metoda FootScan slouží pro vyhodnocení a rozložení sil aj. parametrů v oblasti planty, zaznamenává otisk až od určité síly kontaktu chodidla s podložkou. Nižší citlivost pravděpodobně způsobila vysokou frekvenci výskytu vysoké nohy u námi sledovaných souborů. Největší průměrnou sílu jsme zaznamenali u mužů i žen ve střední části předonoží, následovala pata. Zatížení paty v jednotlivých areách bylo různé u pohlaví i pravé a levé nohy, svou roli sehrála rovněž dominantní končetina.

Klíčová slova: statický a dynamický podogram, klenba nožní, normálně klenutá noha, plochá a vysoká noha, úhel palce, malíku, nohy, FootScan, typ nohy, valgozita, varozita nohy, síly v oblasti jednotlivých částí chodidla.

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PREDICTION OF SUCCESS IN SPORTS DANCING BASED ON MORPHOLOGICAL CHARACTERISTICS AND FUNCTIONAL CAPABILITIES

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Research was conducted on 29 female sports dancers from Niš, aged 11.5 to 13.5. The purpose of the research was to determine the possibility of predicting success in sports dancing competitions on the basis of certain morphological characteristics and functional capabilities.

Predictive variables were made up of morphological characteristics and functional capabilities. Morphological characteristics were rated on the basis of the following parameters: average thorax volume, shoulder width, pelvis width, hip width, biceps skinfold, triceps skinfold, back skinfold and abdomen skinfold. The measurements were conducted according to the regulations of the International Biological programme. Functional capabilities were rated on the basis of the following parameters: vital capacity, the Astradan test of oxygen consumption in 1/min, oxygen consumption per kg of body weight in 1 minute, systolic pressure at rest, diastolic pressure at rest, pulse at rest, systolic pressure under strain, diastolic pressure under strain and pulse under strain.

The criterion variable was determined on the basis of the number of points scored in sports dancing competitions in Serbia, Monte Negro and other countries. The results were processed by regressive analysis. The obtained multiple correlation enables us to make the assumption basis of some morphological characteristics and functional capabilities applied to the sample group of dancers.

Keywords: Sports dancing, morphological characteristics, functional capabilities and successfulness.

INTRODUCTION

All anthropological characteristics to a certain degree are important for a successful sports dancer. There has been very little research dealing with successfulness in dancing. In some cases of research, either the single contribution of a certain capability and characteristics or the contribution of several capabilities and characteristics were proved to be decisive in successfulness in different kinds of dancing such as folk dancing, social dancing, jazz dancing, modern dancing, ballet, aerobics, etc.

Some accessible research reports dealing with morphological characteristics (body composition), functional capabilities, and the physiological indexes of various samples of examined dancers in various dances, were included.

In research done by Dolgener, Spasoff, & St-John (1980), the body build and composition of high ability female dancers were examined. Twenty-nine female ballet and modern dancers were measured for a series of body build and body composition variables. These statistics were compared to nonathletic and athletic women. The researchers found that the dancers had lower body weights and less body fat than the nondancers as well as generally smaller physical dimensions.

The body composition of ballet dancers has been researched by: Gudgeon, Eisenman, Hamblin, & Johnson (1989); Eisenman, Mikat, & Hamblin (1995); Hergenroeder, Brown, & Klish (1993); Hergenroeder, Fiorotto, & Klish (1991); Eliakim, Ish-Shalom, Giladi, Falk, & Constantini (2000) and others.

Pierce & Daleng (1998) researched the body image of a female ballet dancer. To examine body image and possible distortion of body image among elite female dancers, 10 members of a professional ballet company rated both current and ideal body shape. In addition, an objective measure of body composition was obtained via skinfold techniques.

T tests indicated that the mean rating for current body image was significantly higher than the rating for ideal, despite the fact that body-composition measures for all subjects were in an "ideal" range according to normative standards.

Analysis indicated a high distortion of body image among these dancers and support psychophysiological concerns previously raised.

Novak, Magill, & Schutte (1978) examined the influence of habitual dance on cardio-pulmonary fitness and

body composition and found dancers had significantly lower weight, resting heart rate, and diastolic pressure. They not only found that maximal oxygen uptake was higher in dancers when expressed in relative terms, but that this intake was reached at a lower maximal heart rate, a significantly higher grade of elevation and a greater speed of the treadmill.

The purpose of Rimmer & Rosentswieg's study (1982) was to determine the aerobic capacity of highly trained dance majors, and to compare them to other athletes. Eight highly trained female dance majors from Texas Women's University took part in the study. Assessment of maximum oxygen consumption was determined on the treadmill according to the Bruce protocol. Mean values of 52.4 ml/kg/min of oxygen consumption were found in the dancers. The dancers' aerobic power was comparable to elite swimmers and considerably higher than elite gymnasts and school athletes.

Study Lavoie & Lebe-Neron (1982) determined the physiological characteristics of professional jazz dancers and evaluated the effects of an 8-week jazz program on a group of female recreational dancers. Female professionals had low values for body fat, and high values for ectomorphy, VO_2 max, muscular endurance and flexibility. The 8-week dance program was associated with an increase in maximal treadmill work time and a decrease in maximal heart rate but no change in maximal oxygen uptake and body fat.

Kirkendall & Calabrese (1983) discuss dance as a physical activity and describe the effects of dance and training on selected factors of physical fitness. The VO_2 max values of dancers are typical of values seen in other athletes participating in intermittent activities. Dance training has been shown to cause an improvement in VO_2 max and work performance. Professional male dancers show relative strength values typical of other athletes, whereas female dancers have considerably lower levels than their athletic counterparts.

Dance in its many forms has positive effects on cardiorespiratory fitness. The magnitude of such effects in an individual dancer is related to the intensity, frequency, duration and type of habitual activity (Davidson, 1984). Ballet is one of the most complex and highly developed systems of dance.

Cohen, Segal, Witriol, & McArdle (1982) showed that women from the American Ballet theatre had VO_2 max values of 43.7 $ml.kg^{-1}.min^{-1}$. Mean blood pressure rose from 99/68 to 149/65, while mean heart rate increased from 55 to 179. They concluded that the static component of ballet exercises in conjunction with the sprint or burst-like, non-endurance component of ballet, would tend to stimulate aerobic capacity only modestly producing VO_2 max values in the range of non-endurance athletes.

Jaray & Wanner (1984) examined the effect of dancing on the heart and on circulation.

In their study, Evans, Tiburzi, & Norton (1985) examined 15 participants and analyzed them in two separate sessions. In the first session subjects' ages and measurements of height, weight, skinfold thickness, skeletal diameters, and limb circumference were collected.

In the second session fat percentage was calculated from body density as determined by hydrostatic weighing. Comparisons were made to non-dancers, gymnasts and other female athletes. Compared to the general female college population, dancers were significantly lighter and leaner. Gymnasts, on the other hand, had greater muscle mass, but a smaller element of fatness than dancers.

The ideal body type for a dancer would appear to be a balanced somatotype with the muscularity of a mesomorph, the fatness of an endomorph, and the linearity of an ectomorph.

Galanti, Holland, Shafranski, Loy, Vincent, & Heng (1993) determined physiological responses to training for creative jazz dance performance in college-age (17–26) beginning to intermediate female dancers. Eight subjects were tested pre- and posttraining for VO_2 peak during a graded exercise test and body composition. Subjects participated in jazz dance training sessions 4 days per week, 60–120 min a day for 10 weeks at heart rate intensities 70–85 % Harman (mean – 82 % HR max). After 10 weeks subjects performed in a creative jazz dance concert and heart rates were recorded after each of three dance performance routines. The mean performance concert heart rate was 94.3 % of post-test HR max. Post testing revealed significant (.01) increases in relative and absolute VO_2 peak performance and maximal time on the treadmill. No significant differences were noted for body composition.

In conclusion, jazz dance, if performed within American College of Sports Medicine (1) exercise training guidelines, will elicit cardiorespiratory improvement in college-age females.

Zagorc, Karpljuk, & Friedl (1999) analysed the functional strain of top dancers as well as the possibility of the more precise planning of a training process. The functional strains were established on the basis of the heart frequency measurements.

The authors tried to establish how long the strains of high intensity can last during five Latin-American dances and five standard ones under simulated competition conditions (two minutes of dancing, one minute of rest) and they tried to find out the degree of endurance by the means of a modified progressive test on a moving track. The sample group included six male and female dancers, competitors in Latin-American and standard dances, who entered the championship semi-final and

final in Slovenia in the category of senior youth (aged 16–19).

The data were analysed by a SPSS-X statistic package. The results showed that the sports dancers performed mostly dances with a high, intensive strain aside the English waltz, tango, samba and rumba. During the Viennese waltz, the average heard frequency approached 178 beats per minute, a higher frequency was measured in the quick-step (186 beats/min) and extremely high frequency in paso-doble and jive. The competitors spent more than half of their competing time in the zone of highly intensive strain.

A subject of our research is to determine the impact of physical characteristics and functional capabilities on the success of young sports dancers regardless of dancing category.

Purpose of research

The purpose is to determine the degree of the impact of morphological characteristics and functional capabilities on success in sports dancing competitions.

Hypothesis of the research

H1 It is assumed that there is a significant impact of some morphological characteristics and functional capabilities on success in sports dancing.

METHODOLOGY OF RESEARCH

Sample group of dancers

Twenty–nine female sports dancers, members of sports dancing clubs Royal and Step from Niš, (aged 11.5 to 13.5) were measured. All of them have been training sports dancing for more than two years and have won at least one of the first, second or third place prizes in dance tournaments and championships in Serbia, Monte Negro and abroad. They haven't trained any other sports and they have trained three times a week.

Sample of variables

A predictable set of variables consisted of ten anthropometric measurements, which partly covered the space of morphological characteristics. Measurements were taken of: body height (BH), body weight (BW), average thorax volume (ATV), shoulder width (SW), pelvis width (PW), hip width (HW), biceps skinfold (BS), triceps skinfold (TS), back skinfold (BS) and abdomen skinfold (AS). All measures were taken according to the International Biological Programme.

The predictable set of variables also consisted of nine functional capabilities. The following were rated: vital capacity (VC), Astradan test of oxygen consumption in l/min (AS), oxygen consumption per kg of body weight in minute (O_2), systolic pressure at rest (SPR), diastolic pressure at rest (DPR), pulse at rest (PR), systolic pressure under strain (SPS), diastolic pressure under strain (DPS) and pulse under strain (PS). The evaluation of functional capabilities was conducted at the sports centre in Niš.

The criterion variable was determined on the basis of the number of points representing dancers' successfulness. The number of points was the result of the winning position in a competition and the level of competing in the category where they competed. The levels of competition were: the World Cup (5 points), International Tournament (4 points), National Championship (3 points), State Tournament (2 points) and City Tournament (1 point). The awards were: first place (3 points), second place (2 points) and third place (1 point). Their success was assessed by international judges as well as the ones from Serbia and Monte Negro and according to the regulations established by the International Dancing Federation. All the points scored in the competitions in 1996 were summed up for every dancer.

Methodology of data processing

A regressive analysis was conducted to rate dancers' successfulness on the basis of morphological characteristics and functional capabilities. The following were calculated: the coefficient of multiple correlation of the criterion variable and the predictable system (MC), the percentage of explained variants (PV), the importance of the multiple correlation coefficient (PMC), the standard partial regression coefficient of every predictable variable with a criterion (Beta), the importance of the Beta coefficient (PB), a partial correlation (PC) and standard error in the partial regression coefficient (error Beta).

RESULTS AND DISCUSSION

Regarding the scope of the multiple correlation coefficient we can talk about the statistically important impact of morphological characteristics and functional capabilities in success in sports dancing (.93). 86.57 % of the criterion variable variant can be explained by a set of predictable variables. The multiple correlation was important at level .04 (TABLE 1).

Regarding the scope of the partial regression coefficient, the variables with the largest projection on the criteria can be easily distinguished.

As for morphological characteristics, they are: body weight (BW), pelvis width (PW) and triceps skinfold (TSF). As to functional capabilities, they are systolic pressure at rest (SPR), diastolic pressure at rest (DPR) and diastolic pressure under strain (DPS). Body height, vital capacity and abdomen skinfold are close to having statistical importance. Therefore, they shouldn't be

neglected and neither should their impact on successfulness in sports dancing competitions.

Regarding the scope of the partial regression coefficient (Beta) and its prerequisite, the following can be assumed: on the basis of morphological characteristics, those dancers with ideal body composition will be more successful, in other words, the dancers whose body weight corresponds to their body height, who have a narrower pelvis width and who are without excessive body fat.

Regarding functional capabilities, the dancers with a stable, normally high systolic and diastolic pressure (regarding their age) at rest as well under strain will be probably more successful in sports dancing competitions.

Considering the dancers' age (the age range is two years) big differences in the scope of individual numerical values in most of the applied variables were noticed, as expected.

As this is one of the first research projects on successfulness in sports dancing which has been conducted in a sample group of dancers who have been training for more than two years and where successfulness is evaluated on the basis of the contribution of some morphological characteristics and functional capabilities, the results should be accepted only for this sample group regarding the number of dancers in the group and the range of their age.

Moreover, the dancers are in a phase of rapid growth, which can affect some different and unexpected results in regard to the importance of individual morphological characteristics and functional capabilities compared to sample group of adults, conditionally selected for dancing.

It is important to cite the results of accessible research reports that can improve the understanding of the gained results regarding sports dancing.

Jocić (1991) conducted research to determine the possibility of predicting the success in the performing of dancing elements and movements on the basis of morphological, motorical, cognitive and conative status as applied to a group of 199 male students and 86 female students of the Faculty of Physical Culture in Belgrade.

Applied variables were: twelve anthropometrical measurements, sixteen motorical tests, Domino test (D – 48), test S – 1, test F – 1, test F – 6, test Alpha – 4, test Alpha – 7, 16 PF Katel and motivation test dealing with the motives in general success achievement.

The results of regressive analysis confirmed the established hypotheses. The greatest contribution to success in dancing were: performance of rhythmical structures, general coordination, segmental speed and perceptive capabilities.

While researching success in social and jazz dance performing, Kostić (1995) applied cognitive capability variables of musical capabilities, conative characteristics, and the motorical realization of rhythmical structures on a sample group of fifty Greek students as predictable ones (Raven progressive matrices, Seshore test for the musically talented, the Ving intelligence test of music, Eisenck test, Hopping in a circle, Stomping and Clapping with hands) and evaluation for performing dance structures as a criterion. Data were processed by regressive analysis. On the basis of multiple correlations a conclusion was drawn about the significant contribution of the cited capabilities and characteristics to success in performing social and jazz dancing structures.

A connection between capabilities in performing rhythmical structures and of different dancing structures was researched in Kostić's works (1996). A sample group consisted of thirty – seven female students of the Faculty of Physical Culture in Niš. The capability in performing of rhythmical structures was determined on the basis of the following measuring instruments: Stomping while sitting on a chair, Hopping in three squares, Rotating in six squares, Cha-cha-cha, Steps and rotating in five squares, Tramping and steps while moving forwards.

Successfulness in sport dancing was rated on the basis of basic evaluation in the practical part of the folk, social and jazz dancing exams. Data were processed by canonical correlative analysis. Two significant canonical roots confirming the connection between those two were obtained.

One research project closely connected to this one is that of Kostić & Dimova (1998) whose purpose was to determine the connection between morphological indexes and movement frequency on a sample group of thirty sports dancers aged 12–14. Ten variables were applied to determine morphological characteristics and four speed measures for movement frequency.

Data were processed by canonical correlative analysis. Body weight, average thorax volume, biceps skinfold and triceps skinfold on one hand and jumping over a gymnastic bench on the other hand had the largest impact on the connection between those two mentioned areas.

It was concluded that body mass and skinfold volume impeded the speed frequency of movements on the sample group of sports dancers from Niš.

In some accessible research it was proved that there was a significant impact of cognitive capabilities, motorical capabilities, musical capabilities, and conative characteristics on success in sports dancing. The sample members of a group that were examined during research were heterogeneous and mainly older than eighteen. The sample of measuring instruments that had been

applied were diverse so a generally acceptable conclusion couldn't be derived.

Considering the quantity and quality of the research conducted on the sports dancers, the conclusion can be drawn that not only sports dancing is one of the newest sports disciplines but it is unexplored as well.

There is little data about the impact of morphological characteristics and functional capabilities on successfulness in sports dancing competitions. The hypothesis that was set in our research has been proven and indicates that it is possible to predict success in sports dancing competitions on the basis of the values of some of morphological characteristics and functional capabilities. For more competent conclusions it is necessary to conduct research on a larger number of participants of more diverse age.

CONCLUSION

The purpose of this research was to determine if it was possible to predict success in sports dancing on the basis of morphological characteristics and functional capabilities applied to a sample group of dancers aged 11.5–13.5. Ten variables of morphological characteristics and nine variables of functional capabilities were measured. Successfulness in sports dancing was rated on the basis of the number of scored points that had been won at different competitions in Serbia and abroad. The data were processed by the SPSS statistic package on a personal computer.

Regarding the results it can be assumed that the dancers with ideal body composition, narrower pelvis width, normal systolic pressure at rest and lower diastolic pressure at rest. The results should be accepted with a certain degree of reserve considering the dancers' age range.

TABLE 1
The successfulness of regression in sports dancing

Test	Beta	PB	error beta	PC
BH	1.55	.13	.95	.48
BW	1.62	.02	.60	.67
TV	–.09	.78	.33	–.09
SW	–.27	.63	.55	–.16
PW	–1.29	.02	.51	–.64
HW	.49	.28	.44	.34
BSF	–.45	.36	.46	–.30
TSF	2.21	.00	.60	.77
BSF	.08	.70	.21	.13
ASF	–1.10	.09	.59	–.52
VC	–1.01	.13	.61	–.48
AS	.14	.66	.33	.14
O_2	–.03	.89	.25	–.04
SPR	.91	.01	.31	.69
DPR	–.94	.02	.37	–.65
PR	–.42	.25	.34	.34
SPS	–.14	.44	.22	–.25
DPS	–.41	.02	.15	–.65
PS	–.07	.66	.16	–.14

MC .93 PV 86.57 F 3.05 Df 19.9 PMC .04

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PŘEDPOVĚĎ ÚSPĚCHU VE SPORTOVNÍM TANCI, KTERÁ JE ZALOŽENA NA MORFOLOGICKÝCH ZNACÍCH A FUNKČNÍCH SCHOPNOSTECH

(Souhrn anglického textu)

Výzkum byl proveden u 29 sportovních tanečnic ve věku 11,5–13,5 roku z Niš. Účelem výzkumu bylo určit možnost předpovědět úspěch v tanečních soutěžích na základě určitých morfologických znaků a funkčních schopností.

Sledované proměnné byly tvořeny morfologickými znaky a funkčními praktickými schopnostmi. Morfologické znaky byly hodnoceny na základě následujících parametrů: průměrný objem hrudníku, šířka ramen, šířka pánve, šířka boků, kožní řasy bicepsů, tricepsů, zad a břicha. Měření byla prováděna podle předpisů Mezinárodního biologického programu. Funkční schopnosti byly měřeny na základě následujících parametrů: vitální kapacita plic, Astradanův test spotřeby kyslíku v litrech za minutu, spotřeba kyslíku na kilogram tělesné váhy za minutu, systolický a diastolický tlak v klidu, puls v klidu, systolický a diastolický tlak při zátěži a puls při zátěži.

Úspěch v tanečních soutěžích byl stanoven na základě počtu bodů získaných na závodech ve sportovních tancích v Srbsku, Černé Hoře a jiných zemích. Výsledky byly zpracovány regresní analýzou. Získaná násobná korelace umožnila předpokládat, že je možné do určitého stupně předpovědět úspěch ve sportovních tanečních soutěžích, a to na základě některých morfologických znaků a funkčních schopností, které byly zkoumány na výzkumném souboru tanečnic.

Klíčová slova: sportovní tanec, morfologické znaky, funkční schopnost a úspěšnost.

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NSTRUCTIONS FOR MANUSCRIPT FOR THE ACTA UPO GYMNICA

The magazine Acta Universitatis Palackianae Olomucensis Gymnica is an independent professional magazine. The content of the magazine is focused on presentation of research notifications and theoretical studies connected with the problems of kinanthropology. The Editorial Board is looking forward to all manuscripts written on the above subject.

General instructions

The text of the contribution is in English. The contribution is not to exceed a maximum limit of 15 pages (including tables, pictures, summaries and appendices). A summary will be in the Czech language, and by rule 1 page at the most.

The text is to be presented in MS Word editor on a diskette and also as a printout.

All contributions are reviewed anonymously.

Interface of the contribution

Title of the contribution, name(s) of its author(s), workplace, date of handing in the contribution, summary of the text in English, key words.

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Names of individual chapters are to be written in capital letter from the left margin. References to quoted authors see a brief from the publication manual http://www.gymnica.upol.cz.

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We look forward to our further cooperation!

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