SWIMMERS PREPAREDNESS LEVEL DURING TRAINING PERIOD

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Key words: swimmers, sport training, periodization.

INTRODUCTION

It is an imperative to diagnosticate the level of preparedness, especially at the very top level of competitiveness. The performances in the tests inform about the status quo of an organism. Data gained thus enable a continuous effectiveness control of a training process, and along provide pre-conditions for performance improvement in a required direction. Despite this imperative it is often very difficult to incorporate the diagnostics of preparedness, especially at the very top level athletes, so it does not interfere with the training process, and also that the objectivity of achieved results is preserved.

Swimming performance is, most of all, conditioned by the anatomic factors, such as body proportions and size, water resistance, strength of arms and torso, explosiveness (short distances) and endurance (longer distances). What follows then is mastering of a swimming technique and movements coordination [6]. Flexibility of a shoulder joint (backstroke, crawl and especially butterfly), femoral joint, ankle and torso is also important [2].

Endurance performance is mostly covered by activation of the aerobic system, which potential, according to *Basseta a Howleye,* is determined by the combination of three main and independent factors: level of maximum aerobic capacity, i.e. VO_2max.; efficiency of a particular movement in process and physiology of skeletal muscles. It is clear from the maximum oxygen consumption definition itself that it is to be understood as an indicator of maximum aerobic energy production. However, real performance in endurance sports, in other words the ability to sustain high aerobic performance during a lengthy stretch of time, is conditioned by the anaerobic threshold level and efficiency of a movement [1].

Anaerobic speed-endurance training is an inseparable part of training in various sports disciplines. This type of training aims to develop and sustain operational preparedness of an athlete's organism for short, intensive, one-time or repeated loads, lasting up to several tens of seconds. In sports these types of loads occur in training, or on a competitive level in sprinting disciplines. In competitive swimming it would represent performances that last up to 60 seconds, or 100 metres, respectively. This ability is conditioned by the anaerobic capacity of an athlete. Nowadays, there exist many tests that evaluate the anaerobic performance (alactate and lactate) and the anaerobic capacity. One of the most commonly used tests is the Wingate bicycle test, including its modifications on various types of ergometers.

Malina and Bouchard are the supporters of the idea of ectomorph component stability during a body growth. Mesomorph and endomorph components of young boys were not stable in time and this not comparable. During a growth acceleration of boys aged 14-16 years we notice 'slendering' of somatotypes, mesomorph and most of all endomorph declines, and increase of ectomorph. Following this phase, during the ontogenetic phase of pubescence, the level of mesomorph drastically rises, due to the increased testosterone level. Approximate mesomorph levels of adults can be roughly estimated at the age of 17. Endomorph rises significantly in girls after they reach the age of 13, approximately, with mesomorph and ectomorph being on decline. After the body growth is completed at the age around 16, it is possible to observe a slight increase of a mesomorph component [2,5].

RESEARCH OBJECTIVE

The aim of the research was to determine the changes at the preparedness level of swimmers during a preparatory period.

MATERIAL AND METHODS

The monitored group consisted of 5 swimmers (3 boys and 2 girls), with an average age of 15.2 years. Basic anthropometric characteristics were recorded: body height [cm], body weight [kg], ten skinfolds [mm], width parameters [cm], so called epicondylus humeri, epicondylus femoris and circumference of an arm and a calf [cm]. In order to gain the data we used a standard anthropometric set consisting of a stadiometer, scales, little adjustable caliper, skinfold caliper and a winding measuring tape. From the date gained it was possible to determine a somatotype via Somato programme, along with the fat percentage. Based upon this information the swimmers were then categorised into five categories of motor performance according to Chytráčková, thus reflecting the relationship of somatotype to kinetic abilities [4].

The aerobic abilities were tested with the swimming SwimBeep test, which consists of swimming of 25m sections, applying a gradual load increase load methodology after each minute to the maximum. The initial speed was 0.9 m/s, which after every single minute (span of 50-71s) increased by 0.05 m/s into the maximum. The monitored parameters were the swum distance and maximum oxygen consumption (VO_2max).

The anaerobic ability testing was carried out by means of the 30-seconds Wingate test on a bicycle ergometer Monark 894E. The monitored parameters were the peak power [$PP.kg^{-1}$], average power [$AP.kg^{-1}$], and fatigue index [%].By monitoring the lactate metabolization we observed the efficiency of lactate disposal after the Wingate test [%].

RESULTS AND DISCUSSION

It is obvious that some individuals are physically pre-conditioned and ‘gifted’, and thus better ‘equipped’ for some types of kinetic activities or performances. Longer arms, larger hands and legs, more muscular for the movement of upper limbs are more suitable for swimming, as they enable a more powerful and longer stroke in water.

In the monitored group of boys in tab. 1 the most dominant component was ectomorph. This is most likely related to the fact that boys during puberty go through a phase of a fast growth. The body fat level was low for most of the boys, which is likely to be related to the high level of ectomorph component. Similar to the boys, neither the girls, in this phase of the ontogenetic development, have completed their body growth, which reflected in particular somatotype components. Two girls had a somatotype with an increased level of endomorph determined. However, the body fat level was normal, which was probably influenced by the fact both the swimmers specialise in butterfly.

The maximum oxygen consumption raised from the beginning of a general training period up to the beginning of a specific training period from 50.85 ml/kg/min to 53.72-57.18 ml/kg/min (tab. 2). Towards the end of the specific training period, based upon the changed structure of the training load in favour of the anaerobic training load, the level of maximum oxygen consumption dropped to 50.85-60.64 ml/kg/min. According to Wilmore and Costill all the changes at the maximum oxygen consumption level were within the norms for particular age group of both the boys and the girls [7].

Table 1. Basic anthropometric characteristics of monitored swimmers

Name	Sex	Age	Somatotype		Group	Subcutaneous fat (%)		BW (kg)	BH (cm)
J.M.	M	14.1	2-4-5	mesomorph ectomorph	D	11.2	low	58.7	175.0
D.N.	M	16.6	3-5-3	balanced ectomorph	A	13.5	lowered	69.7	178.0
R.T.	M	15.0	3-3-5	balanced ectomorph	A	13.4	lowered	86.7	201.0
C.M.	Ž	15.0	4-4-2	mesomorph-endomorph	A	19.2	normal	66.5	169.0
E.B.	Ž	15.4	5-4-2	mesomorph-endomorph	A	21.9	normal	66.3	166.0

Legend: A – under-average pre-dispositions of speed, endurance and motoric skills, very good strength pre-dispositions D – excellent pre-dispositions for motoric skills, average for endurance and speed, under-average for strength

Table 2. Aerobic performance level of swimmers

Name	Part			VO_2max (ml/kg/min)			Distance (meters)		
	01.02.	**09.03.**	**01.05.**	**01.02.**	**09.03.**	**01.05.**	**01.02.**	**09.03.**	**01.05.**
J.M.	11:02	13:00	12:00	50.85	57.18	53.72	725	825	750
D.N.	11:02	13:02	-	50.85	57.13	-	725	875	-
R.T.	-	12:02	14:00	-	54.29	60.64	-	800	925
C.M.	11:02	12:00	11:02	50.85	53.72	50.85	725	750	725
E.B.	11:02	-	11:02	50.85	-	50.85	725	-	725

Legend: VO_2max – maximum oxygen consumption

Both the maximum and average anaerobic performance has lowered since the beginning of the general training right to the beginning of the specific training. The anaerobic maximum performance at the end of the monitored preparation phase has lowered when compared to its beginning from 9.37-10.66 to 8.52-9.97 W/kg. Almost the same case scenario applied for the average performance.

The higher the maximum anaerobic performance, the higher the energetic pre-dispositions for explosive strength (acceleration strength), maximum strength and speed. The higher the average performance, the higher the pre-conditions for speed and strength endurance. According to *Zupan et al.*, at the beginning of the training period, the maximum anaerobic performance the monitored swimmers reached came under the category of an average performance level. Towards the end of the training period the level dropped to the category of 'sufficient but just', or even to insufficient level [8]. The monitored female swimmers did not reach the typical maximum anaerobic performance levels, stated by Heller at the level of 10,8 W/kg [3].

Table 3 Anaerobic performance level

Name	PP`(W/kg)		AP`(W/kg)		FI (%)		Lactate metabolization (%)	
	01.02.	**01.05.**	**01.02.**	**01.05.**	**01.02.**	**01.05.**	**01.02.**	**01.05.**
J.M.	10.66	9.97	8.38	8.00	25.68	36.73	-	39.80
D.N.	12.30	-	9.00	-	42.26	-	22.75	-
R.T.	-	9.14	-	6.76	-	39.21	-	40.45
C.M.	9.37	9.16	7.39	7.36	32.10	34.54	32.98	8.33
E.B.	9.48	8.52	6.86	6.50	36.55	27.98	27.60	39.50

Legend: PP`(W/kg) – peak power AP`(W/kg) – average power; FI – fatigue index; LM 5. a 15. minute (% decrease): more than 46% excellent; 36-45% good; 26-35% average; less than 25% insufficient

Fatigue index in the Wingate test suggests an increase of dominance of the aerobic abilities over the anaerobic ones, as it improved towards the end of the specific training period from 25.68-36.55% to 27.98-36.73% for majority of the swimmers. Lactate metabolization also implied an improvement of the aerobic abilities after the Wingate test. The efficiency level of lactate metabolization greatly improved towards the end of the training period from z 32.98% to a 40.45% (tab. 3).

CONCLUSIONS AND RECOMMENDATIONS

Constituent type classification may represent an indicator of a future top level performance. It is essential, however, that it shows stability of achieved results recorded in time. The studies proved that some somatotypes are stable in time and some are prone to changes from their original status. These changes thus significantly reflect pre-disposition, biological maturing type and motor activity influence.

Ectomorph component was the dominant one in the group of monitored boys, and the girls had determined a somatotype with an increased level of endomorph. The maximum oxygen consumption level increased from the beginning of the general training period up to the beginning of the specific training period. The maximum oxygen consumption level decreased, which was influenced by the changed structure of the training load in favour of the anaerobic training load towards the end of the specific training period. Increased fatigue index, along with more efficient lactate metabolization towards the end of the training period indicate the dominance of the aerobic abilities over the anaerobic ones.

The fundamental basis of preparatory period is to back up with a ‘sufficient preparedness reserve’ for the main – competitive period. Based on that, it is essential to focus on an increase of so called ‘operational roof’, which is often revealed in the area of cardiovascular system capacity, the respiratory system, or energetic reserves in an organism. The preparedness level of the monitored swimmers during the preparatory period likely suggests an appropriately selected training load structure.

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ANALYSIS OF HANDBALL COACH'S COMMUNICATION

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Key words:
- Nonverbal communication,
- Gestures. Match,
- Training Unit.

Abstract:
The paper deals with the analysis of handball coach's communication. The aim of the paper was to analyze nonverbal component of handball coach's communication using video recordings. The object of the research was the coach of the U15 handball team Tatran Prešov. Indirect observation was used as the basic research method. For the needs of the paper communication was recorded during 3 matches and 3 training units in 2009/2010 and 2010/2011 seasons. Collected data in the form of audiovisual records were transcribed using the software CHAT (Codes for the Human Analysis of Transcripts) of system CHILDES (Child Language Data Exchange System). Coded transcripts were transferred to Microsoft Excel program and subsequently filtered. The analysis was focused on the gestures' selection and their frequency in coach's nonverbal communicative discourse.

INTRODUCTION

Determination of the unique definition of the term communication is very complicated. It is a multiform phenomenon that is the object of the research of many scientific disciplines. These focus mostly only on some part of communication that is emphasized within the definition. Therefore, in the present time, there is no generally relevant/valid and acceptable definition that would describe all the aspects of this phenomenon [2]. [13] understands communication as the dialogue and the word to communicate as to mediate, join. Language communication is the process that mediates mutual information of people. As the information among people are realized and transmitted not only through classic language means, but also non-language signals, in the field of language communication are realized all the ways and means people use within the communication. It is then multilateral group of expressive means and also circumstances of this process. Within the verbal communication the using of language code is the obvious part of communicative competence [14]. [5] presents that from the linguistic point of view verbal communication is searched from z view of effective using of language in the process of communication. Verbal communication can have oral and written form. Nonverbal communication can change in the significant way the meaning of the language component, more or less to modify it. Therefore it is important and necessary the knowledge of relations between verbal and nonverbal communication, their synchronization and mutual functioning [2]. [14], [3] and [15] deal with nonverbal means of communication. [3] divides nonverbal means to: gestures, mimicry, look, touch, position and body posture, distance between communicating, human appearance. [1] presents following body movements: **gestures** – symbols that directly interpret words or phrases. We use them on purpose and consciously. They are specific for certain culture and social groups; **illustrators** – strengthen verbal signals and at the same time they follow them. The most often the hands are used. It is possible to illustrate also with head or whole body. We can use illustrators also for indicating of shape or the size of objects we speak about; **affective expressions** – mimic expressions, but also hand gestures or whole body movements that express emotional meanings. We use them to complete and strengthen of verbal discourse and also as the words substitution. Affective expressions relate mostly to human face; **regulators** – signals that monitor, control, coordinate or keep the speech of the other; **adapters** – gestures that meet some personal need. Adapters can be focused on one's own or on the person we communicate with. Dimunová (2008) assign **gestures – emblems** – have their own meaning that was created by convention. These are gestures that do not need to follow the communication and still one understands them.

In the field of sport in Slovakia following authors have been dealing with analysis of communication within verbal and nonverbal discourse: [4], [7], [6], [12], [11], [9], [10].

AIM

The aim of the paper is the description and following analysis of communication of handball coach with players in pupil's category during handball trainings and matches with focus on coach's nonverbal communicative discourse.

MATERIAL AND METHODS

We addressed the coach of handball team Tatran Prešov M. G. who has been as coach 10 years. He and his team won the 1st place and became Slovak champion in seasons 2009 – 2012. We recorded 3 records of training units and 3 records of matches (2009/2010). The combination of training unit and match was chosen because of the representation of situational interaction complex of coach and players. Audiovisual record was chosen to catch the communication most accurate. Videocamera was used to record the nonverbal communicative discourse of the coach and dictaphone with external microphone to record the verbal discourse. Dictaphone was hung on coach' neck before the start of training unit or the match (similar researches show that so called microphone effect disappears within 5 – 10 minutes, so dictaphone and the fact that discourse is being recorded do not effect on the coach disturbingly). After recording we transcribed the material by the software CHAT (Codes for the Human Analysis of Transcripts) of CHILDES system (Child Language Data Exchange System) that was originally founded for the research into the child speech but i tis suitable for the needs of our research. Within the transcription we synchronized video and audio records and coded the verbal and nonverbal discourse of the coach. The coded transcript was transformed into Microsoft Excel program and consecutively analyzed. On this basis the communicative discourse of the coach was evaluated with focus on its nonverbal part. Methods of the research comes from the project VEGA No. 1/0455/08 Communication between coach and ball games players of older school age.

RESULTS

NONVERBAL COMMUNICATION OF COACH IN MATCHES

We evaluated the gestures occurrence from the percentage and emotional point of view. Although the length of matches is given by the official rules of handball we decided to present results in percentage.

From the total amount that we recorded within handball matches the most frequent gestures were illustrators (fig. 1) (occurrence of illustrators exceeded 60% in all three matches). The second most frequent type of gestures was adapters followed by affective expressions. The less used gestures were emblems. We have not recorded any of regulators type. After focusing on the analysis of particular matches we found out the same order of gestures occurrence. The percentage of all four types of recorded gestures (illustrators and adapters) was almost identical in match 1 and match 2. The biggest difference was recorded in match 3, where percentage of illustrator and affective expressions was lower and level of adapters increased.

Communication of the coach during the match is influenced by the rules. Within coaching the coach has two options – he can sit on the players' bench or he can move in a limited space along the field. This is the reason of such a high percentage of using of illustrators. As all three matches were winning, coach spent most of the play time sitting on or standing by the bench watching the match and giving instructions. We suppose it can be probably connected not only with the match progress but also with the coach's character (it was not examined).

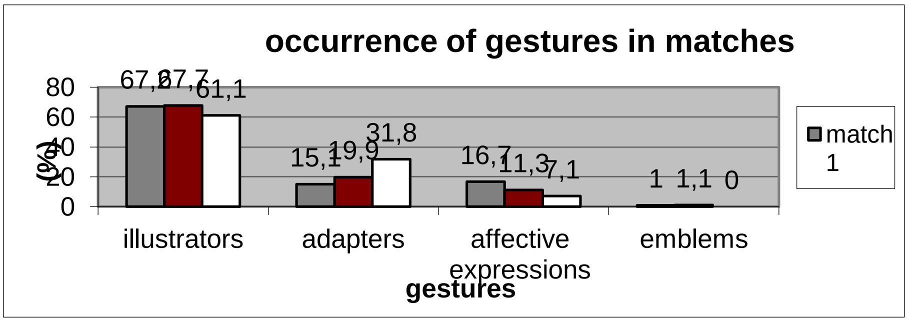

Figure 1. Graphic comparison of occurrence of selected types of gestures in handball matches

The second biggest group of used gestures were adapters. When comparing occurrence of adapters in match 1 and match to we found out only minimal differences. Increased number of used adapters was recorded in match 3. After the analysis of the match record we presume to say that the reason was too easy progress of the match. Players followed coach's instructions and the given tactics and he did not have to correct and instruct players so often. That is why he stared to be focused on himself and the number of subconsciously used gestures focused on the person of coach increased. If players are not successful, do not follow the instructions or do not perform playing skills correctly coach uses verbal discourse which main content are instructions more frequently and so the number of used illustrators increases. Simultaneously there is a smaller space for gestures focused on the person of coach - and vice-versa.

Third in the order of using gestures was the group of affective expressions. Comparing the occurrence of this type of gestures the highest percentage was recorded in match 1. The most used type of affective expressions was hand-clapping. Coached used it after scoring, successful playing combination (defensive or offensive) or observance of playing system and specified tactics.

Emblems were recorded as the less used type of gestures. They occurred only two times within the match when coach signified submission to players sitting on the bench. No regulators were recorded within all three matches.

Used gestures were analyzed also from the emotional point of view (fig. 2). Slančová, Kačúr (2010) came to the finding that the result and the progress of the match markedly influenced using of positive and negative illustrators and in the smaller rate using of affective expressions. As it is mentioned higher all the observed matches were winning. That is why it is difficult to analyze matches from the emotional point of view in detail.

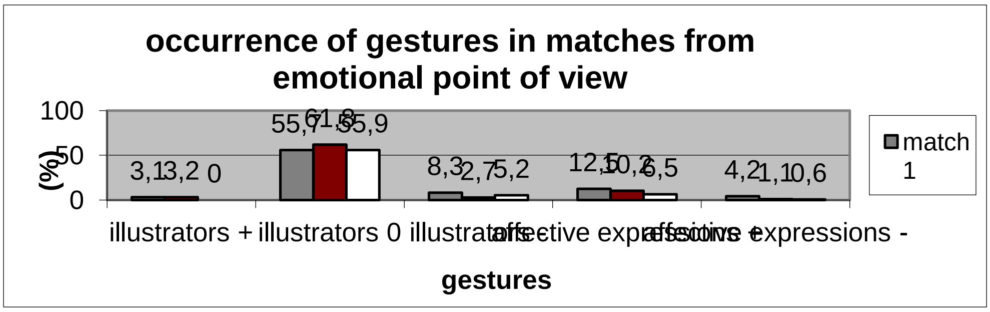

Figure 2. Occurrence of gestures from the emotional point of view in handball matches

NONVERBAL COMMUNICATION IN TRAINING UNITS

Duration of all three observed and analyzed training units was 60 minutes. Their content was of alike character – after general and specified warm up the main content of the unit was developing of playing skills, playing combinations and systems. That is why we decide to present results in one figure (figure 3).

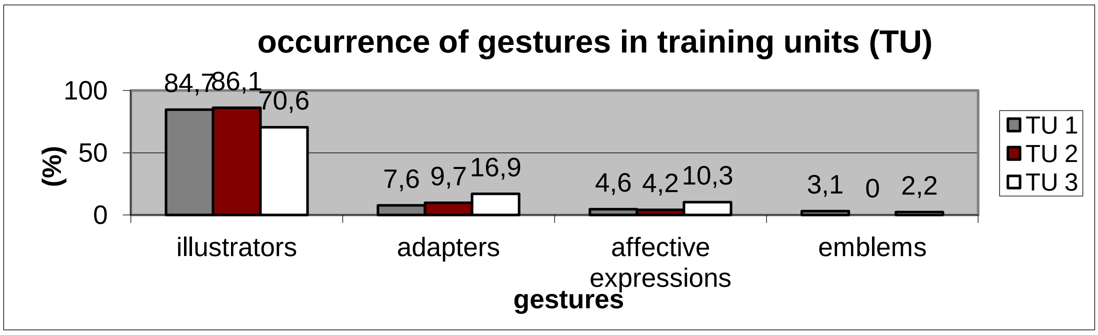

Figure 3. Graphic comparison of occurrence of selected types of gestures in training units

On the basis of observing training units we recorded the same order of gestures occurrence as in the matches – illustrators, adapters, affective expressions and emblems. Percentage of gestures in training unit 1 and 2 is almost identical. We found out the differences in comparison with unit 3. We presume that lower percentage of illustrators and higher percentage of adapters is caused because of insertion of free game into the training unit. From the coach's point of view it means he used less instruction and had more space for using adapters. In connection with this fact also number of affective expressions increased – the part of training unit was very close to the character of match.

With respect to the character of training unit and missing or incomparably lower emotional load we did not pay special attention to individual analysis of gesture occurrence from the emotional point of view.

After analysis of gestures their occurrence was compared in matches and training units (figure 4). With respect to frequency of gestures illustrator were the most used gestures in both match and training unit. In training unit coach used verbal discourse connected with regulation, giving instructions and fault correction more intensively. This is why the percentage of illustrators in training units is higher as in matches. The opposite phenomenon was recorded within the using of affective expressions.

With reference to Perič (2008) competitions and matches are the culmination of training process, it is the time for examination of abilities and skills learned and developed by players. With respect to presence of other people (parents, relatives, friends, or coaches from other teams) matches have higher emotional character in comparison with training units. This emotional involvement is topical not only for players but undoubtedly also for the coach.

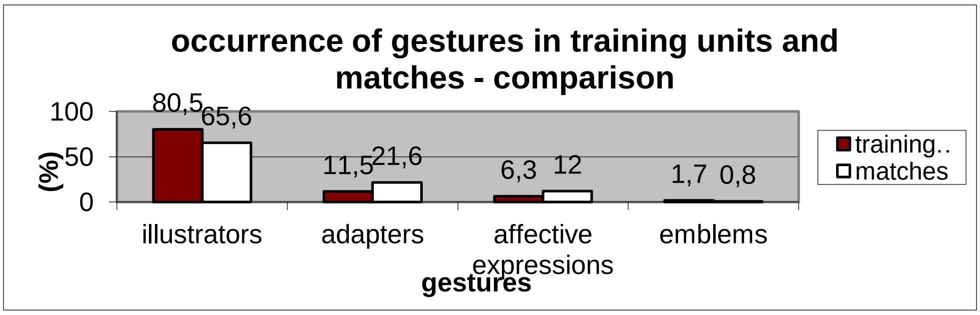

Figure 4. Graphic comparison of occurrence of selected types of gestures in matches and training units

CONCLUSIONS

On the basis of watching audiovisual records we registered four most frequently occurred types of gestures – illustrators, adapters, affective expressions and emblems. The Frequency of illustrators was more often in training units in comparison with matches what is connected with the character and orientation of training unit which main contents was developing of playing skills, playing combinations and systems

In case of affective expressions we recorded small difference between their occurrence in matches and training units. Higher percentage was registered in matches, which the emotional character is typical for.

Communicative discourse of observed coach is specific for himself. It is impossible to generalize this analysis for all coaches of youth categories as it is necessary to regard psychosocial particularities of each coach. The results of our analysis can function as the feedback as well as a starting point for further research and detailed analyzing of communicative discourse of the coach with focusing on its verbal and nonverbal element.

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THE DIAGNOSTICS OF FEMALE BODY COMPOSITION IN ADOLESCENCE AND YOUNGER ADULTHOOD[1]

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Key words:
- body fat,
- body mass index,
- visceral fat,
- waist to hip ratio,
- InBody 230.

Abstract:

The aim of thesis is to analyse and compare chosen body composition`s components of female population in adolescence and young adulthood, specifically female students of secondary school and university in Prešov. Considering the lifestyle of current population, it is important to point out on body composition as one of health state`s indexes, particularly fat mass` portion which can be influenced by nutrition and appropriate movement regime. Body composition was diagnosed on the basis of bioelectrical impedance analysis using InBody 230. Gained data were processed in LookinBody 3.0 and Statistika 10. program. Monitored group S1 consisted of female students of secondary school (n=62) whose average decimal age was 18.9 years. Their average body height was 169.7 centimetres and average body weight was 59.5 kilograms. Group S2 consisted of university`s female students (n=74) whose average decimal age was 21.4 years. Average body height in the file S2 was 166.2 centimetres and average body weight was 58.7 kilograms. Following the results of monitored components, namely: BMI, WHR, VFA and percentage of fat, we find out that gained average data are situated in zone of recommended health standards within monitored ontogeny stages. At the same time it is important to say that group S1 reached fat percentage on the above level of recommended standard, thus 28%. We did not find statistically significant difference comparing groups S1 and S2 besides fat percentage ($p<0.01$) which was higher in file S1, in the group consisted of secondary school`s female students.

INTRODUCTION

Lifestyle itself includes a complex of procedures, principles and life philosophies and ia determined by the overall economic environment, social norms and organizational structure of society [17]. The World Health Organization reports that health depends by 50% on one's lifestyle. Among the basic lifestyle components that significantly promote health are nutrition, physical activity, mental load, stress and the level of material and cultural demands [12]. Lifestyle thus contributes 50 to 60 percent to the overall health. Among the risk factors related to lifestyle are low volume of physical activity, smoking, high energy intake, stress, alcohol consumption and drugs abuse [4]. Body composition is one of the components of health-related physical fitness, which is indicative of one's health status. The body composition itself can be significantly changed via nutrition and physical activity [9]. The assessment of body

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composition is based on the ratio of body fat, water and muscle mass relative to one's body mass [5]. The volume of body fat is dependent on the balance between energy intake and energy expenditure, as the latter can be altered through physical activity, nutrition and genetics [11]. Body composition is regarded as the most important parameter of the developmental stage throughout ontogeny, health status, physical fitness and performance [13]. With respect to ontogeny, the pubertal period is viewed as highly critical as it is characterized by the onset of hormonal changes, changes in interests, reduction in physical activity and decline in physical fitness [1]. Consequently, the periods of adolescence and young adulthood are characterized by maturity of organism, balanced bodily functions, which results in the achievement of peak performance [8]. Furthermore, the incidence of overweight should be lowest in young adulthood as an individual can apply the health- and exercise-related principles very easily, which leads to the adoption of healthy lifestyle [6]. Body composition is proportionate to physical effort and genetic endowment of an individual [3]. The human body composition can be assessed using 5 models: atomic, molecular, cellular, tissue-system and whole-body [10]. The atomic model differentiates between elements as oxygen, hydrogen, carbon, nitrogen, sodium, potassium, chlorine, phosphorus, calcium, magnesium, sulfur etc. [10]. For the analysis of the atomic model a method of neutron activation and determination of total potassium may be utilized [14]. The molecular model distinguishes between body fat, water, proteins, glycogen and minerals, which are sometimes classified either as skeletal or soft tissue minerals. The quantity of particular components may be determined using the method of isotope dilution and the quantity of bone minerals using DEXA [19]. The cellular model differs between fat and non-fat cells, extracellular fluid and extracellular solids [10]. Within the tissue-system model, the authors differ between fat tissue, skeletal muscles, bone tissue, internal organs and other tissues. This level may be analyzed using computer-aided tomography or magnetic resonance imaging [14]. The whole-body model of body composition includes the size, shape and other external somatic parameters. The model makes use of the body height value, length of particular body segments, transverse and circumferential dimensions, skinfold thickness, total body surface, density and body mass index. These values are obtained using the anthropometric methods used to estimate the somatic components on the basis of the previous four models [19]. The methods used to assess body composition may be viewed at 3 levels: 1st level refers to the direct measurement that can be executed after death, the 2nd level requires laboratory conditions and is referred to as hydrodensitometry, measurement of total body water and measurement using the potassium isotope, and the 3rd level makes use of equations determined on the basis of the results of the 2nd level. The third level includes the anthropometric methods and impedance analysis [7]. The selection of particular method and component for analysis depends on the measurement objective and the method availability.

Lifestyle lacking movement is the problem of whole society. Low level of physical fitness in general population is the result of maladaptation to living conditions present in today's world [18]. The assessment and analysis of body composition as one of the health-related parameters forms the basis of potential targeted changes due to the fact that awareness is the basis of physically active lifestyle, which consequently affects not only body composition but also health [2].

THE AIM OF THE WORK

The purpose of the cross-sectional study was to analyze and compare selected components of body composition in adolescent and young adult females.

THE MATERIAL AND THE METHODOLOGY

The first sample consisted of 62 high schools students attending secondary school in Prešov (S1). The mean decimal age was 18.9 years. The second sample consisted of 74 university students attending University of Prešov in Prešov with average age of 21.4 years. Prior to measurement and body composition analysis, body height was measured using anthropometer with 1 mm precision. Body mass and all examined body composition parameters were measured using bioelectric impedance analysis device InBody 230. Bioelectric impedance analysis uses small alternating current that passes through biological structures. The current passes more rapidly through fat-free mass because of the greater water content. Conversely, fat mass is an insulator. The passing alternating current induces electrical resistance [14]. The body composition analysis included the assessment of total body water and percentage body fat. In women, the physiological fat mass content equals 23 % body mass. The volume of fat equaling 28 % body mass represents the obesity limit [21].

We also assessed and compared the BMI values (BMI), visceral fat value (VFA) and degree of obesity in the abdominal area (DO) with recommended population norms. The BMI is expressed as the ratio of body mass and body height squared. Mean values of studied samples were compared with International classification of overweight and obesity accoding to BMI.

Formula for BMI calculation:

$$BMI = \frac{body\ mass\ (kg)}{height^2(m)}$$

Table 1. The International Classification of adult underweight, overweight and obesity according to BMI [20].

Classification	**BMI (kg/m^2)**
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00-16.99
Mild thinness	17.00-18.49
Normal range	18.50-24.99
Pre-obese	**25.00-29.99**
Obese	**≥30.00**
Obese Class I	30.00-34.99
Obese Class II	35.00-39.99
Obese Class III	≥40.00

VFA is stored in the upper body in the visceral area. The value over 100cm^2 indicates visceral type of obesity, which is associated with increased health risks.

WHR, which is the waist-to-hip ratio, was assessed using norms. In women, this ratio should equal 0.7. The obesity limit in women equals the value exceeding 0.8 or 0.85 [15].

The degree of obesity expresses the ratio of actual body mass to ideal body mass on the basis of body height and age. This value is expressed as percentage and the normal range of body mass equals 90 to 110 percent [21].

The collected data were processed using the software LookinBody 3.0 and statistical software Statistika 10. To process the collected data, mathematical and statistical methods were applied. Arithmetic mean as the measure of location and standard deviation as the measure of variation were used. The differences between samples were determined using independent samples t-test.

RESULTS

The data of both samples S1 and S2 collected and processed using the above-mentioned methods, were evaluated and mean values of examined parameters were compared. The first investigated parameter was body height. In sample S1, the mean body heights were 164.8 cm and 166.3 cm in S1 and S2, respectively. The inter-sample difference in body height was statistically insignificant. Mean values of body mass were 59.5 kg and 58.7 kg in S1 and S2, respectively. The inter-sample difference was not statistically significant. This finding indicated more favorable values in terms of percentage of fat, BMI, VFA, WHR and DO in terms of sample comparison.

The evaluation of percentage fat mass did not confirm this assumption. Body fat is the most frequently assessed and most variable component of human body that may be to a large extent altered by nutritional and exercise regime. As mentioned, the limit of obesity equals 28 percent body fat. This limit was found in sample S1of high school students. This is a surprising finding as high school students have relatively stable daily schedule with the option of regular food intake and a minimum of 2 classes of physical and sports education per week. University students were found to have lower percentage body fat equaling 24.7 %. The difference between samples was statistically significant. This finding confirms the lowest incidence of overweight in young adulthood due to awareness and easier adoption of appropriate lifestyle.

The mean values of total body water were 30.8 liters and 32 liters in S1 and S2, respectively. The data on the percentage of total body water confirmed that this human body component falls within the recommended reference range, which equals approximately 53 % body mass in females. In obese people, this body component value equals only 45 % because of the low water content in fat tissue [16]. The mean value of total body water (%) expressed as percentage body mass in sample S1 was 51.8 % and 54.5 %in sample S2. Higher mean percentage of total body water in S2 corresponds with lower mean percentage of body fat.

Table 2. Somatic parameters in samples

	DA		**BH** (cm)		**BM** (kg)		**FM** (%)		**TBW** (l)	
	x	s	x	s	x	s	x	s	x	s
S1	18.9	0.3	164.8	5.9	59.5	11.3	28	7.6	30.8	3.4
S2	21.4	1.5	166.3	6.5	58.7	9.2	24.7	7.6	32	2.9
Sig.	-		0.18		0.66		0.01		0.05	

Legend: S1- high school students, S2- university students, Sig.- statistical significance, DCV- decimal age, TV (cm) - body height, TH (kg) - body mass, FM (%)- fat mass, TBW (l)- total body water in liters, x- arithmetic mean, s- standard deviation.

Data on body height and body mass were used to assess mean body mass index in both samples. In S1 and S2, the mean BMI values were 21.9 and 21.2, respectively. The difference between the mean BMI values was not statistically significant. Therefore, it may be concluded that the mean BMI values fall within the normal physiological range. However, it should be noted that this index provides only orientational value of acceptable body mass not only in athletes, but also in non-athletes. The calculation of the BMI value within the physiological range could evoke the sense of self-satisfaction. Therefore, we considered important to complement this index with other indexes. The mean values of VFA were 40.9 cm^2 in S1 and 37 cm^2 in S2, respectively. The difference between the mean VFA values was not statistically significant. The mean values of VFA index indicative of visceral fat volume fell within the recommended reference range, which is 100 cm^2. This may be regarded as a positive finding.
The mean WHR values in S1 and S2 were 0.82 and 0.81, respectively. WHR indicates the degree of obesity in the abdominal area. The values recorded in both samples were close to the obesity limit as the acceptable value for women is 0.8, or 0.85. In this index, no

statistically significant difference between samples was found. The ratio of actual body mass compared to ideal one expressed in percent was the final investigated index. The mean values in S1 and S2 were 101.6 % and 98.7 %, respectively. There was no statistical difference between samples. Both recorded values of DO fall within the recommended range from 90 to 110 %. However, it should be noted that this index could be regarded as misleading because it does not take into account the ratio of muscle mass and fat mass. We agree with the opinion of Riegerová, Přidalová, Ulbrichová [14] who reported that health is negatively affected not only by excess body fat or insufficient amount of body fat, but also its distribution, which affects the risk of cardiovascular diseases.
Table 3 shows comparison of mean values of BMI, VFA, WHR and DO with reference norms in samples S1 and S2.

Table 3. The comparison of index values in samples with recommended norms

	BMI				**VFA (cm^2)**				**WHR**				**DO (%)**			
	S1		**S2**		**S1**		**S2**		**S1**		**S2**		**S1**		**S2**	
	x	s	x	s	x	s	x	s	x	s	x	s	x	s	x	s
	21.9	3.8	21.2	2.9	40.9	24.6	37	22.8	0.82	0.05	0.81	0.05	101.6	18.0	98.7	13.5
Sig.	0.22				0.34				0.27				0.29			
N	18.50-24.99				<100				<0.80 (0.85)				90-110%			

Legend: BMI- Body mass index, VFA – visceral fat cm^2, WHR – degree of obesity in the abdominal area, DO – degree of obesity %, S1- high school students, S2- university students, Sig.- statistical significance, N – norm, x- arithmetic mean, s- standard deviation.

CONCLUSIONS

The purpose of the cross-sectional study was to analyze and compare selected components of body composition in adolescent and young adult females.

We have decided to investigate body composition due to its effect on the quality of life as the increased proportion and distribution of body fat is associated with a variety of health risks. The study findings have confirmed that the issue of being overweight is becoming topical. The high school students have greater problem maintaining the proportion of body fat relative to body mass under the obesity limit. Body composition and the fat mass component can be markedly influenced by lifestyle that should include adequate physical activity and nutrition. The availability and correctness of information about healthy lifestyle and the relevance concerning assessment and changes in body composition are regarded as the basis of prevention, promotion of responsibility for one's own health, or potential targeted changes.

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THE MOVEMENT INACTIVITY OF GRAMMAR SCHOOL` STUDENTS AND THEIR BODY MASS INDEX

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Key words:
- Movement activity.
- IPAQ questionnaire.
- Body Mass Index.
- Males. Females..

Abstract:

The aim of the paper is to find out the relationship between movement inactivity`s volume of grammar school` male and female students in Vranov nad Topľou and their Body Mass Index (BMI).

The research was applied on 308 students (160 females and 148 males) aged between 15-19 years. For diagnosing of movement activity`s level respectively inactivity was used standardised long version international questionnaire - International Physical Activity Questionnaire (IPAQ). BMI was calculated on the basis of body height and body weight` data of respondents.

During processing of data, we focused on finding out inactive lifestyles especially during weekdays (school attendance days) and during weekends. We presuppose that higher volume of time that students spend in sitting position (eventually lying) will occur during weekdays and lesser during weekends. We also presuppose that higher volume of inactivity will exert on worsened Body Mass Index. Data of students` movement inactivity were related to body mass index. On the basis of correlation`s calculations there was found no relation between mentioned variables.

PROBLEM

Sedentary lifestyle and the lack of children and youth movement are predispositions for movement inactivity in adulthood [4]. Movement inactivity is characterised by minimal energy output during minimal physical motion (sitting, watching television, surfing on internet etc.). Radvanský-Kučera understand movement inactivity as static loading of individual`s muscle apparatus (work from biological aspect) and demand request on mutual proportion between static and dynamic movement activity (work from physical aspect) [6].

Movement inactivity following smoking, high blood pressure and cholesterol is from the health aspect the fourth risk factor of various last illnesses [1].

Within last period, there has been worldwide decrease of children and youth` movement activity which is accompanied by the increase of movement inactivity and remaining occurrence of child`s overweight and obesity.

The lack of movement activity is for the origin of obesity equally dangerous as hyper nutrition. Nevertheless, a daily hour of speed walking decreases the risk of obesity by 24 % and limitation of watching television about 10 hours per week and increase of walking on 30 minutes per day lead to 30% depression of obesity [7].

On the basis of above mentioned knowledge we specified the aim to analyse the relationship between movement inactivity and Body Mass Index of grammar school` students from Vranov nad Topľou. The paper was supported by Slovak Research and Development Agency on the basis of agreement number APVV-0768-11.

METHODICS

The research was applied at Dr. Cyril Daxner grammar school in Vranov nad Topľou in March 2013 in the presence of university tutor. Research group consisted of 308 students (148 males, 160 females), age average was 17.06. For gaining data about the level of movement inactivity was used International Physical Activity Questionnaire that students listed within physical training lessons. We focused on finding out daily average number of hours that students spend inactively within weekdays, weekends and how much time do they spend sitting during travelling. Body Mass Index was calculated following body height and body weight` data of respondents.

We categorised students into four categories on the basis of BMI` percentile norms specified for given gender and age and calculated percentage share of obesity`s occurrence in relation to this index [3]. We used Pearson`s correlation coefficient for investigating the relationship between two variables.

RESULTS AND DISCUSSION

BODY MASS INDEX

The amount of fat mass changes within aging and the amount of body fat shows differences in both genders so we used different criteria for children and adults within interpretation of BMI. Categorisation of students into specific categories of BMI is presented on Fig.1. In our research group we diagnosed 13.1% male students and 2.5% female students with risk values of BMI in relation to obesity within intersexual comparison.

These results correspond to similar research realized in Slovakia just within male group. Gained data show higher prevalence of overweight in overall 12% of children. Generally, the situation in Slovakia is considered to be unfavourable even though it is more favourable than abroad where, for example in Italy or Spain, is more than 30% occurrence of overweight in children [8]. Similar alarming data explicit researches in Czech Republic where live up to 19% of children (aged between 6-14 years) who suffer from overweight of which 10% suffer from obesity. In years 2004-2007 there was percentage increase of overweight and obesity up to 8%. This value corresponds to other European countries [2].

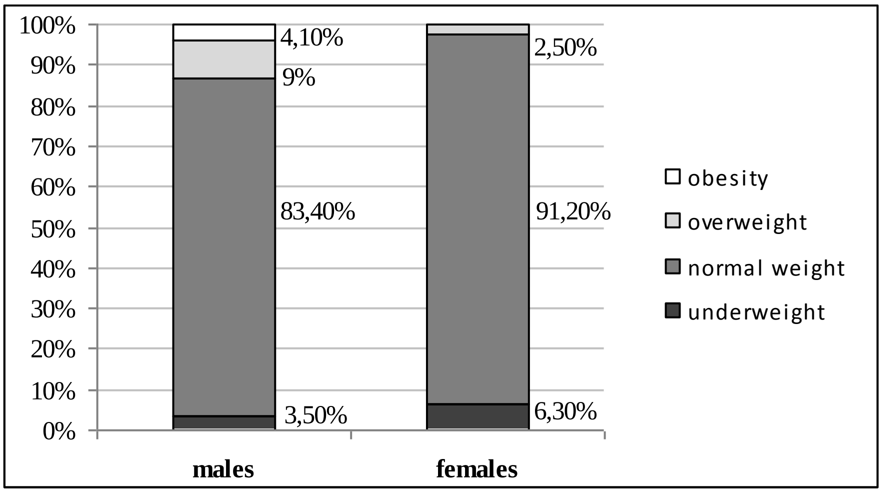

Fig.1 Prevalence of obesity`s occurrence in relation to BMI

MOVEMENT INACTIVITY

The structure of students` movement inactivity consists of: the volume of inactivity during weekdays, during weekends and the period that students spend passively during travelling and transfers. Average data are presented in Table. 1.

During weekdays (school attendance days) male students of our research group spend 8.28 hours and female students up to 9.11 hours passively (static work). Time that is spent at school has mostly passive character, youth seats at the desks during teaching and their loading is mainly psychological and loading on locomotive system has mostly static character. Movement inactivity should be compensated by movement activity during breaks between teaching units. School should be the main pillar of adolescents` active lifestyles and it should not create fundamental stimuli for creating sedentarism in adolescents. Chytilová sees serious problem in low allocation of hours for physical education at schools [5]. With regard to this problem it is problematic to motivate students in the way that students will accept movement activity as a part of daily regime and preserve an idea of active lifestyle. However, there is inevitable cooperation between school and family because child`s upbringing is integrated process (note).

Table 1. Average values of students` movement inactivity

Movement inactivity	males		females	
	x	SD	x	SD
Inactivity during weekdays [hours]	8,28	2,61	9,11	2,42
Inactivity during weekends [hours]	7,39	3,47	6,80	3,00
Inactivity during travelling [hours]	2,93	3,27	3,35	2,82

Legend: x-mean, SD standard deviation

Comparing males and females, results showed for account of males who spent passively fewer time during weekdays. On the contrary, females were inactive 6.8 hours and males up to 7.39 hours during weekends. On the other hand, for example Hamřík et al. found out that more than 55 % of Czech females and 60 % of Czech males aged between 11 – 15 years spend in sitting position (watching television, DVD, chatting etc.) more than 2 hours per day[4].

THE RELATIONSHIP BETWEEN MOVEMENT ACTIVITY AND BMI

The further part of the paper is focused on finding out the relationship between two dependent variables. We presupposed that the volume of students` movement activity would have the influence on body mass index` level. Pearson`s correlation coefficient`s values of males (0.11) and females (0.03) did not confirm linear dependency between the level of movement activity and body mass index (Fig.2). In this way we can talk about no correlation.

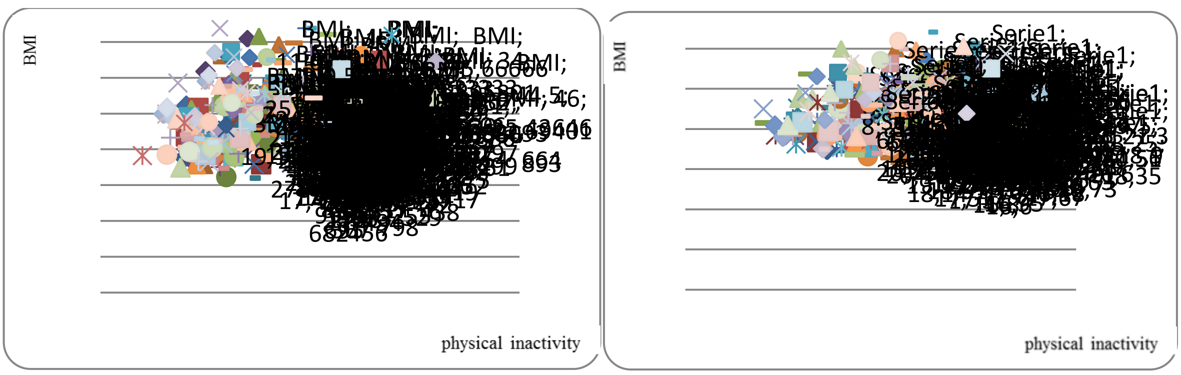

Fig.2 Relationship between Body mass index and physical inactivity

CONCLUSIONS AND RECOMENDATIONS

The aim of the paper was to analyse relationship between the movement activity of grammar school` students from Vranov nad Topľou and their body mass indexes. Results showed that up to 13.1% of male students have overweight or obesity. In female students` group we found out only the occurrence of overweight (2.5%). Underweight is suffered by 6.3% of female students and 3.5% of male students.

Students showed high volume of inactivity during weekdays (males 8.28 hours and females 9.11 hours). More alarming fact is that students continue in the tendency also during weekends when higher values were surprisingly explicated by males (7.39 hours) as well as females (6.8 hours).

The linear dependence between movement activity and body mass index was not found in females or in males.

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PARTIAL STRUCTURE OF PHYSICAL FITNESS IN PARAMEDICS

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Key words:
- Paramedics,
- Partial structure,
- Physical fitness.

Abstract:
The conducted analysis partially reveals what may be referred to as test redundancy, which may negatively affect its information value. The primary problem of such interpretation is whether using the conducted hierarchic cluster analysis it is possible to regard the cluster order as final and determine the contribution of respective variables on their participation. We may assume that such order interprets their status in the actual motor area.

INTRODUCTION

Requirements related to the preparation of students – paramedics in some parameters overlap with the requirements that determine the preparation of physical education students. During the university studies, students undergo a physically demanding training for two hours per week every semester together with facultative classes and outdoor courses of mountain and water rescue. [3] reported that the curve of professional, theoretical and practical knowledge of the applicants and their fitness level reveal a marked dichotomy. At the beginning of their professional careers, applicants are at their so-called nadir of his or her professional skills and experience.

Work tasks that involve prolonged and repetitive pulling, pushing, holding, carrying and lifting can lead to cumulative trauma disorders, lower back pain, sprains, strains, neck pain, etc. Therefore, a systematic and targeted physical training can be used as a preventive and rehabilitative tool in occupational settings increasing worker productivity and effectiveness in physically demanding occupations. Designing exercise programs requires knowledge about basic facts related to motor behavior. These are the base of actual motor fitness in a particular occupation or profession. Work tasks need to be analyzed in terms of the load that has to be lifted, carried, etc., task frequency, distance covered, time intervals necessary for the execution of the tasks involved. At the same time, tasks should be analyzed to determine the energy systems involved, muscle groups employed, requirements for strength and endurance and environmental conditions during work [3]. The definition of general motor fitness is to be based on the premise of inter-relationships between terms physical fitness, motor fitness and motor ability.

Repeated attempts to define the term physical fitness have produced definitions representing the concept of health-related fitness as a complex of five components (Table 1) morphological, muscular, motor, cardiorespiratory and metabolic.

Table 1. Components of health-related fitness (Bouchard et al., 2007)

Morphological component	**Cardiorespiratory component**
Body mass for height Body composition Subcutaneous fat distribution Bone density	Submaximal exercise capacity Maximal aerobic power Heart functions Lung functions Blood pressure
Motor component	
Agility Balance Coordination Speed of movement	
Muscular component	**Metabolic component**
Power Strength Endurance	Glucose tolerance Insulin sensitivity Blood lipids and lipoproteins Substrate oxidation characteristics

MATERIAL AND METHODS

The research project was carried out in cooperation with the Faculty of Sports, the Faculty of Sports' diagnostic center and The Faculty of Health Care of the University of Prešov in Prešov. This cooperation was time-consuming and demanding in terms of coordination, organization as well as ex post facto redundancy of the administration of particular test items, which were continuously administered but have not been included in the final analysis. The reference samples consisted of 1st year full-time and part-time undergraduate students in the study program Rescue health care. The first reference sample comprised 1st year full-time undergraduate students of the study program "Paramedic." The total number of students was 35, 22 men and 17 women. Average age of men and women was 21.6 years and 20.3 years, respectively. The second reference sample comprised part-time undergraduate students of the same study program. The total sample size was 34, 18 men and 16 women with varying practical experience in the field of paramedical services. The average age of men and women was 32.5 and 28.8 years, respectively.

The selection and administration of test items related to target domains "covered" by acceptable degree of error, were conducted taking into account the degree of standardization and were analyzed in terms of their applicability. The research objective was conducted in the field, where no comparable findings are available except some exceptions. The selection of tests was the combination of standardized systems used to test general motor fitness using the EUROFIT test battery according to Adam et al. (1988), which includes 9 motor parameters, three somatic parameters and Body Mass Index as an additional parameter.

The analysis of the partial structure included both field-based and laboratory-based evaluated using linear correlation analysis. Drawing on the analysis, a map of both significant and highly significant correlates was devised. An important part of the analysis is the possibility of comparing the partial structure within the hierarchy of significant correlates. The partial structure allows for the description of the role of particular parameters in the complex motor domain [4].

RESULTS AND DISCUSSION

The analysis in the sample of full-time students (Table 2) showed that the motor base of this reference sample includes endurance and strength, complemented by balance and somatic parameters. In the sample of part-time male students (Table 3), of somatic parameters Body mass index and skinfold thickness are of importance and unlike sample 1 also variable no. 11 – body height. There is a supposition of the effect of age. With respect to general motor fitness, the partial structure is determined by strength and endurance alongside balance and rhythmic ability.

Generally, we may conclude that the comparison of full-time and part-time male students showed higher level of motor fitness to a varying degree determined by an approximate 10-year age difference and partially by the effect of becoming "overweight". Of significance is also the continuous effect of regular physical training undergone by full-time students. This is most probably an important factor affecting the actual state of physical fitness and consequently a factor determining the fitness level when comparing and analyzing researched samples.

Table 2. Correlation matrix men – full-time study (n = 22)

Parameter	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**
1. Flamingo test													
2. Plate tapping													
3. Sit-and-reach test		░											
4.Standing long jump	■												
5. Grip dynamometry				░									
6. Sit-ups 30 seconds													
7. Bent-arm hang				░									
8. Shuttle run 10x5 m				░									
9. Endurance shuttle run	■			■			■	░					
10. Body weight							░						
11. Body height					░								
12. Sum of skinfolds	░						■						
13. Body mass index												░	

Level of significance $p \geq .05$ ░

$p \geq .01$ ■

The analysis of the partial structure included both field-based and laboratory-based measurements evaluated using linear correlation analysis. The next step in interpreting correlation coefficients was to "devise a map" of significant and highly significant correlates. The analysis of higher number of variables may lack transparency. The numerical values and the evaluation of their common variance are then difficult to interpret. It is therefore necessary to make the numerical data transparent without the loss of their information value. Similar analyses may be "affected" by paradoxical correlate values with problematic option of clarifying such situation. This situation is present only sporadically and does not prevent the researcher from interpreting and analyzing the status and organization of particular correlates or groups of correlates with high degree of plausibility. Both reference samples are to certain extent unique as they represent "a population sample", which in the past was not enrolled using a stratified sampling. On the other hand, this population undergoes testing that cannot solve the validity of administered testing procedures in terms of their applicability or inapplicability.

Generally, we may conclude that the comparison of men and women studying full-time and part-time showed higher level of motor fitness to a varying extent determined by 10-year age difference and partially by the effect of overweight. Of significance is also the continuous effect of regular physical training undergone by full-time students. This is most probably an important factor affecting the actual state of physical fitness and consequently a factor determining the fitness level when comparing and analyzing researched samples.

Table 3. Correlation matrix men – part-time study (n = 18)

Parameter	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Flamingo test													
2. Plate tapping													
3. Sit-and-reach test													
4. Standing long jump													
5. Grip dynamometry													
6. Sit-ups 30 seconds													
7. Bent-arm hang	▒												
8. Shuttle run 10x5 m	▒	▒		■									
9. Endurance shuttle run		▒		▒			■	■					
10. Body weight					▒								
11. Body height				■	▒			▒					
12. Sum of skinfolds													
13. Body mass index								▒			▒	■	

Level of significance $p \geq .05$ ▒

$p \geq .01$ ■

CONCLUSIONS

The present analysis was a so-called "test probe" into the motor domain of paramedical students who within their full-time study undergo 3 years of preparation and practice in the part-time study. Differences in findings showed the so-called "shift" in both motor fitness and somatic parameters. This may be caused by "motor patterns" formed by practical experience, which compensate for the decline in physical fitness and increase in body weight. The findings have shown that the base of the performance-related requirements and physical fitness determined by motor fitness includes the alternative of strength-speed capabilities. The issue is the age range associated with decline in job-related fitness. This may be viewed as a recommendation for the field of work medicine. When drafting the research project, the most discussed issue was which test items were to be selected in terms of empirical reality of the profession itself and its content reality, which is expressed as professional competence.

The confrontation of bibliographic sources in the whole range of demands related to profiling has specified the criteria, which the paramedical profession requires in terms of its complex structure from the medical standpoint and the standpoint of physical fitness. The argumentation of views on the profession was based especially on the knowledge of American provenience supported by long-time experience based on relatively extensive research presented in concrete findings. The introductory part dealt with issues that limit the transfer of actual knowledge into the environment of Slovakia. It may be hypothesized that this state is a "long-distance running event." However, one thing has been confirmed. The requirements related to the physical fitness of paramedics as a supportive element include in their base a universal character, which is to be necessarily accepted for their working life.

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THE EFFECT OF DEVELOPMENTAL TRENDS ON SOMATOTYPE COMPONENTS IN ELITE MALE HANDBALL PLAYERS

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Key words:

- kinanthropometry,
- morphological parameters,
- body composition,
- sports games.

Abstract:

The purpose of the cross-sectional study was to determine the effect of developmental trends on particular somatotype components from the viewpoint of playing positions. The results revealed lower endomorphy and ectomorphy with comparable level of mesomorphy in wing players, center backs and backs. Contemporary top male handball players compared to their counterparts are characterized by muscular somatotype and lower body fat percentage. With regard to somatotype categorization, the most significant changes were observed in goalkeepers and center backs.

INTRODUCTION

Over recent decades, team handball has changed due to the implementation of new rules. Along with developmental trends, the game itself has become faster and more dynamic in terms of the execution of game skills. This has resulted in more demanding tempo game in both the offensive and defensive phases of the game. The rules alterations have significantly increased the effectiveness of the playing time utilization placing emphasis on special endurance, power and coordination and taxing the energy systems needed to effectively perform required game skills [8, 14, 17]. As reported by previous studies [1, 5, 6, 7, 9, 10, 11, 18], athletic performance in both individual and team sports is determined by overall somatic profile expressed by somatotype, which is one of the biological factors underlying the effective execution of the specific game skills. This poses the question of the effect of developmental trends and rules changes on somatotype components in elite male handball players with respect to playing positions.

METHODS

The first sample consisted of 256 elite male handball players who participated in 2010 Men's U20 European Handball Championship in Bratislava [18]. The sample tested in 2010 was compared with the sample consisting of 122 elite U19 male handball players who participated in the Handball Tournament Družba held in former Czechoslovakia in 1980[2] [12]. Consistent with the research objective, the players were assigned into position-specific groups: G – goalkeepers, W – wings, CB – center backs, B – backs and P – pivots (see Table 1).

Table 1. Sample characteristics

		Age (n)					Playing position (n)					
Sample	**Mean age**	**20**	**19**	**18**	**17**	**16**	**G**	**W**	**CB**	**B**	**P**	**∑**
2010[1]	19.6	65	82	8	1	-	38	71	45	63	39	256
1980[2]	18.3	-	64	39	15	4	19	32	19	34	18	122

The somatotypes of the U20 players were determined according to Heath, Carter using the following somatic parameters: body height, body mass, skinfold thickness: triceps skinfold, subscapular skinfold, supraspinale skinfold and calf skinfold, biepicondylar humerus breadth and biepicondylar femur breadth as well as flexed and tensed upper arm girth and standing calf girth [4]. The morphology according to Heath, Carter is expressed in a 3 number rating indicative of endomorphic, mesomorphic and ectomorphic somatotype components. The player's somatotypes were classified using 13 somatotype categories devised by Carter, Heath [2].

The collected data were processed using basic statistical characteristics: **x** - arithmetic mean and **s** - standard deviation. The somatotypes were computed using the Somato software. The somatocharts were plotted in CorelDRAW X5. The differences in somatotype components between the samples and playing positions were determined by independent samples t-test.

RESULTS AND DISCUSSION

The endomorphic component is indicative of the volume of subcutaneous fat relative to body build [2]. Endomorphy-dominant athletes are endowed with muscle gain capacity with lower rate of fat reduction [3]. Therefore, the endomorphic and mesomorphic components may be to a large extent influenced by training. In elite male handball players, the endomorphy and mesomorphy values range from 1.0 to 2.5 and from 4.0 to 6.0, respectively. The ectomorphic component is indicative of body linearity, which cannot really be influenced. The recommended ectomorphy values range from 1.5 to 3.0 [19].

Difference in endomorphic component was found in all playing positions but goalkeepers. The differences between mean values ranging from 0.5 to 0.7 were statistically significant (see Table 2). This finding may be attributed to the frequent ball possession of back court players who perform a lot of short sprints with changes of direction as compared to other playing positions. Therefore, back players perform physically demanding and explosive actions. In wing and pivot players, the playing functions have not changed substantively, which is confirmed by the adjustment to the contemporary game trends.

Differences in mesomorphic component in favor of the 1980 sample were observed in goalkeepers, center backs and backs. The differences ranging from 0.1 to 0.3 were statistically insignificant as both samples were found to have well-developed musculature relative to body height. Minimal differences have confirmed the need for high muscle volume. The intensification of the game skills execution has resulted in the increase in the number of physical encounters during the game. Therefore, adequate physique significantly determines the efficiency in 1:1 game situations.

Higher mean ectomorphy values are indicative of relative linearity of body segments. The differences in mean ectomorphy values were found in all playing positions favoring the 1980 sample. The greatest difference of 0.8 was observed in the goalkeeper position. The endomorphy component is important for goalkeepers due to the fact the lengths of individual body segments underlie goalkeeping efficiency. Statistical difference was found in wing and back players as well. Overall, the body build was more linear in players of the 1980 sample.

Table 2. Difference in somatotype components with respect to playing functions

Somatotype	Sample	G	W	CB	B	P	∑
Endomorphy	2010[1]	**2.2**±0.92	**1.4**±0.45	**1.7**±0.61	**1.7**±0.65	**2.0**±0.81	**1.8**±0.73
	1980[2]	**2.2**±0.48	**2.1**±0.55	**2.2**±0.68	**2.3**±0.72	**2.5**±0.70	**2.2**±0.63
	Diff.	*0*	*0.7*	*0.5*	*0.6*	*0.5*	*0.4*
	t	0.05	2.22**	6.22**	4.13**	2.85**	
Mesomorphy	2010[1]	**4.5**±1.27	**4.8**±1.11	**5.0**±0.94	**4.6**±0.89	**4.8**±0.99	**4.8**±1.05
	1980[2]	**4.6**±1.08	**5.1**±0.87	**5.2**±0.93	**4.9**±0.85	**4.8**±0.89	**4.9**±0.92
	Diff.	*0.1*	*0.3*	*0.2*	*0.3*	*0*	*0.1*
	T	0.29	0.14	1.37	1.59	0.77	
Ectomorphy	2010[1]	**2.5**±0.90	**2.5**±0.75	**2.6**±0.76	**2.7**±0.89	**2.3**±0.78	**2.5**±0.82
	1980[2]	**3.3**±0.99	**2.7**±0.79	**2.7**±0.93	**3.1**±0.71	**2.9**±0.84	**2.9**±0.84
	Diff.	*0.8*	*0.2*	*0.1*	*0.4*	*0.5*	*0.4*
	t	3.00**	2.58*	1.22	2.24*	0.44	

* $p<.05$; ** $p<.01$; diff. - difference

The change in somatotype category in the goalkeeping position showed that contemporary goalkeepers are classified as balanced mesomorphs endowed with muscular physique. It may be assumed that such somatotype is beneficial when saving shots from the wing positions, dive shots from the pivot positions and jump shots performed by backs. On the other hand, if a more muscular somatotype is to be productive, the ratio between body mass, percent subcutaneous fat and muscular development should be appropriate relative to body height. The ectomorphy is indicative of body linearity and the symbiosis of the frontal body size and the length of individual segments are among important morphological parameters.

The change in somatotype category was recorded in the playing position of center back as well. Contemporary center backs are categorized as ectomorphic mesomorphs. The primary role of a center back player is to organize, create and complete the game situations predominantly from longer range or under restrained conditions. The players occupying the center back position encounter the opponent's defense consisting of robust and tall players. The need for relatively high values of body height, robust skeleton and muscle mass are highly relevant for contemporary back court players. Center backs, backs and wings showed low endomorphy values. However, the difference between these playing positions is significant in terms of speed, dynamics and coordination of movement.

As reported by Grasgruber, Cacek [3], contemporary male handball players are characterized by balanced somatotype with the rating of 2.5 - 5.0 - 3.0. The overview of studies in elite male handball players (see Table 3) confirms this finding. On the other hand, it should be noted that overall mean value does not refer to the team composition. Therefore, to evaluate players with respect to playing positions seems more appropriate.

Table 3. Somatotypes of male handball players – overview of studies

Study	Sample	n	Age	Somatotype
Štěpnička (1972)	Elite Czechoslovak players	21	24.3	2.7 - 5.0 - 3.0
Štěpnička et al. (1980)	Handball Tournament Družba	122	18.3	2.2 - 4.9 - 2.9
Šibila, Pori (2009)	Slovenian national team	78	25.1	2.3 - 4.9 - 3.0
Urban (2010)	Slovak national teams	49	18.3	2.0 - 4.8 - 2.3
Urban, Kandráč (2010)	Men's U20 European Handball Championship	256	19.6	1.8 - 4.8 - 2.5

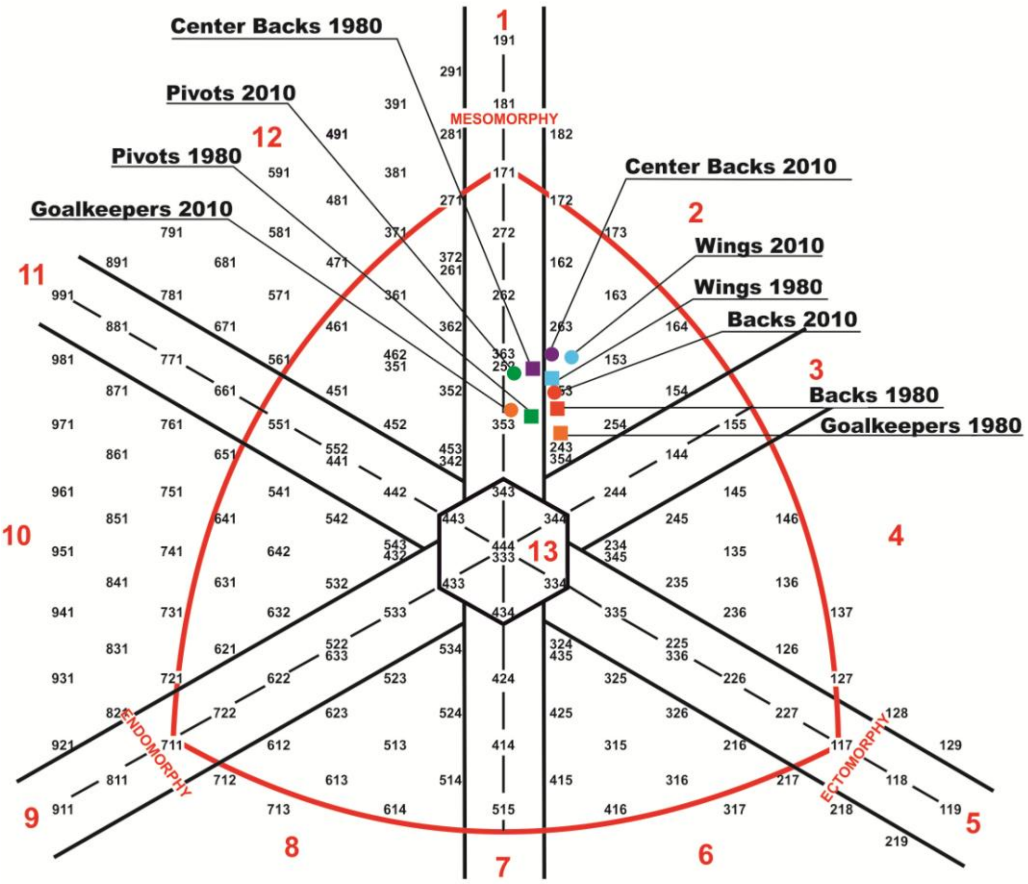

Fig. 1. Categorization of somatotypes

CONCLUSIONS

With respect to particular somatotype components, the differences in endomorphy were found in wing, center back, back and pivot playing positions. Contemporary players have lower volume of subcutaneous fat, which reflects the current character of dynamic handball. In the mesomorphic component, minimal differences were found favoring the 1980 sample. In ectomorphy the differences favored 1980 goalkeepers, wing players and backs. All playing positions were characterized by robust skeleton and well-developed musculature relative to body height. Contemporary players in all playing positions except goalkeepers are endowed with relatively linear physiques and lower amount of storage fat, which confirms the change in the game character and increased training demands necessary for efficient execution of handball skills. Overall, it may be concluded that the developmental trends and rules changes affected mainly endomorphic somatotype component. With respect to playing most profound changes in somatotype components were found in backs and wings.

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SOMATIC PROFILE AND FUNCTIONAL CAPACITY OF VOLLEYBALL PLAYERS

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Key words:

- percentage body fat,
- somatotypes,
- working capacity,
- maximal oxygen uptake,
- volleyball players

Abstract:

The present study deals with partial findings of the research project VEGA No. 1/1020/11 targeted at the variability of aerobic and anaerobic fitness in athletes throughout the annual training cycle. Complex baseline evaluation of somatic development and aerobic fitness was conducted in 14 players aged 24.2 4.5 years on the volleyball team VK Mirad PU Prešov. The players were tested for the measures of body height, body mass and percentage body fat using the personal digital scales Omron BF 511. The somatotypes were determined according to Heath-Carter (1967). Functional parameters of working capacity (W170.kg^{-1}), peak power output (Wmax. kg^{-1}) and maximal oxygen uptake (VO_2 max. kg^{-1}) were measured using a spiroergometric test on a cycle ergometer to exhaustion. The results showed that the value of percentage body fat (11.5 %) was consistent with reference values for volleyball players and mean somatotype (2.1 - 3.6 - 3.0) was categorized between mesomorphic ectomorph and mesomorph-ectomorph. The comparison with reference values of functional parameters showed that mean value of peak power output (3.6 W. kg^{-1}) equaled 05 % of the reference value and maximal oxygen uptake equaled 104 %, which showed to be lower than the reference values.

INTRODUCTION

Volleyball is one of the most popular team and net games in the world. Contemporary volleyball requires all-round and well-conditioned players and high level of technical and tactical skills together with high quality of moral and volitional qualities. Similarly to other sports, volleyball places different demands on genetic endowment, somatic parameters and functional capacity of players. Emphasis is placed especially on body build, lengths and proportionality of body segments (Havlíčková, 1993). These requirements differ between playing positions. As reported by Grasgruber, Cacek (2008) above-average body height and long extremities are important when jumping and playing at the net. Therefore, spikers and blockers usually have longer legs and shorter trunk. Defensive players are shorter, which is important for their flexibility. Most individual game skills are performed at maximum intensity in the shortest possible time requiring high level of explosive power, reaction speed and locomotion. The most important precondition in terms of energy supply and production in volleyball is the high capacity of anaerobic alactacid energy system (ATP-CP). Another important precondition is the capacity of aerobic zone of energy supply during the game. As compared to other team games, volleyball does not require such a high level of cardiorespiratory fitness. Therefore, this type of fitness is developed to a minimum extent (Přidal, Zapletalová, 2010). Aerobic capacity of volleyball players (VO_{2max}) should range from 50 to 60 ml. kg^{-1}. min^{-1} (Grasgruber, Cacek, 2008, Vavák, 2011). The present study presents partial findings on functional capacity and somatic profile of volleyball players dealt with within the research project VEGA No. 1/1020/11.

METHODS

The study sample consisted of 14 volleyball players of VK Mirad PU Prešov of the Slovak top volleyball league. The mean age of the players was 24.2 ±4.5 years. The players were tested for body height using stadiometer with 0.1 cm precision, body mass and percent body fat using personal body composition monitor Omron BF 511. The somatotypes of players were determined according to Heath, Carter (1967) using the following parameters: body height, body mass, skinfold thickness on 4 sites (triceps, subscapular, supraspinale, calf), biepicondylar breadths of the humerus and the femur and limb girths of flexed upper arm and tensed calf. The somatotype data were processed using SOMATO software. Functional capacity was assessed by a sports physician working for a private sports medicine center SportmedEast s.r.o. in Prešov by means of spiroergometric testing to volitional fatigue. The testing was based on the progressive load increase and was performed on the cycle ergometer Ergoline. In terms of functional capacity, players were tested for working capacity (W_{170}), maximum power (W_{max}), maximal oxygen uptake (VO_{2max}) and oxygen pulse ($VO_2.SF^{-1}$). The functional capacity was evaluated using relative values per kilogram body mass. The results of exercise testing were processed using the software developed by Schiller company. The software allows for the comparison of the values of maximal oxygen uptake, maximal power and oxygen pulse with reference values according to age, gender, body height and body mass of the tested person. The collected data were characterized by descriptive statistical measures of location: arithmetic mean (x), maximal and minimal value and statistical measure of variation: standard deviation (s).

RESULTS AND DISCUSSION

Table 1 shows statistical characteristics of investigated somatic parameters. With respect to somatic parameters in volleyball, body height is considered to be a crucial somatic factor, which in elite volleyball players ranges from 190 to 210 cm. Among the shortest players are setters and the tallest ones are blockers. The mean body height of players was 190.8 cm. The lowest body height value 179.6 cm was recorded in a setter, while the highest value 197.8 cm was found in a blocker. Body mass is one of the most variable somatic parameters affected by the quality of nutrition. Inadequate nutrition can impair performance. The mean body mass of players was 85.1 kg. The highest body mass 102.8 kg was observed in a 187.6 cm tall player, whose percentage body fat was 19.1 %, which was the highest value of all players. Mean BMI value was 23.4, which according to the WHO classification for adults falls within the normal BMI range. Besides basic somatic parameters, athletes should be aware of their body composition. Volleyball players are required to have low percent body fat due to good preconditions for jumping performance (Havlíčková, 1993). As reported by Grasgruber, Cacek (2008), recommended percent body fat in volleyball players should equal 10 %. The results showed that percent body fat 11.5 % was close to percent body fat recommended for volleyball players. The intra-individual analysis showed that recommended percent body fat was observed in half of the sample. Body fat percent around 13 was found in one third of players. Values of percent body fat exceeding this value were found in two players with percent body fat 15.5 and 19.1 %.

The most complex parameter of body build is the somatotype. In volleyball, there is a variety of somatotypes. Generally, volleyball players are tall and have long legs (Přidal, Zapletalová, 2010). Mean somatotypes of volleyball players relative to their body height and agility are slender, not robust. As reported by Grasgruber, Cacek (2008) mean values of somatotypes components are 2.0 - 4.5 - 3.5. In general, high performance level was found in players with ectomorphic-mesomorphic somatotypes with predominant mesomorphic component and minimal endomorphy rating (Vavák, 2011). Modern volleyball is becoming faster, therefore, strength components are beneficial. Therefore, certain degree of endomorphy in volleyball players is associated with the strength component underlying sports performance.

Table 1. Basic statistical characteristics of somatic parameters in volleyball players

Somatic parameter	Volleyball players VK Mirad Prešov (n = 14 , age x = 24.2 years)			
	x	**s**	**max**	**min**
Body height (cm)	190.8	5.9	197.8	179.6
Body mass (kg)	85.1	8.6	102.8	70.3
BMI (kg. m^{-2})	23.4	2.3	29.0	19.8
Percent fat	11.5	3.7	19.1	5.0
Endomorphic component	2.1	0.7	3.7	0.8
Mesomorphic component	3.6	1.2	5.8	1.6
Ectomorphic component	3.0	1.1	4.9	0.7

Legend
x - arithmetic mean   s - standard deviation   n - sample size
min - minimal value   max - maximal value   BMI - body mass index

As shown in Table 1, the mean somatotype of players was 2.1 - 3.6 - 3.0, which was on the range between mesomorphic ectomorph and mesomorph-ectomorph. The comparison with mean somatotype recommended for volleyball players (2.0 - 4.5 - 3.0) showed low mesomorphy rating, which is indicative of insufficient muscular development. The intra-individual analysis showed that somatotypes of two players with higher percent body fat were categorized as endomorphic mesomorphs (12), who are characterized by both high mesomorphy and endomorphy rating. The somatotype category of balanced mesomorph (1) and ectomorphic mesomorph (2) characterized by predominant mesomorphy was observed in 4 players. The mesomorph-ectomorph (3) somatotype category, where mesomorphy and ectomorphy do not differ by more than one-half unit, was found in 3 players. The categories characterized by predominant ectomorphy and low mesomorphy rating (4, 5, 6) was found in three volleyball players.

Cardiorespiratory fitness in volleyball players was evaluated using the following functional parameters: working capacity (W_{170}), which is a submaximal test of performance at 170 heart beats per minute, maximal power (W_{max}), which is indicative of strength and endurance of the tested person and maximal oxygen uptake (VO_{2max}), which is the most valuable parameter of cardiorespiratory fitness and oxygen pulse ($VO_2 . SF^{-1}$), which is the oxygen uptake per heartbeat at rest. Table 2 shows basic statistical characteristics of functional parameters in volleyball players measured by spiroergometric testing on a cycle ergometer.

Compared to the findings reported by Komadel (1997) the mean value of working capacity W_{170} 3.4 $W.kg^{-1}$ fell within the recommended range for volleyball players (3.6 $W.kg^{-1}$). However, mean values of maximal power 3.6 $W.kg^{-1}$ and maximal oxygen uptake 45 ml. $kg^{-1}.min^{-1}$ were not within the recommended range. The values of maximal power are influenced especially by high exercise intensity and volitional qualities. In volleyball players, the value of maximal power should oscillate around the value of 4.4. $W.kg^{-1}$. Maximal oxygen uptake is one of the most important indicators in terms of functional capacity assessment. The sufficient VO_{2max} value ranges from 50 to 56 $ml.kg^{-1}.min.^{-1}$ (Laczo, 1996). The required VO_{2max} level above 50 ml. $kg^{-1}.min^{-1}$ was found in only fifth of the sample.

Table 2. Basic statistical characteristics of functional parameters in volleyball players

Functional parameter	**Volleyball players VK Mirad Prešov (n = 14 , age x = 24.2 years)**			
	x	**s**	**max**	**min**
W_{170} (W. kg^{-1})	3.4	0.3	3.9	2.9
W_{max} (W. kg^{-1})	3.6	0.3	4.2	3.0
VO_{2max} (ml. kg^{-1}.min^{-1})	45.0	5.8	54.8	32.8
VO_2 . SF^{-1} (ml)	21.3	3.8	27.5	13.7

Legend

W_{170} - work capacity at 170 bpm W_{max} - maximal power

VO_{2max} - maximal oxygen uptake VO_2 . SF^{-1} - oxygen pulse

x - arithmetic mean   s - standard deviation   max - maximal value

min - minimal value   n - sample size

The comparison of maximal power values and maximal oxygen uptake with reference values for volleyball players showed that the values equaled 105 % and 104 % of reference values, respectively. Maximal power did not fall within the recommended range in only one fifth of the sample. The lowest value of maximal power 3.0 W.kg^{-1} equaled only 75 % of the reference value, while the highest value of maximal power 4.2 W.kg^{-1} equaled 116 % of the reference value. In maximal oxygen uptake, the intra-individual analysis showed that the VO_{2max} values did not fall within the required range in one third of the sample. The lowest VO_{2max} value 32.8 ml. kg^{-1}.min^{-1} equaled only 76 % of the reference value and the highest VO_{2max} value 54.8 ml. kg^{-1}.min^{-1}. Oxygen pulse (VO_2 . SF^{-1}) is the indicator of the cardiovascular fitness. The oxygen pulse values in athletes range from 20 to 28 ml. The mean value of oxygen pulse was 21.3 ml, which equals 109 % of the reference value. The highest value of oxygen pulse was 27.5 ml, which equals 131 % of the reference value and was found in a volleyball player with VO_{2max} 47.3 ml. kg^{-1}.min^{-1}, equaling 124 % of reference value.

CONCLUSIONS AND RECOMMENDATIONS

Volleyball is a team game specific in terms of somatic parameters. The analysis of the somatic profile showed that mean body height 190.8 cm in volleyball players of VK Mirad Prešov is at the lower limit of the range recommended for volleyball players. The mean percent body fat 11.5 % falls within the recommended range. The somatotype analysis showed low mesomorphy rating, which is indicative of insufficient muscular development. The assessment of cardiorespiratory capacity revealed low level of aerobic capacity. Only fifth of volleyball players were found to have maximal oxygen uptake higher than 50 ml. kg^{-1}.min^{-1}, which is the lower limit of the range recommended for volleyball players. This leads to the conclusion that training process should be targeted especially at the development of muscular fitness and aerobic capacity.

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EVALUATION OF THE SELECTED MARKERS OF PHYSICAL DEVELOPMENT OF STUDENTS AT THE TECHNICAL UNIVERSITY OF KOSICE

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Key words:

- university population,
- parameters of physical development,
- body fat,
- body mass index,
- active body mass.

Abstract:

The article in question deals with selected markers of physical development among students of Technical University in Kosice. It compares the parameters of body height and weight, body mass index (BMI), quantity of body fat, muscles and visceral fat with the results of different studies.

Entry (pre) measurements were taken in 1042 students of Technical university in Kosice (n1=1042, 512 females and 530 males, september 2012), exit (post) measurements in 670 students (n2=670, 302 females, 368 males, may 2013) where the average age was 21,1±1,4 years. The paper also presents the entry data collected at the Pavol Jozef Safarik University in Kosice in (n=951, 672 females and 279 males, average age =21,5±3,5 years, september 2012).

The primary goal of this study was to gain insight and evaluate the impact of the changing living conditions on physical development of college students. The assessment of body weight, BMI, body composition – proportion of body fat and active body mass (muscles) is part of health state valuation. Higher values of the above-mentioned parameters represent a significant risk factor related to a whole number of health disorders.

INTRODUCTION

Statistics in Slovakia show that only 40% of males and 56% of females at the age of up to 35 years have weight in proportion to their height. The aim of the survey carried out in the years 1992 – 2007 among 4590 undergraduate students was to find out the mean BMI values in this group of population. 22% of males and 8% of females were diagnosed as being above the ideal weight. The increasing BMI values over the course of years were found in males in particular [4]. The study performed between the years 2007 – 2011 at the University of Nebraska with more than 2530 participants revealed overweight in more than 30,5% of probands [6]. The reasons for the increased number of overweight individuals were associated with the change of their lifestyle towards the increasingly hypokinetic way of life. To tackle the challenges of university studies undergraduates are required to devote more time to learning which leads to a gradual shift to a sedentary way of life. Most of them leave their families and for a certain period of time are exposed to a new environment where they live and study. This is closely related to the change in their daily routine and eating habits. Irregularity and changes in schedules make them unable to keep their regular eating patterns.

The primary goal of this study was to gain insight and evaluate the impact of the changing living conditions on physical development of college students. The assessment of body weight, BMI, body composition – proportion of body fat and active body mass (muscles) is part of health state valuation. Higher values of the above-mentioned parameters represent a significant risk factor related to a whole number of health disorders. It leads to an increased probability of cardiovascular diseases, diabetes, provides a precondition for a decreased mobility as well as life span thus deteriorating the quality of life.

The following study was carried out as part of the VEGA project No 1/1343/12 „ Selected risk factors of obesity and preventive measures for mobility „.

METHODS

The study of the selected parameters of the physical development was performed in students of the 1^{st} – 5^{th} year of the Technical university of Kosice (TUKE). In September 2012 the entry (pre) and in May 2013 the exit (post) diagnostics of the followings parameters was carried out: body height, body mass index (BMI), body composition – amount of body fat and active body mass (muscles).

The professional OMRON Body Composition Monitor BF511 was used for the diagnostics of the physical development; body weight was measured using a stadiometer to the nearest 0,5cm. Entry (pre) measurements were taken in 1042 students (n1=1042, 512 females and 530 males), exit (post) measurements in 670 students (n2=670, 302 females, 368 males) where the average age was 21,1±1,4 years. The paper also presents the entry data collected at the Pavol Jozef Safarik University in Kosice in September 2012 (n=951, 672 females and 279 males, average age =21,5±3,5 years).

The results of the survey obtained were statistically weighted and subjected to classified and logical analysis. The arithmetic mean (x) from the statistical characteristics of the position and the standard deviation from the characteristics of the variability rate were used to compare the values with the results of similar surveys. The normality of data distribution was assessed using the Pearson's chi-square test for goodness-of-fit. To determine the homogeneity of variances necessary for statistical evaluation, an F-test for independent groups was used. The statistical significance of differences was tested at the level of significance 0,05. Statistical calculations were performed using Matlab and Microsoft Excel.

RESULTS AND DISCUSSION

All the data measured in individual groups were assessed using the Pearson's chi-square test, the results of which disproved the hypothesis of normality for distribution of frequency. The paired t-test could not be used for the statistical analysis due to the different sample of probands in the entry (pre) and exit (post) measurements. The assessment of changes of individual parameters in the TUKE students using t-tests for independent groups showed significant differences in measurements taken in September 2012 and May 2013 only in the BMI parameter in the female group (T=0,005). The mean BMI value of females decreased by 1,2 kg/m^2. Comparison of the average values of other parameters showed that males' weight in the exit (post) measurement was higher by 1,2 kg which appears as the most significant change along with the decrease in the proportion of body fat in females from 30,6%±7,1 to 27,4%±7,1 and the increase in active body mass (muscles) from 28,4%±3,0 to 30,2%±3,0. Based on the data of the study from the years 1992 – 2007, the changes in the average BMI values [4] were expected to show an increase. This 15-year study revealed the trend of increasing BMI over the years, especially in males. (Fig.1). No significant changes were observed between the entry (pre) and exit (post) measurements at the TUKE due to a short (only 8 months) time interval between them.