

ISSN 1840-3662



SPORT SCIENCE

INTERNATIONAL SCIENTIFIC JOURNAL OF KINESIOLOGY



*Association for
Research, Education
and Development*

Vol.9, Issue 1; June, 2016.

SPORT SCIENCE

Vol. 9, Issue 1. June 2016.

INTERNATIONAL SCIENTIFIC JOURNAL OF KINESIOLOGY

Publisher: Association for Research, Education and Development "NIA"

Aleja konzula br. 5, Travnik, Bosnia & Herzegovina

Print ISSN 1840-3662, Web ISSN 1840-3670

UDK 796, Catalogued in: COBISS BH

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Print & Web:

Print: Print doo 72270 Travnik, Aleja Konzula 5. B&H; Printed: 300 copies

Front page design and DTP: Jasmir Smailbegović

Web preparation: Maid Omerović & Aljo Delić, Travnik – B&H

Webhosting: TOTOHOST - Zagreb, HR;

Publishing:

Sport Science publishes twice a year in English with Bosnian abstracts.

Communication:

Sport Science – International scientific journal of kinesiology.

Association for Research, Education and Development "NIA"

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E-mail: info@sportscience.ba

Full journal text available on <http://www.sportscience.ba/>

Dear readers,

We are introducing a new issue of the scientific journal "Sport Science" which is as always composed of scientific articles from the field of kinesiology.

During all the years of its existence, the journal has been representing a relevant source of new scientific and professional information. "Sport Science" was well accepted among Bosnian and Herzegovinian readers, as well as international readers.

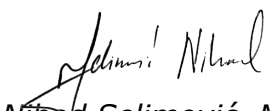
This issue of the journal is made up of different problems that the science of kinesiology studies. We believe that our journal makes a great contribution in the connection of scientific knowledge and scientific work in sport.

Our intention is to continue to work intensively on the development of science, and through that to expand the journal "Sport Science". The Scientific Committee of the journal, which consists of relevant professors in the field kinesiology is deeply convinced that the development of science in sports is possible only with a free exchange of ideas that is not limited by state and national borders. Therefore, we must emphasize that the authors of papers published in this issue come from several european countries, and that they presented their papers in the areas in which they are specialists.

Your commitment gives us more strength to continue our efforts and to publish and make better and more interesting journals. Our efforts towards progress can be seen in this issue, which contains interesting and high-quality scientific publications.

We would like to thank the authors who have pleasantly surprised us with a great number of articles, and with their serious approach, the quality of ideas and their elaboration, as well as their scientific attempt to clarify some issues handled in this journals issue.

Thank you for your support and we hope that our scientific cooperation in the future will be even more successful and more intense.


Dr. Nihad Selimović, MSc
Editor in chief

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TECHNIQUE MODEL OF THE TRIPLE JUMP FOR WOMEN

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Faculty of Sport, University of Ljubljana, Slovenia

Original scientific paper

Abstract

The purpose of the study was to examine relevant parameters of kinematical model in the triple jump. An analysis has been carried out on a single measured subject, one of the top elite female athletes in this discipline. The latest biomechanical technology and methodology of measurements in the triple jump have been used. The OPTO-TRACK technology and 3-D kinematical technology were used to determine, which parameters generate the results in this track and field discipline in women. Measured subject is a representative of the type of triple jump model, where the final result is defined with the velocity potential, strength potential and the optimal execution of technique. Efficient transformation of run-up speed into take-off velocity, optimal proportion of partial phase lengths with an emphasis on the jump phase, maintaining the horizontal velocity of body centre of gravity in various phases, optimal proportion between support and flight phases and a high kinaesthetic and visual control of movement are those biomechanical factors, which generate the result in the triple jump.

Keywords: Triple jump, kinematic, technique, model.

Introduction

From the biomechanical aspect, triple jump is one of the most complex track and field disciplines and consists of the run-up phase and three consecutive flight phases. The result is defined mainly with the speed of run-up and the optimal proportion between the distances of three flight phases (Hay, Miller, 1985; Hay, 1992; Grahman-Smith, Lees, 1994; Miladinov, Bonov, 2004). Each of the structural units represents a specific motor task with certain characteristics and tasks, which an athlete has to complete in order to execute a successful triple jump. According to some of previous studies (Conrad, Ritzdorf, 1990; Grahman-Smith, Lees, 1994; Hay, 1999; Jurgens, 1998; Panoutsakopoulos, Kollias, 2008), preservation of optimal horizontal velocity in the hop, step and jump phases is a crucial factor for achieving maximal distance in the triple jump. A critical moment in the triple jump is a transition from hop into step phase. From the aspect of motor pattern structure, triple jump can be regarded as a connection of cyclic and acyclic movements. Efficient transformation of run-up speed into take-off for hop phase is correlated with the correct rhythm and visual as well as kinaesthetic control (Yu, Hay, 1996; Hay, 1999; Kyrolainen et al., 2007). The first phase (hop) is the longest and represents 36 – 39% of overall distance of three phases (Grahman-Smith, Lees, 1994; Kyrolainen et al., 2007; Panoutsakopoulos, Kollias, 2008). Therefore, an efficient execution of hop phase is a key element for execution of the next two phases (step and jump) and thus the entire triple jump. The proportion of distances of three phases depends on various motor strategies for both genders of triple jumpers. Three techniques of triple jump have been identified: »Hop Dominated«, »Hop Jump« and »Balanced« technique. In the first (hop dominated) technique an emphasis is on the distance of first phase (hop), in the second technique an emphasis is on the distance of last phase, whereas in the third technique a balance between the distances of all three phases is emphasised. Distances and proportions of different phases are defined with the execution of support and flight phases. Transition of horizontal velocity is correlated mostly with the efficient technique of take-off action. The optimal proportion

between horizontal and vertical component of body centre of mass (BCM) velocity in support phase is very important. An athlete should maintain as large horizontal velocity as possible whilst ensuring adequate vertical velocity for an efficient triple jump. The increase of horizontal velocity component results in reduced vertical velocity component and vice versa.

The purpose of the study was to establish relevant kinematical parameters of individual phases in the triple jump technique on a sample of one measured female athlete of highest international quality. Collected data will serve as a basis for objectivisation and optimisation of motor structures in the triple jump. The latest co-dependent and synchronised technologies, required for this type of biomechanical studies, were used. The focus of the study was a run-up speed, the structure of the last two strides in the run-up and the kinematics of individual phases in the triple jump.

Methods

The measured subject is one of the best female triple jumpers in the world, M.Š. (age 28, height 172 cm, weight 66.5 kg, personal triple jump record 15.03m, 6th place at the 2008 Olympic Games). Measured subject had six attempts and the two longest jumps were included in the study. Measurements were carried out in the preparation phase prior to the 2008 Olympic Games in Beijing. OPTO-TRACK technology by the Italian manufacturer Microgate was used to measure the distances of different phases, support and flight times in the run-up phase as well as in hop, step and jump phases. The basic components of the measuring system represent interlinked rods (100cm x 4cm x 3cm), with built-in optical sensors and the computer programme for data recording and analysis. Each of the rods contains 32 sensors – photo cells, which are positioned every 4cm and placed 0.2cm above the surface. The total length of interlinked rods was 20 metres. The rods of the measuring system were placed on each side of the run-up track (width = 1.22 m). A system of infrared photo cells (BROWER – Timing System) has been used in order to measure the run-up speed (11-6m, 6-1m). Kinematical analysis has been carried out with the use of recordings made via four

synchronised video cameras (SONY DVCAM DSR-300 PK) with the frequency of 50 Hz and definition of 720 x 576 pixels, which were placed on a 90° angle to the optical axis. The first two cameras have covered the area of last two steps in the run-up and hop phase, the remaining two cameras have recorded step and jump phases of the triple jump. In order to achieve better precision and for the purpose of biomechanical analysis of the take-off action in hop and step phases, two high-speed digital cameras MIKROTRON MOTION BLITZ CUBE ECO-1 and DIGITAL MOTION ANALYSIS RECORDER were used. The cameras could record 6 seconds of movement with the frequency of 100 frames per second and definition of 640 x 512 pixels; however, a frequency of 500 frames per second has been chosen for the present study. The analysed area of the last two run-up steps and three triple jump phases (hop, step and jump) have been calibrated with a referential measuring frame with dimensions 1m x 1m x 2m, whilst considering eight referential corners. The length of analysed movement has been defined with »x« axis, height with »y« axis and depth with »z axis«. For calculation of kinematical parameters of technique, a 3-D software equipment APAS (Ariel Dynamics Inc., San Diego, Ca) was used (Figure 1). Digitalisation of 15-segment model of the athlete's body has been performed; the model has been defined with 18 referential points (according to M. Dempster via Miller and Nelson: Biomechanics of Sport, Lea and Febiger, Philadelphia, 1973). The coordinates of body points were smoothed with a digital Butterworth level 7 filter. SPSS software package has been used for statistical data analysis.

Results and Discussion

Optimal speed and correctly structured run-up in the last three strides are requirements for a good triple jump result. The results in Table 1 show that the measured subject developed a speed of 8.20ms⁻¹ in the 6 – 1 m zone. In the last stride (1L) the speed increased to 8.35ms⁻¹. Observed values are slightly lower in comparison to the values of female athletes in competition conditions. An average speed of the triple jump finalists at the IAAF World Championship in Athletics, Helsinki 2005, was in the last stride 9.30ms⁻¹. The last stride (1L = 2.20m) was longer than second to last (L2 = 2.30m), which is atypical. As a rule, female triple jump athletes have shorter last than the second to last run-up stride. A tendency of a longer last stride, compared to the second to last, has been more often seen also in some other elite triple jumpers: Savige (CUB), Smith (JAM), Lebedeva (RUS), Rahouli (ALG), Topic (YUG). The length of the last stride is in correlation with the transformation of horizontal into vertical velocity, which affects the height of trajectory of the body centre of mass (BCM) in the first (HOP) phase.

According to the total and relative distances of individual phases, the measured subject is a typical representative of a »Jump Dominated« technique with particularly emphasised last (JUMP) phase. The distance of the first phase (HOP) was 4.73m (34.6%), second phase (STEP) 4.01m (29.3%) and third phase (JUMP) 4.94m (36.1 %). Kyrolainen et al. (2009) have found that partial proportions between different phases of female athletes at the 2005 World Championships in Helsinki amounted

to 36.2 % : 29.4 % : 34.5 %. »Hop Dominated« technique is most often in both male and female triple jumpers. The characteristic of representatives of »Hop Dominated« technique is a large speed, which is developed in the run-up and the first take-off action. The characteristic of measured subject M.Š. is to have larger potential in elastic strength than in speed, the former being utilised mostly in the second and third phases of the triple jump. Partial distances of three phases and their proportions depend on the individual strategy of an athlete. Motor strategies are influenced by the morphological characteristics, coordination, visual perception and the ability to control movement (Winter, 1990; Latash, 1994; McGinnis, 1999; Schmidh, R. & Lee, T., 1999).

In the measured subject, partial distances of the phases were in strong correlation with the duration of support and flight phases. The duration of support in the HOP phase was 0.11 second, in the STEP phase 0.15 second and in the JUMP phase 0.16 second. Support times increased with the reduction of horizontal velocity of BCM (Figure 2). The athlete M.Š. slightly deviates from the model of support times of elite female triple jumpers (Kyrolainen et al., 2009) in the take-off and flight parts of the JUMP phase. The last phase (JUMP) is in its kinematical structure more similar to the long jump. Partial contribution of the JUMP phase distance to the final distance came to a high 36.1 %. In the last phase a high take-off angle value (27.7 °) could also be noticed. The value differs significantly from some of the previous studies (Panoutsakopoulos, Kollias, 2008; Kyrolainen et al., 2009; Mendoza et al., 2010). High take-off angle also resulted in the high flight trajectory of the BCM and is manifested in the duration of the last flight phase in the JUMP (0.65s).

Undoubtedly, the horizontal velocity in individual take-off phases is a crucial generator of competition success in this track and field discipline. The smaller reduction of horizontal velocity, the better is final result. The measured subject has achieved the highest horizontal velocity in her last stride (L1) 8.35ms⁻¹. The decrease of horizontal velocity at the end of take-off action in the HOP phase amounted to -0.47ms⁻¹ or 5.6 %. In the take-off action of the STEP phase the horizontal velocity decreased by 7.3 %. In the JUMP phase, the decrease of horizontal velocity in comparison to the previous take-off action came to 19.8 %. The decrease of horizontal velocity is a result of ensuring the optimal vector of vertical velocity (Figure 3). Vertical velocity is the highest in the first (HOP) and last (JUMP) phases of the triple jump, whereas the lowest vertical velocity has been recorded in the STEP phase (1.86ms⁻¹). The basic strategy of the measured subject was to preserve as high horizontal velocity together with the optimal vertical velocity. The magnitude of vertical velocity is correlated with the take-off angle, which was also the highest in the first and third phases of the triple jump. The study by Kyrolainen et al. (2009) showed the following average values of take-off angles of the finalists at the IAAF World Championships in Athletics, Helsinki 2005: HOP= 15.50 , STEP= 11.40 and JUMP= 21.40. In comparison, significantly higher values of angles have been noticed for the measured subject in the present study. The motor pattern of the triple jump in the measured subject emphasised to larger extent the height of individual

phases, which was related to the lower horizontal velocity of the subject. Lower flight trajectories are usually characteristic of female and male jumpers with higher basic speed (Hay, 1992; Kreyer, 1993; Panoutsakopoulos, Kollias, 2008).

The total speed – 3D velocity of the BCM (V_{xyz}), developed by the measured subject in individual support phases does not reveal such extreme decrease as in a case of horizontal velocity of the BCM. Preservation of total speed is in correlation with higher vertical velocity in support parts. Efficient take-off action is a product of optimal horizontal and vertical velocities for ensuring the length and height of the jump.

Take-off actions in the triple jump are the most typical motor situations, when the release of reaction force of the surface combined with eccentric and concentric muscular contractions is required. From the point of view of motor strategies and motor structure, the take-off actions differentiate both in the duration as well as in kinematical and dynamic parameters. According to the duration of support part, the shortest take-off time was noticed in the take-off of the first - HOP - phase (0.12s) and the longest was the take-off in the last - JUMP -phase (0.18s). Eccentric-concentric cycle in the take-off action is a result of muscle-lengthening due to external force and muscle- shortening in the second phase (SSC: stretch – shortening cycle, Komi and Gollhofer, 1997; Komi, 2000, Nicol et al., 2006). In eccentric phase a certain amount of elastic energy is stored in the muscular-tendon complex, which can be then used in the second phase. A part of elastic energy, which has been accumulated in a muscle, is available only for certain time. This time is being defined with the lifespan of muscle cross bridges and lasts between 30 to 140 milliseconds.

Table 1. Kinematical parameters in the triple jump

PARAMETERS	PHASE	R
Result (m)		13.68
Run –Up Velocity (m.s-1)	11 – 6 m	6.94
	6 – 1 m	8.20
Run – Up Stride length (m)	2L	2.20
	1L	2.30
Run – Up Velocity (m.s-1)	2L	8.25
	1L	8.35
Stride length (m)	Hop	4.73
	Step	4.01
	Jump	4.94
Relative distance (%)	Hop	34.6
	Step	29.3
	Jump	36.1
Horizontal velocity (m.s-1)	Hop	7.88
	Step	7.35
	Jump	5.89
Loss of horizontal velocity (m.s-1)	Hop	-0.47
	Step	-0.53
	Jump	-1.46

(Cavagna, 1977; Enoka, 2003). From the aspect of force production it is important that the muscle in eccentric contraction develops as high force as possible and consumes less chemical energy than in concentric contraction (Komi and Gollhofer, 1997, Enoka, 1998; Enoka, 2003). The time of switch also influences the efficiency of eccentric-concentric contraction. The longer the switch between two types of contraction, the less efficient the contraction is. The duration of transformation from eccentric to concentric contraction is in correlation with the amortisation angle in the knee of the take-off leg (Figure 4). Small oscillation of the BCM in the vertical axis can be noticed in the measured subject, pointing to the small amplitude of angle in the knee with the maximal amortisation in the take-off action. Variation of the BCM height in the first two phases is 16cm, whereas the difference between the highest and the lowest point of the BCM in the JUMP take-off is 24cm in vertical axis. Beside the magnitude and the speed of change of the muscle length and the duration of switch, pre-activation is also very important for the efficiency of eccentric-concentric contraction (Gollhofer, Kyrolainen, 1991; Komi, 2000; Enoka, 2003). Pre-activation defines the first contact of the foot with the surface. The measured subject M.Š. placed her foot extremely actively in the direction down and backwards. Pre-activation suitably prepares the muscles for extension and is being manifested in the number of joined muscle cross bridges and the change of excitation of $\dot{\alpha}$ - motor neurons. Both factors influence the larger short range stiffness. If the short range stiffness is larger, the lengthening of ligaments and tendons is more pronounced, resulting in smaller consumption of chemical energy in the muscle. Smaller consumption of chemical energy is particularly important in those motor situations, where a particular movement has to be carried out with large speed and the triple jump is one of the most typical examples of such movement.

Vertical velocity (ms ⁻¹)	Hop	2.54
	Step	1.86
	Jump	2.64
3-D velocity – xyz (ms ⁻¹)	Hop	8.28
	Step	7.58
	Jump	6.46
Duration of the support phase (s)	Hop	0.11
	Step	0.15
	Jump	0.16
Duration of the flight phase (s)	Hop	0.48
	Step	0.39
	Jump	0.65
Angle off take-off (°)	Hop	19.2
	Step	14.9
	Jump	27.5
Maximal height of the C.C (m)	Hop	1.06
	Step	1.06
	Jump	1.15
Minimal height of the C.C (m)	Hop	0.90
	Step	0.90
	Jump	0.91

Figure 1. 3-D software equipment APAS (Ariel Dynamics Inc., San Diego):

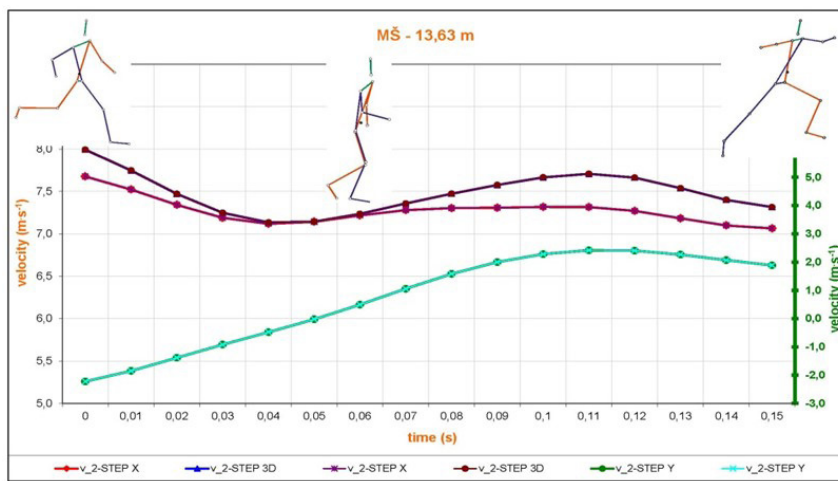


Figure 2. Horizontal velocity of BCM and the duration of support phases – M.Š:13.68 m

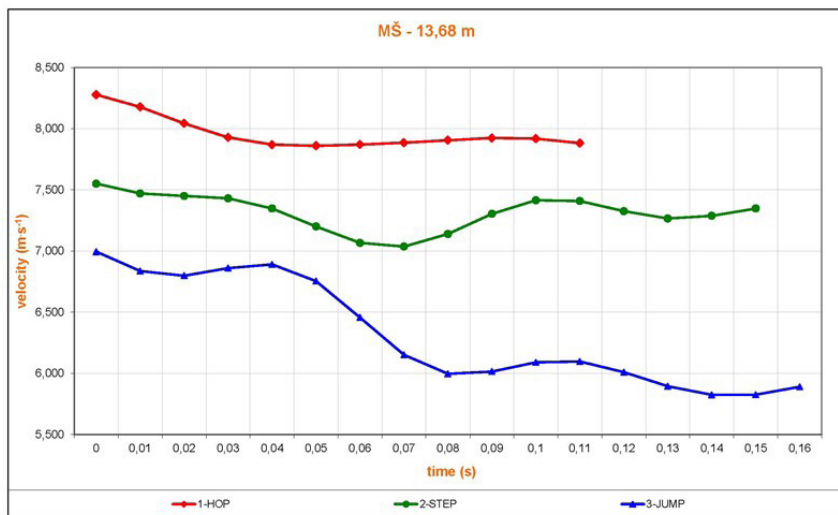


Figure 3. Vertical velocity of BCM and the duration of support phases- MŠ:13.68 m

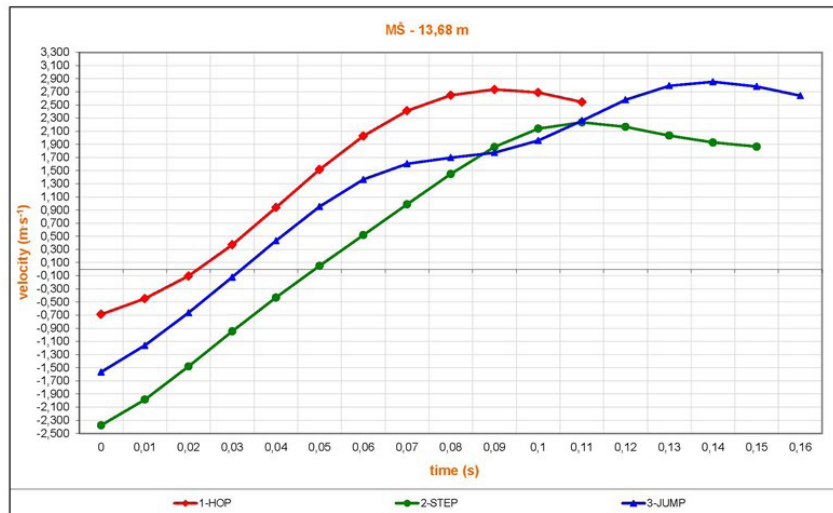
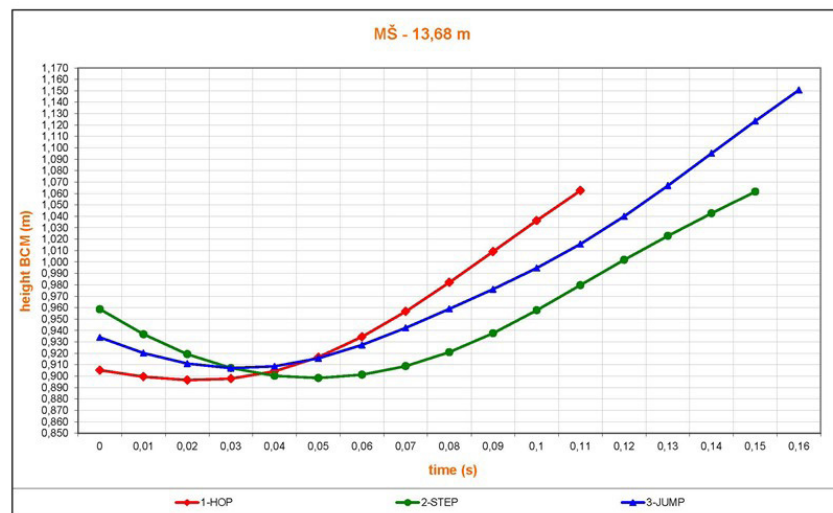


Figure 4. The height of body centre of mass (BCM) and duration of support phases- MŠ: 13.68 m



Conclusion

Triple jump is a typical complex track and field discipline, where the result depends on the speed potential, strength potential and the technique of an athlete. The present study examined kinematical model of the triple jump in the elite female athlete with an aim of finding those key parameters, which generate the competition result. The most modern technology and methodology were used, providing extremely precise data. The following findings can be presented on the basis of 3-D kinematical analysis:

- The result in the triple jump depends on the efficiency of transformation of run-up speed into take-off velocity in the HOP phase,
- In the motor structure of the run-up the last stride is longer than the second to last; the athlete achieved the maximal horizontal velocity in the last stride,
- The proportions between partial distances of

triple jump phases (hop-step-jump) depend on individual bio-motor characteristics,

- A crucial factor is preservation of horizontal velocity of the BCM in HOP, STEP and JUMP phases,
- The proportion between the overall duration of support and flight parts was 28 % : 72 %,
- Partial distances of triple jump phases depend on the duration of support parts and optimal proportion between horizontal and vertical velocity in take-off actions.

Although the results of the study cannot be generalised, they still provide the information, which is important for the planning and control of technical training as well as for sports practice and sports science in the field of biomechanics. Understanding biomechanical principles and mechanisms will facilitate the development of suitable methods and resources in the triple jump training.

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MODEL TEHNIKE TROSKOKA KOD ŽENA

Sažetak

Svrha rada bila je ispitati relevantne parametre kinematičkog modela u troskoku. Analiza je provedena na jednom izmjerenom subjektu, jednoj od najboljih elitnih sportašica u ovoj disciplini. Korišteni su najnovije biomehaničke tehnologije i metodologija mjerenja u troskoku. OPTO-TRACK tehnologija i 3-D kinematička tehnologija korišteni su za određivanje koji parametri generiraju rezultate u ovoj atletskoj disciplini kod žena. Izmjereni subjekt je reprezentativan primjer modela u troskoku, gdje je konačni rezultat definiran s potencijalom brzine, potencijalom snage i optimalnim izvođenjem tehnike. Učinkovita transformacija brzine zaleta u brzinu odraza, optimalan udio parcijalnih faza dužine s naglaskom na faze skoka, održavanje horizontalne brzina težišta tijela u raznim fazama, optimalan omjer između podrške i faze leta, te visoka kinaestetička i vizuelna kontrola kretanja su oni biomehanički faktori koji stvaraju rezultat u troskoku.

Ključne riječi: : Troskok, kinematika, tehnika, model.

Received: June 01, 2016

Accepted: June 15, 2016

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CONTEMPORARY TECHNOLOGY PROCEDURES IN ELITE SPORT: APPLICATION OF SCIENTIFIC FINDINGS IN TRAINING

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Original scientific paper

Abstract

General and information technologies have become an important supporting aspect of many sports. Coaches increasingly rely on researchers for evidence-based information and guidelines on how to use this information in training. In some cases, athletes request from their coaches to use new methods and new technologies in communication and training implementation as well as in the monitoring and control of sports preparation programmes. In sports, science and new technologies are used to improve sports preparation so as to increase the performance of the athletes and the accuracy of preparedness diagnostics, as well as to improve planning and programming of the activities in order to plan for the peaking and tapering for the most important competitions. This paper reviews three aspects of application of new technologies in sport: diagnostics, training methodology and planning and programming. Using new equipment, diagnostics procedures, training load monitoring and scientific research findings on the recovery and tapering for the most important competitions, the athlete and the coach can achieve a significant improvement of the abilities, characteristics and skills of the athlete, which leads to better results at the competitions. New technologies in sport offer great benefits and efficiency in planning and programming of the training, diagnostics of preparedness levels of the athletes, implementation of training or competition, and the efficiency of recovery.

Keywords: Elite sport, diagnostics, scientific findings, technology procedures.

Introduction

Just like the majority of human activities, sports has also been affected by strong technological development. General and information technologies have become an important supporting aspect of many sports. Coaches increasingly rely on researchers for evidence-based information and guidelines on how to use this information in training. In some cases, athletes request from their coaches to use new methods and new technologies in communication and training implementation as well as in the monitoring and control of sports preparation programmes. In sports, science and new technologies are used to improve sports preparation so as to increase the performance of the athletes and the accuracy of preparedness diagnostics, as well as to improve planning and programming of the activities in order to plan for the peaking and tapering for the most important competitions.

Contemporary Technological Procedures in Diagnostics of Athletes' Preparedness

Due to the undisputable value of diagnostics, data measuring equipment is increasingly becoming part of everyday coaching practice, and new and more sophisticated systems for measuring or testing are being regularly introduced with the fast development of technology. Therefore, various devices which were previously used only in laboratories can today be seen on practice fields, providing instant data on the screen for the coach and the athletes. Besides technological advancements in diagnostics, it is very important to mention new diagnostic methods resulting from the employment of a wider, multidisciplinary approach. Therefore, we should mention some of the measuring systems which have been increasingly widely used: Isokinetic diagnostics for measuring unilateral and bilateral muscle strength parameters; Telemetric electromyography for measuring muscle activation during the motor performance; Morphometrics using the Bod Pod system; Field and laboratory kinematic analysis of space-time parameters of the movement;

Spiroergometric functional diagnostics using the Cosmed K4 system, and functional measurement of the movement based on the physical methods for measuring locomotor system functions (Milanović et. al., 2011). Table 1 shows the results of the research conducted with the aim of finding evidence for the validity and pragmatic value of technologies used in measuring subcutaneous adipose tissue and body composition. These sophisticated methods are more reliable than previous anthropometric testing methods.

Scientific evidence shows a significant correlation between low percentages of subcutaneous adipose tissue and improved performance but also its relevance as a predictor of injuries of the athletes. Since no statistically significant differences were found between the measures of the Bod Pod device and hydrostatic weighing, we can confidently switch to a more practical measurement of the body composition, called air plethysmography or Bod Pod.

Furthermore, genetic analysis also presents an important new development in the field of sports diagnostics. The use of genetic analysis in the field of sport in order to determine someone's genetic predispositions for top sport achievements or the risk of injury is a relatively new concept (Ostojić et. al., 2013).

Elite sport performance is a result of an indefinite number of factors that affect the shaping of talented individuals into top athletes in a complex way, which has so far not been explained. Sport science perceives elite performance as a result of a combination of training and genetic factors (Table 2). However, to what extent are champions born or created is a question of a significant interest, due to its implications on the decisions related to the identification and training of talented individuals for top sport results (Šalaj and Brusač, 2013).

Top sport performance is a polygenic characteristic (Costa et. al., 2012 according to Ostojić, 2013).

Currently, 52 variants (polymorphisms) have been identified in 36 genes classified in five categories of sport achievement: endurance, muscle characteristics, cardio-respiratory system capacity, metabolic characteristics and tendon-ligament apparatus quality. The analysis of athletes focuses on the detection of polymorphisms which are used to determine for which sports and activities a person has better genetic predispositions. Currently, there are several international companies/laboratories offering genetic profiling aimed at the identification of sports potentials. In genetic laboratories, it is possible to determine the genes which are responsible for sport achievement or an increased risk of injury. Genetic testing can be used to steer the children towards the sport which will best fit their abilities and thus allow the realisation of their potentials. Nevertheless, the genotype is not a guarantee of top results, since there are various mental and environmental factors which affect gene expression.

A long-term, intensive training process also has an effect on sport results, which means that a favourable genotype is not sufficient to become a champion. In the best case, genetic and other forms of testing conducted as a part of a selection process can help identify individuals with favourable physiologic, morphologic and mental characteristics as well as individuals with a higher capacity for adjustment to training and lower injury risk (Šalajand Brusač, 2013).

The question is: is it possible to identify talents and to carry out the selection of the athletes using genetic research? Currently, the number of genetic variations that could potentially explain the elite sport status is much larger than the number offered by the numerous biotechnological companies which conduct genetic analyses of athletes. Nevertheless, in the very near future, genetic testing will definitely become a part of talent identification (Sigal Ben-Zaken, et.al. 2013).

The studies examining the impact of genetics on sport performance in specific sport disciplines are very demanding, especially with respect to the number of subjects and the dissipation of the sample. In the future, the very important and changeable variable of training should be taken into account, since there are strong reasons to believe that it, besides genetic variations, significantly affects the prediction of the results and sport performance. Despite the great advancement of technology, more sophisticated devices will be required to predict sport results using genes and genetic variations. At the moment, we can already use scientific findings showing the correlation of the prevalence of certain genes and the probability of injury or proneness to injuries of the ligament system (Salles, J.I., et.al. 2015).

A large number of unknown factors still have to be examined in order to achieve full applicability of genetic research, but the current studies can identify advantages and disadvantages of the variables being manipulated in the genetic research. Besides, each conducted research opens new

horizons and hypotheses, which will eventually lead to the establishment of genetic research in sport.

New Technologies in Training Methodology and Monitoring of Training

In implementation and monitoring of training, many athletes, coaches and assistant staff use an evidence-based approach. Implementation of training is increasingly characterised by the individualisation of training loads and the focus on the regulation of fatigue and recovery. Appropriate load monitoring can help in monitoring of preparedness and adaptation of athletes to the load, but it also minimises the risk of overtraining and illness and/or injuries. A certain number of tools for quantification and monitoring of the training load have been identified in the research, including devices for measurement of the force, time and space parameters analysis, subjective load measures, exertion perception, heart rate, blood lactates, etc.

Unfavourable relations of external and internal load measures can help identify the occurrence of fatigue. Some top athletes have more sophisticated tools at their disposal, which include devices for monitoring the heart rate recovery, neuromuscular functions, biochemical, hormonal and immunological indicators, questionnaires and diaries and analysis of the quality and the amount of sleep (Halson, 2014). The use of scientific approach in the detection of changes can foster trust of the athletes and the team of experts in the training process. However, the monitoring system should provide a high-quality data analysis and interpretation as well as simple and efficient data collection tools, which will yield scientifically valid feedback. Therefore, in Table 3 the parameters that should be monitored during the implementation of training are shown.

Individual subjective load is controlled using the Borg's scale of perceived exertion (RPE), which is also used to determine the training exertion index (session RPE) – the subjective load on the scale of 1-10 is multiplied by the training duration in minutes. Individual load is mostly controlled using heart rate monitors, which are also used to determine the load zone on the basis of the maximum heart rate. The ratio of the heart rate to RPE value is also used. In a similar way, the ratio of lactates to RPE is used to determine the fatigue level. The heart rate during recovery (HRR- heart rate recovery) indicates a decrease of the heart rate after exercise and it seems to be a good marker of the autonomous function and the training condition of the athlete (Halson, 2014). It is usually calculated as the difference between the heart rate measured immediately after the exercise and the heart rate measured 60 seconds later. Variability of the resting heart rate or the heart rate after the training is also one of the indicators of positive or negative adaptation to training.

Furthermore, the lactates concentration is changing in relation to the intensity and duration of the training or competition, but, up to a certain point, its everyday use is limited due to its dependence on the environment temperature, hydration, diet, glycogen, previous training, the amount of active body mass, and the mode of sampling.

Therefore, the research of physiological, biochemical

and motor adaptation reactions of 12 top wrestlers during five matches at the competition in the form of a one-day tournament, conducted by Barbas and associates (2010), provides important findings on the lactic acid concentration (lactates) before (2.5 mmol/L) and after (21 mmol/L) the wrestling match. These values indicate extreme glycolytic exertion generated during the wrestling match consisting of three two-minute periods (Figure 1).

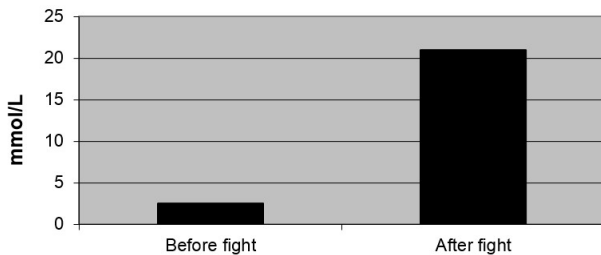


Figure 1. Lactic acid (lactate) concentration before and after the wrestling match (Barbas et. al. 2010)

The wrestler participates in several matches during the one day, which significantly decreases its neuromuscular capacities. Hand grip strength indicators before and after each wrestling match in one competition show a significant decrease of motor potential defined by the hand grip strength test measured using the dynamometer (Figure 2). Basal indicators of the morning and afternoon test before the matches were higher than the values measured before, and especially after the wrestling matches (Kreamer, W. J. et. al., 2001).

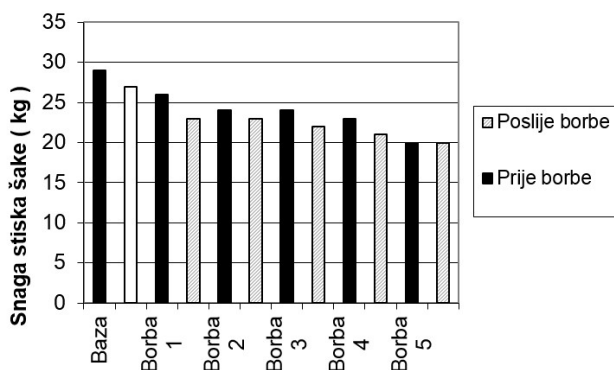


Figure 2. Hand grip strength indicators before and after each wrestling match during one competition (Kreamer, W. J., et. al. 2001)

A large body of research in sport is concerned with the biochemical, hormonal and immunological indicators, while monitoring the preparedness and the recovery level of the athletes (Halson, 2014). Popular indicators include creatine kinase, cortisol, testosterone and immunological function markers, like immunoglobulin A. Questionnaires and diaries are subjective indicators of the mood and load perception of the athletes of which the most commonly used are POMS (Profile of Mood States), REST-Q-sport (Recovery Stress Questionnaire for Athletes), DALDA (Daily Analysis of Life Demands for Athletes) i TQR (Total Recovery Scale). The speed of psychomotor reaction is sometimes analysed as a measure for the detection of fatigue, since athletes experience difficulties in their focus and cognitive functions while fatigued. The reaction time and the time required to solve visual tasks is measured in

computer-based tests, making the use of these tests very simple. Lack of sleep has a significantly negative effect on the performance, motivation, exertion perception and other biological functions. Monitoring quality and the amount of sleep can be useful in the prevention of these problems.

Coaches have long ago recognised the importance of the application of the research findings in training as well as the need for new applied research, which will provide information that will help explain the mechanisms responsible for the improvement of sport performance. Laboratories have become a common training environment in which scientifically sound ideas for the improvement of the preparedness of athletes are created, resulting in new evidence-based training methods. In order to achieve this, it is necessary to establish cooperation between scientists and experts and, very often, also with other strategic partners in the field of research and development, kinesiology and other scientific disciplines. Table 4 – vibration training and Table 5 – occlusion training show examples of new training methods used in sport and their effects confirmed in scientific research.

Vibration training, as a new technology, was efficient in flexibility and vertical jump height development, while it is not recommended in training of speed, since this kind of training does not provide better results when compared to the standard speed training. Positive effects of the vibration training on the stability have been confirmed and stability training can be included in speed development. The exact reason for the positive correlation between the vibration training and stability has not been determined, which opens a topic to be addressed in future research.

Occlusion training was very useful in the development of muscle hypertrophy and strength. Different variations of occlusion training and protocols in which it is used are useful not only in rehabilitation and prevention, but also in hypertrophy programmes and the training aimed at maintenance and development of aerobic endurance.

Contemporary Approach in Planning and Programming of the Training

Monitoring of the training process and training loads based on data stored in a data base provides an opportunity for the analysis of the implemented plan and programme of the training. Systematic monitoring of training loads or data bases can be beneficial in many ways with respect to the communication and building of mutual trust between athletes, assistant staff and coaches. Engaging the athletes in monitoring can have an effect on their motivation. Of course, the data can be used in the selection of the team or team members on the basis of their preparedness for enduring training and competition loads.

Big sport clubs have scientific research project leaders who are responsible for updating the coaches on recent findings, who then implement these findings into the everyday training practice. Tapering before a big competition is one of the scientifically proven procedures improving preparedness and increasing the probability for achieving good results

at the competition.

Figure 3 shows the training programme before the competition with training loads defined using the heart rate, and the tapering period of two weeks before the competition, which shows a decrease of the total load (Papacostaet. al., 2013). Shaded parts show the training load level in relation to the maximum heart rate (HRmax).

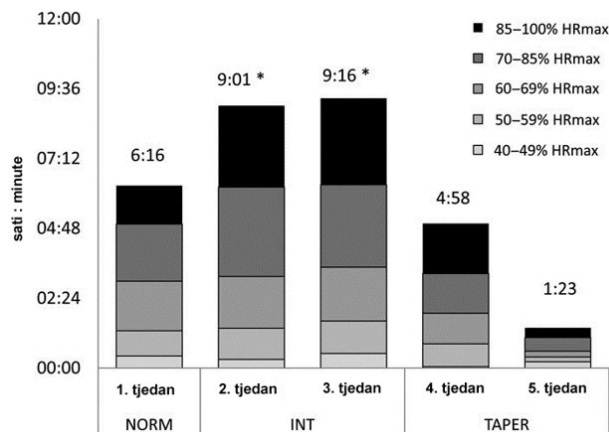


Figure 3. Load changes in the heart rate zones during the periods of normal training (NORM), intensive training (INT) and tapering (TAPER)

The figure shows a decrease in the total training volume from 9 to 5 hours in the first week of tapering, and to only 1.5 hours in the second tapering phase, in which the percentages of training means with low and high training loads are also proportionally decreased. Roughly, the training volume is decreased by 45% in the first week, and by 85% in the second week of tapering. Tapering periods were responsible for a significant transformation in the abilities of the athletes, which was confirmed by the results at the speed endurance test, consisting of running 3x300 meters, shown in Figure 4. The first week of tapering alone brought a certain degree of transformation as compared to the period of intensive training before the tapering period. Coaches can find similar examples of tapering for specific sports in scientific papers and modify them to suit their training programmes for the pre-competition period.

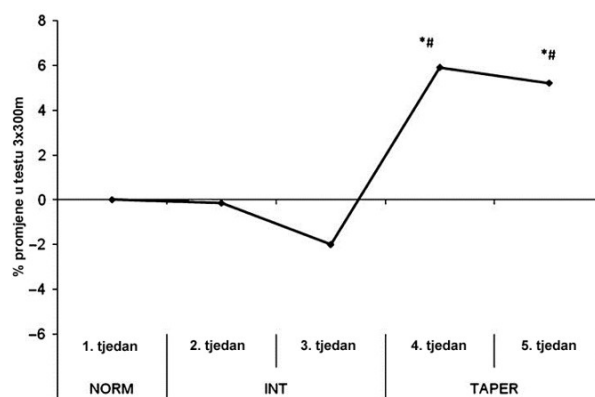


Figure 4. Percentages of transformation in the 3x300meters running test during the pre-competition period. *significant difference from NORM, # significant difference from INT

Conclusion

Recently, the use of new technologies in sport has become more frequent. The sport training process offers many opportunities for the coach and the athlete to increase the possibilities for achieving sport goals and to extend the sport career. Using new equipment, diagnostics procedures, training load monitoring and scientific research findings on the recovery and tapering for the most important competitions, the athlete and the coach can achieve a significant improvement of the abilities, characteristics and skills of the athlete, which leads to better results at the competitions. The large and complex field of sport genetics is still very much unknown, but it will have a big impact on the sport and sport performance in the future.

New technologies in sport offer great benefits and efficiency in planning and programming of the training, diagnostics of preparedness levels of the athletes, implementation of training or competition, and the efficiency of recovery. Unfortunately, the coaches and athletes who do not keep pace with the technological development will not be able to benefit from new and simpler methods for the development of athlete's abilities and achievement of maximal sport results.

Table 1. Research examples in which new diagnostic technologies were used with the objective of injury prevention and improvement of the abilities of the athletes

Author	Sample size	Sport	Device	Objective	Conclusion
Medeiros RM (2015)	17	Paralympic swimming	Bod Pod	To examine correlation between body composition and sport performance.	Decrease in fat percentage is in correlation with the result improvements in the 50-meter freestyle discipline.
Portal, S. (2010)	29	Volleyball	Skinfolds, BMI, BIA, Bod Pod	To examine correlation between the methods for the estimation of the subcutaneous adipose tissue percentage and BMI.	BMI percentile is not a reliable measure for determining the percentage of the fat tissue.
Goncalves, EM. et.al (2015)	27	Judo	BIA, 4C Model, Bod Pod	Examination of the accuracy of the bio-electric impedance device in comparison with the standard - Bod Pod.	Although considered less reliable, no statistically significant differences were determined between the BIA and the standard.

Bogdan, A-G. et.al. (2015)	30	Rugby	BIA InBody720	Examination of the practical value of the data related to the percentage of the subcutaneous adipose tissue in relation to the injury prevention and the training individualisation.	Among other predictors, body composition can be used to predict the risk of injury.
Utter, A.C. Et. Al. (2003)	66	Wrestling	Bod Pod, Hydrostatic weighing	Examination of differences in the accuracy of the measurement between Bod Pod and hydrostatic weighing.	No statistically significant differences were determined.

Table 2. Research examples in which new diagnostic technologies in the form of genetic analyses were used

Author	Sample size	Sport	Objective	Conclusion
Sigal Ben-Zaken, et.al. (2013)	13	Track running	Prediction of transfer success after transferring from middle-distance running to long-distance running.	It is possible to predict a successful modification in the specialisation of young track runners after transferring from middle-distance running disciplines to long-distance running disciplines, using the examined genetic profiles.
Šelingerova, M., Jaklić, H., Šelinger, P. (2012)	162	Ice Hockey	Determining genetic predispositions for speed and endurance.	During the examination of athletes with good speed abilities, the prevalence of (D/D) genotype was determined.
	222 / 215	Half-marathon / marathon		During the examination of athletes competing in endurance sports, the prevalence of (I/I) genotype was determined.
	252	Control group		
Grealy, R. et.al. (2015)	196	Triathlon Ironman	Is it possible to increase the probability of prediction of time needed to complete the Ironman triathlon using the interaction of 7 polymorphisms closely related to endurance?	More sophisticated genetic models are required in order to predict the time needed to complete the Ironman race more accurately. Genetic analyses should include an extremely important variable – training. High quality genetic analysis requires high cooperation of subjects and large sample size.
Salles, J.I., et.al. (2015)	138	Volleyball	Examination of the relation between genetic variations and occurrence of the tendon inflammation in top volleyball.	Haplotypes in BMP4 and FGF3 genes can cause tendon injuries in top volleyball.
Mounier R. et.al. (2009)	30	Swimming and track and field	Determination of body response – blood markers, to the altitude training.	Internal relations between HIF-1 mRNA, EPO and VEGF have been confirmed in a research in which the response of the athletes to the altitude training was studied. Variations in molecular markers as a response to the altitude training and "altitude sickness" were also discovered.

Table 3. Variables for monitoring training load and fatigue

Variable	Description
Frequency	of training, per day, week, month
Duration	Seconds, minutes, hours
Intensity	Absolute, relative
Training type	Methods, environment
Maximum exertion	Strength, jump height
Repetitive exertion	Number of repetitions, repetitions quality
Volume	Duration, repetitions
Exertion perception	Borg's scale of subjective load

<i>Fatigue and rest perception</i>	<i>REST-Q questionnaire</i>
<i>Illness</i>	<i>frequency, duration</i>
<i>Injury</i>	<i>Type, duration</i>
<i>Biochemical and hormonal analysis</i>	<i>Basal, rest, load response</i>
<i>Technique</i>	<i>Movement deviation analysis</i>
<i>Body composition</i>	<i>Body weight, body fat, lean body mass</i>
<i>Sleep</i>	<i>Quality, amount, rhythm</i>
<i>Mental aspects</i>	<i>Stress, anxiety, motivation</i>
<i>Emotions</i>	<i>Hope, neutral, discontent</i>

Table 4. Overview of the research into the effects of vibration training on athletes' abilities

<i>Author</i>	<i>Subjects</i>	<i>Sport</i>	<i>Objective</i>	<i>Conclusion</i>
<i>Dallas G, et.al (2015)</i>	<i>18</i>	<i>Diving</i>	<i>To determine acute reactions caused by various vibration stimuli related to the flexibility and explosiveness of the lower extremities.</i>	<i>It is recommended to use the vibration training for the whole body, as a method for flexibility and vertical jump height training.</i>
<i>C. Delecluse, et.al (2005)</i>	<i>20</i>	<i>Track running</i>	<i>To examine the effect of the vibration training on various speed components (start speed, start acceleration, maximum speed).</i>	<i>Vibration training did not produce better results when compared to the standard protocol for the development of speed abilities.</i>
<i>Cole, K.J, Mahoney, S.E. (2010)</i>	<i>8</i>	<i>Track and field</i>	<i>To examine the efficiency of the vibration training in speed, strength and flexibility training.</i>	<i>The vibration training should be included in strength development but it is not efficient in the sprint training.</i>
<i>Kurt, C., Pekunlu, E. (2015)</i>	<i>20</i>	<i>Combat sports</i>	<i>To examine the efficiency of the vibration training in combat sports in explosive power and flexibility training.</i>	<i>The vibration training was efficient only in hand grip strength development.</i>
<i>Cloak, R., Nevill, A., Wyon, M. (2016)</i>	<i>44</i>	<i>Soccer</i>	<i>To examine the efficiency of the vibration training on balance and stability.</i>	<i>The vibration training has a positive effect on the stability development but the mechanism for this still has to be explained.</i>

Table 5. Overview of the research into the effects of the occlusion training on athletes' abilities

<i>Author</i>	<i>Subjects</i>	<i>Sport</i>	<i>Protocol</i>	<i>Objective</i>	<i>Conclusion</i>
<i>Luebbbers, PE. et. Al. (2014)</i>	<i>62</i>	<i>American football</i>	<i>Bench press and squat: 30 repetitions with 20% 1RM 3 sets of 20 repetitions with 20%1RM</i>	<i>To examine the effect of a seven-week partial occlusion training in combination with strength training on the level of muscle strength.</i>	<i>Occlusion training as a supplement to the standard training can have a positive effect on the increase of 1 RM.</i>
<i>Cook, CJ., Kilduff, LP., Beaven, CM. (2014)</i>	<i>20</i>	<i>Rugby</i>	<i>Bench press and squat: 5sets of 5 repetitions Pull-ups - 70% 1RM</i>	<i>To examine the effect of the training with moderate load, with and without the use of occlusion principle on strength, force and the ability to repeat sprints.</i>	<i>Occlusion training has the potential to affect the improvement of strength components and to delay fatigue.</i>
<i>Kubota, A. et.al. (2013)</i>	<i>7</i>	<i>Swimming</i>	<i>Biodex device: 150 repetitions 3-4 sets rest between sets: 3 minutes</i>	<i>To examine the effect of passive exercises in combination with occlusion training on muscle strength of the knee joint.</i>	<i>Passive exercises combined with the occlusion training can be useful for the increase of the muscle volume and strength.</i>

Yamanaka T., Farley, RS., Caputo, JL. (2012)	32	American football	Bench press and squat: 30 repetitions with 20% 1RM 3 sets of 20 repetitions with 20%1RM rest between sets: 45seconds, 3 times per week	To examine the effect of a four-week low-intensity occlusion training on the hypertrophy effects of the upper and the lower part of the body.	Occlusion training can be efficient for hypertrophy or strength development.
Park. S. et.al (2010)	12	Basketball	Walking 3 minutes (4-6km/h 5% incline). 5 sets, 1 minute rest between sets. 2 weeks, 2x per day, 6 days per week.	To examine the effect of occlusion principle of training during walking, on general endurance and muscle strength.	Occlusion training while walking can be useful in the rehabilitation of athletes who want to maintain or improve their aerobic endurance level.

Table 6. The overview of research into the effects of tapering on the abilities and the results of athletes

Author	Subjects	Sport	Tapering	Objective	Distances/Tests/ Whatwas examined	Conclusion
Pugliese, L.. et.al (2015)	10	Swimming	6 weeks high volume, low intensity +6 weeks low volume, high intensity. After each 6-week period, 1 tapering period.	To examine the effect of the volume and intensity manipulation on the performance and mental results.	Maximal oxygen uptake, individual aerobic threshold, time at 100, 400, 2000 m freestyle	High volume, low in- tensity has a positive effect on the improve- ment of the VO2max and on the results in middle-distance and long-distance running. High intensity, low volume has a positive effect on the anaerobic capacities and on the results in short-dis- tance running.
Camila G. et.al. (2014)	11	Soccer	2 weeks of training using the overlapping load, 2 weeks of tapering	To examine the effect of the two-week training using the overlapping load followed by the two-week tapering on the stress tolerance total load and cortisol level.	Cortisol, respiratory tract infections overall body load	The training in the period of overlapping load resulted in an increase of the overall internal load, more cases of respiratory tract infections and higher levels of cortisol in rest, there were no differences in the level of stress
Hellard, (2013)	P.et.al. 32	Swimming	3 weeks of overload, 3 weeks of tapering	To determine best training protocols in the last 6 weeks before the big competition	Manipulation of training variables and loads was individualised for each swimmer in the relation to the previously measured maximum values.	The best results were achieved using the overlapping load during the 3-week period followed by the sharp decrease in load in the next 3 weeks of tapering.
Aubry, A. et.al (2014)	33	Triathlon	8-week period, the tests were conducted: a) after first week of moderate training, b) after 3 weeks of supraliminal training load, c) after each week during the 4-week tapering period.	To determine the supercompensa- tion values after the acute over- training caused by the accumulation of the overlapping loads.	Maximal oxygen uptake	Better results and VO2max values are achieved using the overload if it does not lead to the acute over- training. Supercom- pensation effects are not postponed by the tapering if supralimi- nal loads were used. Functional overtraining increases the risk of infections and caus- es week adaptation to training.
Martin, D.T. et.al (1994)	11	Cycling	6 weeks of high intensity interval aerobic training 2 weeks of tapering	To determine the transformations in isokinetic strength of the leg muscles in comparison with the parallel studying of the cycling	4 days in a row inter- vals (30 minutes at 82.2 plus/minus 0.74 % of HRmax, 1:1 work-rest (differenc- es in results) 4 days in a row cy- cling 1-2 hours 65- 80% HRMax 70-80 rpm (isokinetics, in- crease of the quadri- ceps strength).	Improvement of results by 8% after 2 weeks of tapering. Improvement of quadriceps strength by 9%.

Figure 1. Lactic acid (lactate) concentration before and after the wrestling match (Barbas et. al. 2010)

Figure 2. Hand grip strength indicators before and after each wrestling match during one competition (Kreamer, W. J., et. al. 2001)

Figure 3. Load changes in the heart rate zones during the periods of normal training (NORM), intensive training (INT) and tapering (TAPER)

Figure 4. Percentages of transformation in the 3x300 meters running test during the pre-competition period.

*significant difference from NORM, # significant difference from INT

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SAVREMENE TEHNOLOŠKE PROCEDURE U VRHUNSKOM SPORTU: PRIMJENA NAUČNIH DOSTIGNUĆA U TRENINGU

Sažetak

Opće i informacione tehnologije su postale sastavni aspekt mnogih sportova. Treneri se sve više oslanjaju na istraživače i rezultate zasnovane na dokazima i uputama kako koristiti nove metode u treninzima. U nekim slučajevima, sportisti zahtijevaju od svojih trenera da koriste nove metode i nove tehnologije komunikacije i implementacije treninga kao i nadzor i kontrolu programa za sportsku pripremu. U sportu, nauka i nove tehnologije se koriste za poboljšanje sportske pripreme i poboljšanja izvedbe sportista i tačnosti pripreme dijagnostike, kao i poboljšanje planiranja i programiranja aktivnosti u cilju dostizanja vrhunca forme za najbitnija takmičenja. Ovaj rad recenzira tri aspekta primjene novih tehnologija u sportu: dijagnostika, metodologija treninga i planiranje i programiranje. Koristeći novu opremu, dijagnostičke procedure, nadzor nad težinom treninga i naučnoistraživačke pronalasci vezane za oporavak i pripremu za najvažnija takmičenja, sportista i trener mogu postići značajno poboljšanje sposobnosti, poboljšanje karakteristika i sposobnosti sportiste, koji dovode do boljih rezultata na takmičenjima. Nove tehnologije u sportu nude velike prednosti i efikasnost u planiranju i programiranju treninga, dijagnostiku nivoa spremnosti sportiste, implementaciju treninga ili takmičenja i efikasnost oporavka.

Ključne riječi: *Elitni sport, dijagnostika, naučna otkrića, tehnološke procedure.*

Received: June 01, 2016

Accepted: June 15, 2016

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GRAPH THEORY AND SOCIAL NETWORK ANALYSIS APPLIED TO THE STUDY OF YOUNG BASKETBALL PLAYERS: VARIANCE OF CENTRALITY LEVELS

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Original scientific paper

Abstract

Graph theory and social network analysis have been used in match analysis to identify some properties of the team. In this study, our aim was to characterize the centrality levels of young basketball players and analyse the differences between positions of the court. Thirty-two young basketball players (11.56 ± 0.68 years old; 2.97 ± 0.35 years of practice) participated in this study. The one-way ANOVA tested the variance between positions for the %ODC, %IDC and %BC variables. Statistical differences were found in %ODC ($p = 0.001$; $ES = 0.63$; minimum effect), %BC ($p = 0.001$; $ES = 0.81$; minimum effect) and %IDC ($p = 0.001$; $ES = 0.52$; minimum effect). Results suggest that guards are the positions with greater participation and more relevant centralities on the game.

Keywords: Applied mathematics; graph theory; network analysis; centrality measures; match analysis; basketball.

Introduction

Cooperation and opposition are two main relationships that simultaneously occurs during invasive team sports (Gréhaigine, Richard, & Griffin, 2005). The cooperation can be characterized by the capacity of create functional and dynamic links with teammates to achieve common goals (Bourbousson, Sève, & McGarry, 2010). In the other hand, the opposition can be defined as a rapport of strength between the two teams (Gréhaigine, Godbout, & Zerai, 2011). Both contribute for an understanding of the game and for that reason match analysis have been focused in to characterize the events that can be observed in the cooperation-opposition relationships (Travassos, Davids, Araújo, & Esteves, 2013).

The specific case of cooperation can be understood as a network that emerge during the game (Gréhaigine, Bouthier, & David, 1997). The emergence is influenced by some rules of play that can be described as the tactic principles (Gréhaigine, Godbout, & Bouthier, 1999). Moreover, the specific position of players during the game (strategic factor) can also constrain the relationships among teammates and the network structure of the team (Clemente, Martins, Wong, Kalamaras, & Mendes, 2015). In the end, the specific network structure influenced by the positions cans also constraint the volume of play of each player (Clemente, Martins, & Mendes, 2015).

An important issue that associate the specificities of relationships inside the network and the volume of play may be the prominence level in young players (Clemente, Martins, & Mendes, 2015). If the tactical position constrain the volume of play, it is possible to predict that some players will have more volume of play than others. The volume of play in young and novice players may influence the capacity of develop their skills and their participation in match (Unnithan, White, Georgiou, Iga, & Drust, 2012).

Social network analysis have been used in some researchers to study the network structure of basketball teams (Bourbousson, Poizat, Saury, & Seve, 2010; Clemente, Martins, Kalamaras, & Mendes, 2015; Fewell, Armbruster, Ingraham, Petersen, & Waters, 2012). The main results suggest that teams tend not to act necessarily as a unit and some specific coordination may emerge from sub-phases (Bourbousson, Poizat, et al., 2010). A complementary research in a NBA team also found some star patterns, suggesting a prominence of specific players (point guards) (Fewell et al., 2012). Similar evidences were found by a study conducted in Under-14 and Under-18 teams (Clemente, Martins, Kalamaras, et al., 2015).

The lack of researches that used network analysis to classify the prominence and centrality levels of basketball players is evident. Moreover, no study analysed the centrality levels of very young and novice players (Under-12). Both factors motivated us to use the social network analysis to identify the prominence levels of very young basketball players and analyse the influence of tactical positions in the centrality levels of these players. Analysis of variance between positions was carried out to test the centrality levels of network during attacking process.

Methods

Participants

Thirty-two young basketball players (11.56 ± 0.68 years old; 2.97 ± 0.35 years of practice) from three different teams were observed during 10 home matches. A minimum observation of 15 minutes per players per match was the criterion to include the players in the study and to ensure similar conditions of analysis. A total of 30 matches were observed for this study. An individual informed consent was signed for each parent. The study was conducted

based on the ethical standards of the Declaration of Helsinki.

Procedures

Only home matches were observed during this study. Ten official matches were observed and only players that acted 15 minutes in average per match were included in the sample. The observation consisted in to analyse the attacking building of the teams. The focus of the analysis was to identify the network properties that were built during the ball circulation with three sequential passes at least. Per each unit of attack (passing sequence without interception) was generated an adjacency matrix in which the players were the nodes and the volumes of passes between players were the arrows. In the end of each match a full adjacency matrix of the match was generated based on the sum of the units of attack built during the observation. Thus, a total of 30 adjacency matrices were used for the statistical procedures. A weighted digraph was considered, thus the volume of passes in the same direction was important (e.g., 2 passes from player A to B and 5 from B to A). The procedures conducted in this study can be fully observed in previous studies (Clemente, Martins, Wong, et al., 2015; Clemente, Martins, Kalamaras, Wong, & Mendes, 2015). The players were codified based on their positions of the court (tactical line-up). The following codes were attributed to each position: P1 – shooting guard (SG); P2 – point guard (PG); P3 – Small forward (SF); P4 – Power forward (PF); and P5 – Post (PT). The classification of players’ position and sequences of passes were made by the same researcher that hold a experienced greater than 5 years in match analysis. A test-retest protocol with 20-days interval was established before collecting the data. A Cohen’s kappa test was applied to test the reliability of the observation. A value of kappa of 0.79 was obtained, thus ensuring a enough level to continue with the observation (Robinson & O’Donoghue, 2007).

Network Analysis

The full data collected from the observations were treated in the Social Networks Visualizer (SocNetV, version 1.9) that allow to visualize the graphs and compute the centrality measures (Kalamaras, 2014). The following three centrality measures were computed: i) outdegree centrality; ii) indegree centrality; and iii) betweenness centrality. OutDegree Centrality (ODC) This measure allows identifying the prominence level of each player in, to contribute to build the passing sequences. In the ODC index, for a vertex n_i of weighted digraph G with n vertices, $C_{(D-out)}^{w-out}(n_i)$ is the proportion of the weight of vertices and can be calculated as follows (Opsahl, Agneessens, & Skvoretz, 2010):

$$C_{(D-out)}^{w-out}(n_i) = \frac{k_i^{w-out}}{\sum_{i=1}^n \sum_{j=1, j \neq i}^n a_{ij}}$$

where k_i^{w-out} is the degree centrality index of the vertex n_i and a_{ij} are elements of the weighted adjacency matrix of a G (Clemente, Martins, & Mendes, 2016).

Betweenness Centrality (BC)

BC measure may characterize the capacity of a player to act as a link of the teammates. Greater values of BC means that player hold an important role in to ensure the connections among teammates. The standardized BC for weighed digraphs can be calculated as follows (Rubinov & Sporns, 2010):

$$C'_b(n_k) = \frac{1}{(n-1)(n-2)} \sum_{\substack{n_i, n_j \in V \\ i \neq n_j \neq k}} \frac{g_{ij}(n_k)}{g_{ij}}$$

where $g_{ij}(n_k)$ is the number of shortest paths between n_i and n_j that pass through n_k and g_{ij} is the number of shortest paths between n_i and n_j (Clemente et al., 2016).

InDegree Centrality (IDC)

IDC measure represents the prestige of a player in to receive the ball from the teammates. Greater values suggest greater prestige. For weighted digraphs, the proportion of the weighted vertices that is adjacent to n_i , $P_{(D-in)}^{w-in}(n_i)$, can be calculated as follows (Opsahl et al., 2010):

$$P_{(D-in)}^{w-in}(n_i) = \frac{k_i^{w-in}}{\sum_{i=1}^n \sum_{j=1, j \neq i}^n a_{ij}}$$

where k_i^{w-in} is the degree prestige index of the vertex n_i and a_{ij} are elements of the weighted adjacency matrix of a G (Clemente et al., 2016).

Statistical procedures

Positions of the players (SG, PG, SF, PF and PT) were classified as factors for this study. The dependent variables were the %ODC, %BC and %IDC measures. The one-way ANOVA followed by the Tukey HSD post hoc tested the variance of measures between positions. Effect size (ES) was tested and interpreted using the follow criteria (Ferguson, 2009): no effect ($\eta^2 < 0.04$), minimum effect ($0.04 < \eta^2 < 0.25$), moderate effect ($0.25 < \eta^2 < 0.64$) and strong effect ($\eta^2 > 0.64$). SPSS software (version 23.0, Chicago, Illinois, USA) was used to compute the statistical procedures. A statistical significance of 5% was defined.

Results

The one-way ANOVA tested the variance between positions for the %ODC, %IDC and %BC variables. Statistical differences were found in %ODC ($p = 0.001$; ES = 0.63; minimum effect), %BC ($p = 0.001$; ES = 0.81; minimum effect) and %IDC ($p = 0.001$; ES = 0.52; minimum effect). Descriptive statistics can be found in the following Figure 1.

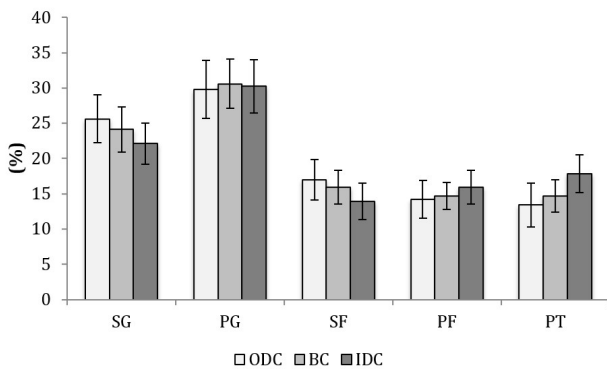


Figure 1. Mean and standard deviation of %ODC, %BC and %IDC between positions.

Statistical differences were found in %ODC between SG and SF ($p = 0.001$), PF ($p = 0.001$) and PT ($p = 0.001$). It was also found statistical differences in %ODC between PG and SF ($p = 0.001$), PF ($p = 0.001$) and PT ($p = 0.001$). The greatest values of %ODC was found in PG position.

Post-hoc test revealed that SG and PG positions were statistical different from SF ($p = 0.001$), PF ($p = 0.001$) and ($p = 0.001$) in %BC measure. The greatest value of this measure was found in PG position.

Finally, the comparison of %IDC between positions also found that SG and PG were statistical different from ($p = 0.001$), PF ($p = 0.001$) and PT ($p = 0.001$). The greatest value of %IDC was found in PG.

Discussion

The aim of this study was to analyse the centrality levels of young basketball players. The results revealed that both guards (shooting and point) were the players with greater relevance and prominence in the attacking building. Point guard was the position with greater levels of outdegree, indegree and betweenness centrality.

A previous study conducted in players from different competitive levels (U14, U16, U18 and amateurs) revealed that point guard was the more central node of the graph during attacking building (Clemente et al., 2015). In our study, point guard followed by shooting guard were the positions with greater values of outdegree. These values suggest that both positions represent the playmakers of the team. This is in line with the main role of point guard that is hold the ball and organize the collective organization of the team during attacking moments (Sampaio, Janeira, Ibáñez, & Lorenzo, 2006). Smaller values of outdegree were found in post that is the ultimate attacker of the team and maybe the player with smaller space and more defensive pressure against he.

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Following the values obtained from outdegree, it was also found that point and shooting guards were the positions with greatest values of betweenness centrality. The linkage role of both players may be the factor to justify these results. It can be observed that this particular measure may characterize the capacity of player to be the 'transition player', thus being the man that links both sides of the court.

Finally, the indegree centrality also revealed that guards obtained the greatest values. Nevertheless, it was found that the position of post assumed the third greatest value, thus representing their greater prominence and prestige in the final phase of attacking building. The highest values of indegree in guards may be justified by their linkage role, passing and receiving many passes from their teammates.

This study had some limitations. The study was only conducted in one competitive level and the sample should be bigger to generalize the findings. Moreover, a complementary tactical analysis based in observation and notational process would help to justify some empirical evidences. Based on these findings, it is suggested that future studies increase the sample of the study, track the evolution of each player during youth levels and add some tactical measures to cross with network analysis.

This study may have some practical implications for coaches. Network analysis can be defined as a low-cost and user-friendly process to characterize the prominence of each player in the team. Moreover, the use of such analysis may help to classify the volume of play and the relevance of each player for the network structure of the team. Would be also useful to use this data to manage the volume of practice that each player have in specific positions and fight the early specialization that may constraint the volume of play and the skill development of these young players.

Conclusion

This study revealed that point guard and shooting guard are the most prominent positions during the attacking building of young basketball teams. Point guard was also identified as the central player that acts as a link between teammates. This relevance leads to greater volume of play and for that reason early specialization should be avoid to not constraint the players that act in different positions and reduce their actions in training sessions and matches. A proper management of players by different positions may provide equality in the opportunities to develop the specific basketball skills.

Acknowledgments

This work was supported by the FCT project PEST-OE/EEI/LA0008/2013.

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PRIMJENA TEORIJE GRAFOVA I ANALIZE DRUŠTVENIH MREŽA U ISTRAŽIVANJU MLADIH KOŠARKAŠA: VARIJANSA CENTRALNIH RAZINA

Sažetak

Teorija grafova i analiza društvenih mreža korištene su i analizi utakmica kako bi se identificirala pojedina svojstva tima. U ovom istraživanju, naš cilj bio je da se obilježe nivoi centralnih tendencija mladih košarkaša i analizirati razlike između pozicija na terenu. Trideset i dva mlada košarkaša (11,56 ± 0,68 godina starosti; 2,97 ± 0,35 godina prakse) sudjelovala su u ovom istraživanju. Univarijantnom ANOVA-om testirali smo varijancu između položaja za %ODC, % IDC i % BC varijabli. Statističke razlike su pronađene u % ODC (p = 0,001 ; ES = 0,63 , minimalni efekat) ,% BC (p = 0,001 ; ES = 0,81 ; minimalni efekat) i % IDC (p = 0,001 ; ES = 0,52 ; minimalni efekat). Rezultati ukazuju na to da pozicije bekova imaju veće učešće u igri i više relevantnih centraliteta na igru.

Ključne riječi: *Primijenjena matematika; teorija grafova; analiza mreža; mjere centralnih tendencija; analiza utakmice; košarka.*

Received: June 13, 2016

Accepted: June 15, 2016

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THE PRESENCE OF TRANSFORMATIONAL LEADERSHIP IN THE SPORTS CLUBS MANAGEMENT

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Original scientific paper

Abstract

The survey was conducted at Sloboda Workers' Sports Association from Tuzla using 15 different sports clubs. The research sample consisted of the managerial staff in the sports clubs. The aim of the research was to examine the presence of transformational leadership and analyze its factors. The research results show that the transformational leadership is present to a significant degree at Sloboda WSA, Tuzla, but not equally in all sports clubs, and not at the same level. The factor status per sport is such that: the presence of Idealized influence-attributed factors is the most represented in track and field, and the least in wrestling; Idealized influence-behavior is the most represented in track and field and handball, and the least in wrestling; Inspirational motivation is the most represented in track and field, and the least in wrestling; Intellectual stimulation is the most represented in track and field, and the least in rhythmic gymnastics; Inspirational motivation is the most represented in track and field, and the least in chess. The overall presence of transformational leadership per factor is as follows: Idealized influence-attributed Mean 3.99; Idealized influence-behavior Mean 3.83; Inspirational motivation Mean 4.21; Intellectual stimulation Mean 4.32; Inspirational motivation Mean 3.98. The total results of all the factors show the presence of transformational leadership across all levels at Sloboda. This means that transformational leadership affects the greater motivation of the members of the collective to achieve the objectives and better results, thus increasing their productivity and overall satisfaction with the work they do. These results can lead to the conclusion that transformational leadership can be applied to other sports organizations in the Tuzla Canton when we look at the effectiveness and success of Sloboda. The emphasis is on the fact that the results have given a significant evaluation, indicating that transformational leadership in management is present, and the degree of its presence mostly depends on the success of the club.

Keywords: Transformational leadership, management, factors, sports club.

Introduction

In view of the above specifics of management and leadership in sports organizations, and the evident need for the implementation of transformational change in this area, there is also a need to explore new leadership forms that would be more effective in the new competitive environment. Taking this into account, it seemed justified to carry out research on the degree of implementation of transformational leadership in sports organizations in the Tuzla Canton. The transformational leadership concept was introduced by political scientist and historian James MacGregor Burns (1978). Burns approaches leadership from two aspects. The first deals with the relationship between leaders and followers, and the second deals with beliefs, needs and values of the followers. Leadership is an activity that creates vision, shapes the behavior of the staff, and creates an organizational culture of the company. Schein, E., (1996) The following can be emphasized in terms of the advantages of transformational leadership: there are many scientific studies of this leadership style with different approaches; it has intuitive appeal; it is seen as a process that takes place between leaders and followers; transformational approach allows a broad vision that widens other leadership models; the needs, values and morals of the followers are extremely pronounced in transformational leadership; there is overwhelming evidence that transformational leadership is an effective form of leadership. Northouse, G.P., (2008) The three main

roles and functions of transformational leadership are:

1. Recognize the need for revitalization (revival)
2. Create a new vision
3. Introduce change

Therefore, this research has been done on the biggest sporting association, including all its clubs, with the aim to review the situation and the presence of transformational leadership to explain any changes in the leadership system.

Method

The subject of this paper is an analysis of the presence of transformational leadership in the management structure of sports clubs. The challenge is to understand which are the transformational leadership factors and to which degree are they present in the management system.

The aim of the paper is to analyze the degree to which transformational leadership is present in the sports clubs management.

The tasks of the paper include explaining the concept, transformational leadership characteristics, and its importance in the functioning of sports organizations;

The participant sample

The respondents were the two most competent people in the club who performed management functions. The basic frame of the study included the Sloboda WSA, Tuzla management and sports clubs. The survey was carried out in 15 sports clubs of Sloboda Sports Association on a sample of 30 respondents, two respondents per club.

The sample of variables

As part of the primary research (field research), we collected data using a written test technique with a questionnaire as a data collection form. The questionnaire was composed of a multifactorial leadership questionnaire (LQ), which is used to measure the degree of implementation of transformational leadership.

Data processing methods

During the elaboration and analysis of certain theoretical, methodological and empirical aspects of the observed problems, we used methods of analysis and synthesis, that is, induction and deduction, the systematization and classification method, as well as data processing statistical methods with the necessity of using a systemic approach to research. For data processing we used descriptive and inferential statistics and correlation analysis. The

analysis of the collected data was carried out using appropriate software support (IBM SPSS, MS Excel, etc.). The analysis of the collected data was carried out using appropriate software support Statistical Package for the Social Science (SPSS) 17.0 for Windows MS Excell and so on.

Results

Table 1 shows the results of responses from the management group respondents to questions P1 to P20. The table contains data on the number of respondents who responded (N), the mean (average) value of the responses from all respondents (Mean), standard deviation (SD), and minimum (Min) and maximum (Max) value of the response. Respondents from the management group were asked 20 questions related to transformational leadership. Of the 20 listed questions, 4 related to the 5 factors of transformational leadership. Transformational leadership factors: Idealized influence-attributed, Idealized influence-behavior, Inspirational motivation, Intellectual stimulation, Inspirational motivation. The Table shows that certain questions are not answered by all respondents. The average score is calculated based on the number of questions answered, and not based on the number of respondents. It also shows that the mean moves: Mean 3.47 to Mean 4.63.

Table 1. Management

Question	Description of the question	N	Mean	SD	Min.	Max.	Sum
1.	<i>I question important assumptions to see if they are appropriate</i>	30	4.30	.651	3	5	129
2.	<i>I talk about the values important to me</i>	29	3.48	1.153	1	5	101
3.	<i>I look for various options when solving problems</i>	30	4.63	.556	3	5	139
4.	<i>I speak optimistically about the future</i>	30	4.77	.430	4	5	143
5.	<i>I make others proud for working with me</i>	30	3.90	.923	2	5	117
6.	<i>I speak enthusiastically about the things that need to be accomplished</i>	30	4.37	.718	3	5	131
7.	<i>I specify the importance of a strong feeling of importance</i>	29	3.62	1.147	1	5	105
8.	<i>I spend time studying and practicing</i>	29	3.69	1.198	2	5	107
9.	<i>I place the good of the team above my personal interests</i>	30	4.60	.563	3	5	138
10.	<i>I train others as separate individuals rather than just members of a team</i>	30	3.60	1.070	1	5	108
11.	<i>I act as to build the respect of others for me</i>	30	4.00	.947	2	5	120
12.	<i>I take moral and ethical consequences of decisions into consideration</i>	30	4.50	.572	3	5	135
13.	<i>I keep records of all errors</i>	29	3.72	1.334	1	5	108
14.	<i>I show a feeling of power and self-confidence</i>	30	3.47	1.383	1	5	104
15.	<i>I show an indomitable vision of the future</i>	28	3.54	1.261	1	5	99
16.	<i>I express confidence that the goals will be met</i>	30	4.17	.913	1	5	125
17.	<i>I motivate the players to see the problems from different angles</i>	30	4.20	.714	3	5	126
18.	<i>I help the players develop their thinking</i>	30	4.23	.774	3	5	127
19.	<i>I suggest new ways to perform tasks</i>	30	4.13	1.042	2	5	124
20.	<i>I understand that different individuals have different needs, abilities and expectations of others</i>	29	4.41	.628	3	5	128

The results of the responses of the Management to questions P5, P9, P11 and P14, referring to the factor Idealized influence - attributes are shown in Table 2. The results show us that the most common response was almost always, but because of the lower

significance of responses of other respondents, the mean value of this factor was Mean 3.99. It must be emphasized that the results do not match the most common response of respondents, which explains that there is a great variability in the responses.

Table 2. *IIa - Idealized Influence (attributed)*

<i>IIa - Idealized Influence (attributed)</i>	<i>P5</i>		<i>P9</i>		<i>P11</i>		<i>P14</i>	
	<i>F</i>	<i>f%</i>	<i>f</i>	<i>f%</i>	<i>f</i>	<i>f%</i>	<i>f</i>	<i>f%</i>
<i>never</i>		0.00		0.00		0.00	4	13.33
<i>rarely</i>	2	6.67		0.00	3	10.00	4	13.33
<i>sometimes</i>	8	26.67	1	3.33	4	13.33	4	13.33
<i>often</i>	11	36.67	10	33.33	13	43.33	10	33.33
<i>almost always</i>	9	30.00	19	63.33	10	33.33	8	26.67
<i>Total</i>	30	100	30	100	30	100	30	100
<i>Mean</i>		3.90		4.60		4.00		3.47
<i>Std. Error of Mean</i>		.168		.103		.173		.252
<i>Std. Deviation</i>		.923		.563		.947		1.383
<i>Variance</i>		.852		0.317		0.897		1.913
<i>Range</i>		3		2		3		4
<i>Minimum</i>		2		3		2		1
<i>Maximum</i>		5		5		5		5

Table 3 shows the status of the idealized influence-attribute factor and its presence in sports. The responses are presented per question, and the

mean is characterized so that we see that the most important value, Mean 5, is represented in track and field, and the least important in wrestling, Mean 2.8.

Table 3.

	<i>IIa</i>				
	<i>P5</i>	<i>P9</i>	<i>P11</i>	<i>P14</i>	<i>M</i>
<i>Track and field</i>	5	5	5	5	5
<i>Wrestling</i>	3	4.5	2.5	1	2.8
<i>Bowling</i>	4	5	4	4	4.3
<i>Tennis</i>	4	4.5	4	3.5	4
<i>Karate</i>	3.5	5	3	4	3.9
<i>Rhythmic gymnastics</i>	2	3.5	4	1.5	2.8
<i>Volleyball</i>	4	4.5	4.5	5	4.5
<i>Basketball</i>	3	5	3	2	3.3
<i>Handball</i>	4.5	4.5	5	5	4.8
<i>Boxing</i>	3.5	4.5	5	3	4
<i>Chess</i>	5	5	3.5	4	4.4
<i>Amateurs</i>	5	4	4	4	4.3
<i>Youth Drive</i>	3.5	4.5	5	3	4
<i>Swimming</i>	4.5	4.5	4.5	4	4.4
<i>Soccer</i>	4	5	3	3	3.8
	3.9	4.6	4	3.5	4

The results of the responses of the Management to questions P2, P7, P12 and P13, referring to the Idealized influence - behavior factor are shown in Table 4. The results show us that the most common response was sometimes, but because of the difference in responses of other respondents, the

mean value of this factor was Mean 3.83, which had a somewhat lower response significance than the first factor. It must be emphasized that the result does not match the most common response of respondents, which speaks of the great variability in the responses.

Table 4. I Ib - Idealized Influence (behavior)

I Ib - Idealized Influence (behavior)	P2		P7		P12		P13	
	F	f%	f	f%	f	f%	f	f%
never	1	3.45	1	3.45	1	3.33	2	6.90
rarely	6	20.69	4	13.79	13	43.33	5	17.24
sometimes	6	20.69	8	27.59	16	53.33	3	10.34
often	10	34.48	8	27.59		0.00	8	27.59
almost always	6	20.69	8	27.59		0.00	11	37.93
Total	29	100	29	100	30	100	29	100
Mean		3.48		3.62		4.50		3.72
Std. Error of Mean		.214		.213		.104		.248
Std. Deviation		1.153		1.147		.572		1.334
Variance		1.330		1.315		.328		1.778
Range		4		4		2		4
Minimum		1		1		3		1
Maximum		5		5		5		5

Table 5 shows the status of the factor idealized influence-behavior and its presence in sports. The responses are presented per question, and the mean is characterized so that we see that the most

important value is represented in track and field and handball, Mean 5, and the least important in wrestling, Mean 2.4.

Table 5.

	I Ib				
	P2	P7	P12	P13	M
Track and field	5	5	5	5	5
Wrestling	1.5	2	4	2	2.4
Bowling	4	3	4	4	3.8
Tennis	3.5	3	5	4.5	4
Karate	2	4.5	5	2	3.4
Rhythmic gymnastics	3	2.5	4.5	5	3.8
Volleyball	4.5	4.5	4	4	4.3
Basketball	3	2.5	4	2.5	3
Handball	5	5	5	5	5
Boxing	4.5	2	4.5	2.5	3.4
Chess	3	3	4.5	1	2.9
Amateurs	4	4	4	4.5	4.1
Youth Drive	2.5	4	4.5	4	3.8
Swimming	2	4.5	5	3.5	3.8
Soccer	3	3	4.5	4.5	3.8
	3.4	3.5	4.5	3.6	3.7

The results of the responses of the Management to questions P4, P6, P15 and P16 referring to the factor Inspirational motivation are shown in Table 6. The results show us that the most common response was almost always, and that the mean value of this

factor was Mean 4.21 because the other responses were of lesser significance. It must be noted that this factor is the second most represented in this study on the presence of transformational leadership.

Table 6. Descriptive statistics: IM - Inspirational Motivation

IM - Inspirational Motivation	P4		P6		P15		P16	
	F	f%	F	f%	f	f%	f	f%
never		0.00		0.00	3	10.71	1	3.33
rarely		0.00		0.00	2	7.14	1	3.33
sometimes		0.00	4	13.33	7	25.00	1	3.33
often	7	23.33	11	36.67	9	32.14	16	53.33
almost always	23	76.67	15	50.00	7	25.00	11	36.67
Total	30	100	30	100	28	100	30	100
Mean		4.77		4.37		3.54		4.17
Std. Error of Mean		.079		.131		.238		.167
Std. Deviation		.430		.718		1.261		.913
Variance		.185		.516		1.591		.833
Range		1		2		4		4
Minimum		4		3		1		1
Maximum		5		5		5		5

Table 7 shows the status of the Inspirational motivation factor and its presence in sports. The responses are presented per question, and the mean is characterized so that we see that the most

important value is represented in track and field, Mean 5, and the least important in wrestling, Mean 2.8.

Table 7.

	IM				
	P4	P6	P15	P16	M
Track and field	5	5	5	5	5
Wrestling	4	4	1	2	2.8
Bowling	5	3	3	4	3.8
Tennis	5	4	2.5	4	3.9
Karate	4.5	5	4	4.5	4.5
Rhythmic gymnastics	5	4	3	4	4
Volleyball	5	4.5	4.5	4.5	4.6
Basketball	4.5	4.5	2.5	4	3.9
Handball	4.5	5	5	5	4.9
Boxing	5	4.5	4	5	4.6
Chess	5	4	3	4	4
Amateurs	5	4	4.5	3	4.1
Youth Drive	5	5	3	4.5	4.4
Swimming	4.5	4.5	2	5	4
Soccer	4.5	4.5	2.5	4	3.9
	4.8	4.4	3.3	4.2	4.2

The results of the responses of the Management to questions P1, P3, P17 and P19 referring to the Intellectual stimulation factor are shown in Table 8. The results show us that the most common response was almost always, and that the mean value of this

factor was Mean 4.32 because the other responses were of lesser significance. It must be noted that this factor is the most represented in this study on the presence of transformational leadership.

Table 8. IS - Intellectual Stimulation

IS - Intellectual Stimulation	P1		P3		P17		P19	
	F	f%	F	f%	f	f%	f	f%
never		0.00		0.00		0.00		0.00
rarely		0.00		0.00		0.00	3	10.00
sometimes	3	10.00	1	3.33	5	16.67	5	16.67
often	15	50.00	9	30.00	14	46.67	7	23.33
almost always	12	40	20	66.67	11	36.67	15	50.00
Total	30	100	30	100	30	100	30	100
Mean		4.30		4.63		4.20		4.13
Std. Error of Mean		.119		.102		.130		.190
Std. Deviation		.651		.556		.714		1.042
Variance		.424		.309		.510		1.085
Range		2		2		2		3
Minimum		3		3		3		2
Maximum		5		5		5		5

Table 9 shows the situation of the Intellectual stimulation factor. The responses are presented per question, and the mean is characterized so that we

see that the most important value is represented in track and field, Mean 5, and the least important in rhythmic gymnastics, Mean -3.6.

Table 9.

	IS				
	P1	P3	P17	P19	M
Track and field	5	5	5	5	5
Wrestling	3	4.5	4	4	3.9
Bowling	4	4	4.5	5	4.4
Tennis	4.5	5	3.5	4.5	4.4
Karate	4.5	5	4.5	5	4.8
Rhythmic gymnastics	5	4	3.5	2	3.6
Volleyball	5	5	4	3.5	4.4
Basketball	4	5	3.5	3.5	4
Handball	5	4.5	5	5	4.9
Boxing	4.5	5	4.5	4.5	4.6
Chess	3.5	5	4	2.5	3.8
Amateurs	4	4.5	4.5	4	4.3
Youth Drive	4	4	3.5	5	4.1
Swimming	4.5	4.5	4.5	4.5	4.5
Soccer	4	4.5	4.5	4	4.3
	4.3	4.6	4.2	4.1	4.3

The results of the responses of the Management to questions P8, P10, P18 and P20 referring to the Inspirational motivation factor are shown in Table 10. The results show us that the most common

response was almost always, and that the mean value of this factor was Mean 3.9 because the other responses were of lesser significance.

Table 10. IC - Individual Consideration

IC - Individual Consideration	P8		P10		P18		P20	
	F	f%	F	f%	f	f%	f	f%
never		0.00	1	3.33		0.00		0.00
rarely	6	20.69	3	10.00		0.00		0.00
sometimes	8	27.59	10	33.33	6	20	2	6.90
often	4	13.79	9	30	11	36.67	13	44.83
almost always	11	37.93	7	23.33	13	43.33	14	48.28
Total	29	100	30	100	30	100	29	100
Mean		3.69		3.60		4.23		4.41
Std. Error of Mean		.223		.195		.141		.117
Std. Deviation		1.198		1.070		.774		.628
Variance		1.436		1.145		.599		.394
Range		3		4		2		2
Minimum		2		1		3		3
Maximum		5		5		5		5

Table 11 shows the status of the Inspirational motivation factor and its presence in sports. The responses are presented per question, and the mean is characterized so that we see that the most

important value is represented in track and field, Mean 5, and the least important in wrestling, Mean 3.5.

Table 11.

	IC				
	P8	P10	P18	P20	M
Track and field	5	5	5	5	5
Wrestling	4	2	4	4.5	3.6
Bowling	5	4	5	3	4.3
Tennis	2.5	4.5	4	4.5	3.9
Karate	4.5	3	5	4.5	4.3
Rhythmic gymnastics	2.5	4	4.5	4	3.8
Volleyball	4	4	3	4	3.8
Basketball	2.5	2.5	3	4.5	3.1
Handball	5	4.5	5	5	4.9
Boxing	3.5	3.5	4	4	3.8
Chess	2	4	3.5	4.5	3.5
Amateurs	4	3.5	4	4.5	4
Youth Drive	2	3.5	4	2	2.9
Swimming	4	4	5	5	4.5
Soccer	3	2	4.5	5	3.6
	3.6	3.6	4.2	4.3	3.9

Table 12 shows the cross-section of the mean of the transformational leadership factor. The results show that: Idealized influence-attributed Mean 3.99; Idealized influence-behavior Mean 3.83; Inspirational motivation Mean 4.21; Intellectual stimulation Mean 4.32; Inspirational motivation

Mean 3.98. When everything is taken into account, the result is Mean 4.07, which indicates the presence of transformational leadership in Sloboda sports association when it comes to the management of clubs at a significant level.

Table 12.

Management	IIa	IIb	IM	IS	IC	Average
Mean	3.99	3.83	4.21	4.32	3.98	4.07

Conclusion

The research results show that transformational leadership is present at Sloboda WSA, Tuzla, but not equally in all sports clubs, and not at the same level. All these factors are not equally represented in all sports organizations in the Tuzla Canton. The results show us that in terms of the Idealized influence – attributed factor, the most common response was almost always, but because of the lower significance of responses of other respondents, the mean value of this factor was Mean 3.99. The result does not match the most common response of respondents because of the great variability in the responses. The results in terms of the Idealized influence – behavior factor show that the most common response was sometimes, but because of the responses of other respondents the mean value of this factor was Mean 3.83, which had a somewhat lower response significance than the first factor. Also, the result does not match the most common response of respondents, also because of the great variability of the responses. When it comes to the Inspirational motivation factor, the results show us that the most common response was almost always, and that the mean value of this factor was Mean 4.21 because the other responses were of lesser significance. It must be noted that this factor is the second most represented in this study when it comes to the presence of transformational leadership. Intellectual stimulation as a transformational leadership factor shows us that the most common response was almost always, and that the mean value of this factor was Mean 4.32 because the other responses were of lesser significance. It must be noted that this factor is the most represented in this study when it comes

to the presence of transformational leadership. The results in terms of the Inspirational motivation factor show us that the most common response was almost always, and that the mean value of this factor was Mean 3.9 because the other responses were of lesser significance. The total results of all the factors show a significant presence of transformational leadership at Sloboda sports association when it comes to the club management. The factor status per sport is such that: the presence of the idealized influence-attributed factor is the most represented in track and field, and the least in wrestling; Idealized influence-behavior is the most represented in track and field and handball, and the least in wrestling; Inspirational motivation is the most represented in track and field, and the least in wrestling; Intellectual stimulation is the most represented in track and field, and the least in rhythmic gymnastics; Inspirational motivation is the most represented in track and field, and the least in chess. The overall presence of transformational leadership per factor is as follows: Idealized influence-attributed Mean 3.99; Idealized influence-behavior Mean 3.83; Inspirational motivation Mean 4.21; Intellectual stimulation Mean 4.32; Inspirational motivation Mean 3.98. These results can lead to the conclusion that transformational leadership can be applied to other sports organizations in the Tuzla Canton when we look at the effectiveness and success of Sloboda. Transformational leadership affects the greater motivation of the members of the collective to achieve the set objectives and better results, thus increasing their productivity and overall satisfaction with the work they do. The overall result is a long-time survival of the sports association as a collective, which is cohesively connected into one whole.

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PRISUTNOST TRANSFORMACIONOG LIDERSTVA U UPRAVLJAČKOM SEKTORU SPORTSKIH KLUBOVA

Sažetak

Istraživanje je rađeno u radničkom sportskom društvu „Sloboda“ iz Tuzle koje broji 15 različitih sportskih klubova. Uzorak istraživanja su bili rukovodeći kadar u sportskim klubovima. Cilj istraživanja je bio ispitati prisutnost transformacionog liderstva i analiza njegovih faktora. Rezultati istraživanja pokazuju da je transformacijsko liderstvo zastupljeno na značajnom nivou RSD "Sloboda" Tuzla, ali ne podjednako u svim sportskim klubovima i ne na istom nivou. Stanje faktora po sportovima je tako da: prisutnost faktora (Idealized influence–attributed) je najviše zastupljen u atletici a najmanje u hrvanju, (Idealized influence–behavior), je najviše zastupljena u atletici i rukometu a najmanja u hrvanju, (Inspirational motivation) najviše je zastupljen u atletici a najmanja u hrvanju, (Intellectual stimulation) je najviše zastupljen u atletici a najmanja u ritmičkoj gimnastici, (Inspirational motivation) je najviše zastupljen u Atletici a najmanja u šahu. Po faktorima ukupna prisutnost transformacionog liderstva je: Idealized influence–attributed Mean-3.99; Idealized influence–behavior Mean-3.83; Inspirational motivation Mean-4.21; Intellectual stimulation Mean-4,32; Inspirational motivation Mean-3.98. Ukupni rezultati svih faktora pokazuju prisutnost transformacionog liderstva na značajnom nivou u sportskom društvu „Sloboda“. To znači da transformacijsko liderstvo utiče na veću motiviranost članova kolektiva za ostvarenje postavljenih ciljeva i boljih sportskih rezultata, čime se povećava njihova produktivnost i opšte zadovoljstvo poslom kojim se bave. Ovakvi rezultati mogu dati zaključak, da se transformaciono liderstvo može primijeniti i na ostale sportske organizacije na području Tuzlanskog kantona, kada gledamo efektivnosti i uspjeh sportskog društva „Sloboda.“ Naglasak je da su rezultati dali veoma značajne ocjene, što pokazuje da je transformaciono liderstvo u upravljačkom sektoru prisutno, a koliko je prisutno, to je zavisno najviše od uspjeha kluba.

Ključne riječi: : Transformaciono liderstvo, uprava, faktori, sportski klub.

Received: June 01, 2016

Accepted: June 15, 2016

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DIFFERENCES IN PHYSICAL ACTIVITY LEVEL BETWEEN STUDENTS WITH REGARD TO THEIR AEROBIC CAPACITY

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Original scientific paper

Abstract

The level of physical activity decreases as person becomes older and that entails many health problems. Because of that, the aim of this study is to determine differences in physical activity level between Faculty of Teacher Education students with regard to their aerobic capacity. The study involved 281 students of first and second year. Basic descriptive parameters were calculated for all the variables and the homogeneity of variance was tested by Levene's Test. ANOVA with LSD post hoc test was used to determine the difference in the level of PA due to the aerobic capacity. Results of analysis of variance show that there is statistical significance between groups that are categorized according to the level of aerobic capacity. Just slightly over a 10% of students have average or above average level of aerobic capacity which is very upsetting information.

Keywords: 20 m shuttle run test, female students, VO2 max.

Introduction

One of the many definitions of a physical activity says that PA is any movement carried out by the skeletal muscles activation that requires energy consumption (Caspersen, Powell & Christenson, 1985). Regular physical activity helps in achieving an optimal health condition and therefore leads to a reduced development of many chronic diseases (Blair, Cheng & Holder, 2001). It can help in preventing many different diseases such as type 2 diabetes, cardiovascular diseases, obesity, some types of cancer (Warburton, Nicol & Bredin, 2006).

To maintain health, all healthy adults (18-65 years) should conduct physical activity of moderate intensity 5 times a week for 30 minutes, or 3 times a week for 20 minutes of vigorous physical activities (Haskell, Lee, Pat & Blair, 2007). Although the well-being of physical activity is proven, level of physical activity decreases as a person becomes older (Telama & Young, 2000), especially in adolescence (Stone, McKenzie, Welk & Booth, 1998) and it has greater decline in girls than in boys (Sallis, 1993). Decrease in the level of physical activity of the student population has been observed over the past few decades (Sacheck, Kuder & Economos, 2010).

On the other hand, aerobic capacity (VO2 max) relates to intensity of aerobic process, indicating the maximal capacity for transmission and usability of oxygen during training performed at increasing intensity (Shete, Bute & Deshmukh, 2014). It is an index of someone's cardiorespiratory fitness (Bandyopadhyay, 2015). Aerobic capacity is one of the crucial markers (along with blood pressure and heart rate) in estimating cardiorespiratory fitness (Magutah, 2013).

Many studies have shown that with age VO2 max linearly decline 10% for sedentary individual (Stathokostas, Jacob-Johnson, Petrella & Paterson, 2004) and 5% for highly active one (Wiswell et al., 2001). Because of that, the aim of this study is to determine differences in physical activity level between students with regard to their aerobic capacity.

Methods

The study included 281 female students of the Faculty of Teacher Education, University of Zagreb. Participants attended the 1st and 2nd year and the measurement was conducted in the academic year 2014/15. All participants were healthy and ready for the survey. The sample of variables consisted of anthropometric measures of body height and body weight. Aerobic capacity was obtained by multi-stage 20 meter shuttle run test (Leger & Lambert, 1982). Body mass index was calculated based on the BMI formula ($\text{kg/m}^2 = \text{weight (kg)} / (\text{height (m)})^2$) (Garow & Webster, 1985). Intensity of the usual level of physical activity of students was determined by the application of the Baecke's questionnaire (Baecke, Burema & Frijters, 1982). From the responses to the questionnaire, load indexes for certain segments of physical activity were calculated. Three indexes were distinguished: work index (because this study examined only students the work index was adapted to faculty index), sport index and free time index. The maximum value of each index is 5.0, which represents the maximum load, while the minimum value of 1.0 represents the minimum load.

Statistical analysis

Basic descriptive parameters, arithmetic mean (AM), standard deviation (SD), minimum (MIN), maximum (MAX), Skewness and Kurtosis, were calculated for all variables. The homogeneity of variances was tested by Levene's Test. As the results of these two tests did not show statistical significance, analysis of variance (ANOVA) and its LSD post hoc test were used for the establishment of a difference according to the level of aerobic capacity. Data analysis was performed with the program STATISTICA version 7.1. (Data analysis software system). Statistical significance was tested at a significance level of $p < 0.05$.

Results

Table 1. Results of descriptive statistics of anthropometric characteristics, aerobic capacity and physical activity evaluation for the total sample of participants

	AM	Min	Max	SD	Skew	Kurt
FAXIND	2,65	1,75	3,63	0,31	0,14	0,09
SPOIND	2,63	1,25	4,50	0,67	0,57	0,12
FRTMIND	3,27	1,50	4,75	0,63	-0,24	-0,38
TPA	8,55	5,13	11,63	1,16	-0,04	-0,01
VO2MAX	28,80	18,50	50,80	6,08	0,72	0,21
BH	167,31	150,00	189,00	6,74	0,32	0,00
BW	61,53	41,00	135,50	11,45	2,32	10,01
BMI	22,15	16,63	50,81	3,64	2,95	15,84

FAXIND= faculty index; SPOIND= sport index; FRTMIND= free time index; TPA= total physical activity; VO2MAX=maximum oxygen uptake; BH= body height; BW=body weight; BMI=body mass index; AM-arithmetic mean; Min-minimum value; Max-maximum value; Skew-skewness; Kurt-kurtosis

Results in Table 1 show the arithmetic mean values of the examined variables. In variables that assessed physical activity at faculty and sport, medium load levels are visible; this means that the participants are not physically active in this area. Results of free time index show that students are more active in this area. The total physical activity of students is not at the satisfactory level (TPA=8,55). Results of maximum oxygen consumption (28,80 ml/kg/min) shows a very poor level (The Physical Fitness Specialist Certification Manual, 1998).

Table 2. The percentage of participants with regard to maximum oxygen uptake VO2max

	N	%
Very bad	136	48,40
Bad	81	28,83
Below average	34	12,10
Average	21	7,47
Above average	6	2,14
Very good	3	1,07

Looking at the results in Table 2, it is clear that over 77% of students have poor or very poor level of aerobic capacity. Slightly more than 10% of the student has a satisfactory level of aerobic capacity.

Table 3. Correlation coefficient results

	VO2MAX
FAXIND	0,06
SPOIND	0,42
FRTMIND	0,25
TPA	0,39

FAXIND= faculty index; SPOIND= sport index; FRTMIND= free time index; TPA= total physical activity; VO2MAX=maximum oxygen uptake

Table 3 shows the results of the coefficient of correlation between indicators of physical activity and maximal oxygen uptake as an indicator of aerobic capacity. The results show that the Pearson correlation coefficient is significant and that the increasing levels of physical activity significantly increases the maximum oxygen uptake and aerobic capacity among students.

Table 4. Levene's test results

	F	p
FAXIND	0,22	0,96
SPOIND	2,30	0,05
FRTMIND	0,31	0,91
TPA	0,21	0,96

FAXIND= faculty index; SPOIND= sport index; FRTMIND= free time index; TPA= total physical activity; VO2MAX=maximum oxygen uptake; BH= body height; BW=body weight; BMI=body mass index; AM-arithmetic mean; Min-minimum value; Max-maximum value; Skew-skewness; Kurt-kurtosis

Table 4 shows the results of Levene's test for testing the equality of variances in analysis of variance. It is evident that the test does not show statistical significance and analysis of variance was used in the further processing to determine the difference.

Table 5. Results of analysis of variance according to the level of aerobic capacity

	SS effect	df effect	MS effect	F	p
FAXIND	0,44	5	0,09	0,90	0,48
SPOIND	24,28	5	4,86	13,27	0,00
FRTMIND	7,08	5	1,42	3,77	0,00
TPA	58,35	5	11,67	10,15	0,00

FAXIND= faculty index; SPOIND= sport index; FRTMIND= free time index; TPA= total physical activity

Results of analysis of variance (Table 5) show that there is statistical significance between groups that are categorized according to the level of aerobic capacity. Statistical significance occurs in all variables except in faculty index ($p=0,48$). As analysis of variance proved to be statistically significant for three study variables, post-hoc test will be used in further analysis to determine significant differences between groups (Tables 6, 7 and 8).

Table 6. Results of LSD post hoc for variable "sport index" according to the level of aerobic capacity

SPOIND	Very bad M=2,44	Bad M=2,55	Below average M=2,93	Average M=3,24	Above average M=3,42	Very good M=3,83
Very bad		0,20	0,00	0,00	0,00	0,00
Bad	0,20		0,00	0,00	0,00	0,00
Below average	0,00	0,00		0,06	0,07	0,01
Average	0,00	0,00	0,06		0,52	0,11
Above average	0,00	0,00	0,07	0,52		0,33
Very good	0,00	0,00	0,01	0,11	0,33	

Table 7. Results of LSD post hoc for variable "free time index" according to the level of aerobic capacity

FRTMIND	Very bad M=3,18	Bad M=3,26	Below average M=3,32	Average M=3,60	Above average M=3,71	Very good M=4,17
Very bad		0,34	0,21	0,00	0,04	0,01
Bad	0,34		0,61	0,03	0,08	0,01
Below average	0,21	0,61		0,11	0,16	0,02
Average	0,00	0,03	0,11		0,69	0,13
Above average	0,04	0,08	0,16	0,69		0,29
Very good	0,01	0,01	0,02	0,13	0,29	

Table 8. Results of LSD post hoc for variable "total physical activity" according to the level of aerobic capacity

TPA	Very bad M=8,23	Bad M=8,50	Below average M=8,95	Average M=9,48	Above average M=9,71	Very good M=10,63
Very bad		0,07	0,00	0,00	0,00	0,00
Bad	0,07		0,04	0,00	0,01	0,00
Below average	0,00	0,04		0,08	0,11	0,01
Average	0,00	0,00	0,08		0,64	0,08
Above average	0,00	0,01	0,11	0,64		0,23
Very good	0,00	0,00	0,01	0,08	0,23	

Students who show a higher physical activity in the sports index have a significantly higher aerobic capacity compared to students who demonstrate lower physical activity (p = 0.00). When displaying variables to estimate the index of physical activity in leisure time, it is evident that the students with very good aerobic capacity are significantly more physically active than those with poorer levels of aerobic capacity (p = 0.00). The students with average and above average levels of aerobic capacity are equally physically active in their free time. In

variable which estimated the total physical activity, it is evident that the differences are significant (p = 0.00) compared to a students with a higher level of aerobic capacity to those who have a lower level.

Discussion

The primary purpose of this research was to establish the difference in physical activity level between college students with regard to their levels of physical fitness (aerobic capacity - VO2max) measured by multi-stage 20 meter shuttle run test. In a past few years, there have been numerous studies that dealt with investigation of the quantity of aerobic capacity performed by college students. Pribis, Burtnack, McKenzie and Thayer (2010) in their study found slow, gradual decline in fitness levels during the last 13 years, measured as an estimation of maximal oxygen consumption (VO2max) on a bicycle ergometer in college men and women. Their results showed that almost 60% of female students fit in poor fitness categories, 20% in fair, 15% in fit and only 8% in excellent fitness categories. The similar results was obtained in this study where almost 77% of students have poor or very poor level of aerobic capacity and slightly more than 10% of the female student has a satisfactory level of aerobic capacity. Recommendation of Physical Activity Guidelines for Americans (2008) is that adolescents should be engage in 60 minutes or more of physical activity daily. Most of the 60 minutes or more should be either moderate- or vigorous-intensity aerobic physical activity, and should include vigorous-intensity physical activity at least three days a week. Students who follow these guidelines should be able to improve or at least maintain their VO2max levels. Khushoo, Rafiq & Qayoom (2015) also have for aim to assess and compare the cardio respiratory fitness in terms of maximum aerobic capacity among the young adult male and female medical students. The result of their study showed that mean value of VO2max for females was 37.85 +4.3 ml/kg/min. On comparison of students VO2max value with the standard VO2max classification, their subjects fitted in the category of fair on cardio respiratory fitness scale. They concluded that the reason for that is decreased physical activity, unhealthy lifestyle behaviors during the years of gaining education. This is also shown in our study, where students who fit in lower levels of aerobic capacity are also less physically active equally during faculty, sport and leisure time. The similar findings determine in their research Dalleck & Schilter (2010). They concluded that college students that self-reported vigorous (n=55) rather than moderate (n=134) physical activity levels had significantly (p<0.05) higher VO2max and suggested the necessity of prevention programs that should focus on modifying physical activity behaviors in students. Bray et al. (2011) reported a study about problems of transition to the first year of university which is linked to steep decline in moderate-vigorous physical activity (MVPA). They investigate the effects of a targeted, theory-driven, print-based intervention on MVPA during transition to university. The authors concluded that after six weeks students who received the targeted first-year student physical activity brochure (Canada's Physical Activity Guide) reported significantly higher levels of moderate-vigorous physical activity (MVPA) compared to no-intervention control group (p < .05).

Conclusion

The results of this study demonstrate that there is insignificant number of female college students who are physically in shape. The multi-stage test run 20 meter (shuttle run test) shows that over 77% of measured students have poor or very poor level of aerobic capacity and slightly more than 10% of the female students has a satisfactory level of aerobic capacity (VO₂max). The results of physical fitness level are highly correlated with physical activity of students. That is to say increasing levels of physical activity significantly increases the maximum oxygen uptake and aerobic capacity among students. Also, the female students that are physically more active in area of sport and free time have significantly higher level of aerobic capacity. The observed results

demonstrated that level of physical activity can have positive effect on personal health in case of physical fitness level. Based on the findings of this study it can be concluded that students who were enrolled in the first year of Faculty of Teacher Education were not physically active during the study. Some of the students who are more active in their free time and practice a particular sport are physically in better shape. Since the sedentary lifestyle and bad physical shape is in relation with chronic diseases and health risk behaviors (such as smoking, drinking alcohol, bad nutrition...) it is necessary to stimulate the students to be physically active during faculty and in their free time. They should also be motivated to attend elective courses in the field of kinesiology (swimming, dancing).

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RAZLIKA U RAZINI TJELESNE AKTIVNOSTI STUDENTICA S OBZIROM NA AEROBNI KAPACITET

Sažetak

Razina tjelesne aktivnosti (TA) smanjuje se kako osoba postaje starija što za sobom donosi i mnoge zdravstvene probleme. Stoga je cilj ovog istraživanja utvrditi razliku u razini TA studentica Učiteljskog fakulteta s obzirom na njihov aerobni kapacitet. U istraživanju je sudjelovala 281 studentica prve i druge godine studija. Za sve varijable izračunati su osnovni deskriptivni parametri dok je homogenost varijance testirana Levenovim testom. Za utvrđivanje razlika u razini TA s obzirom na aerobni kapacitet korištena je ANOVA s LSD post hoc testom. Rezultati analize varijance pokazali su da postoji statistički značajna razlika između grupa kategoriziranih s obzirom na razinu aerobnog kapaciteta. Samo nešto više od 10 % studentica ima prosječnu, odnosno, iznadprosječnu razinu aerobnog kapaciteta što je veoma zabrinjavajući podatak.

Ključne riječi: VO₂ max, 20 m shuttlerun test, studentice.

Received: April 13, 2016

Accepted: June 15, 2016

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ANALYSIS OF ORGANISATIONAL STRUCTURE AND FINANCIAL ASPECT OF SUUCCESSFUL EUROPEAN CLUBS

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Original scientific paper

Abstract

Creating an adequate organisational structure of a certain organisation provides efficient achievement of goals. Following trends and making changes that can affect their work is responsibility of every organisation in order to create conditions in which athletes can reach their potentials. Sport organisations consist of certain subsystems, which by all its characteristics, function independently. Since sport organisations are different from one another by its aims and characteristics, there is no unitary organisational structure that can be applied to all organisations. Therefore, the aim of this paper is to determine organisational structures of football clubs, their functionality, role of an individual and subsystem which work within the structures and the funds that are planned and extended for one competitive season. The aim of paper is to analyse the work of organisation of football clubs in order to revise all segments that are necessary in achieving top results and profitability. 30 (40%) clubs (of 75) is in private possession, 24 (32%) clubs are founded as association and 21 (28%) clubs are founded as joint-stock company. Most private clubs are from Belgium and Italy while clubs from Germany are registered as the associations. Only two clubs from Germany (of 11) are registered as joint-stock company: FC Schalke 04 & 1.FC Köln. All clubs of Bundesliga are organized as sport association but they can select professional section as joint-stock company. The base of this German model is the rule of "50% + 1". That means that if the clubs decide to select professional section the majority of shares (50% + 1 share) is controlled by the club/association. Analysis of organisation of football clubs showed that the clubs that are in private possession don't have management body and that the decisions related to work and development of the football club depend on the owner of the club. Clubs that are formed as association or joint-stock company have formed body that manages the club and which was founded in a form of assembly or presidency. All clubs have established departments of finance and marketing and some clubs, apart from social networks and websites, have their own TV/radio channel. Budget of the football club depends on owner's structure and the country it comes from and development of football as business activity respectively.

Keywords: Football, clubs, organizational structure, financial aspect.

Introduction

Key role in development of sport and achieving success and top results have sport organisations and their management because they need to be managed quality and efficiently. Sport organisation includes organisation, coordination and management of all units as a whole, function, processes within and achieving sport results. Creation of adequate organisational structure of a certain organisation provides efficient achievement of goals. Following trends and making changes that can affect their work is responsibility of each organisation in order to create conditions in which athletes can reach their full potentials. It is evident that sport organisations which followed changes in sport industry and reacted on time, increased their efficiency, improved their business activities and influenced on segments of further growth of sport. The main form of sport organisations are sport clubs (The Law of Sport of Bosnia and Herzegovina (Official Gazette 42/04)). Those are independent organisational units, independent in setting the goals of its organisation and in selection of strategies and action plans for achieving goals. The aim of this paper is to point to the role and the work of organisations through the work and the organisation of football clubs. Sport is a field in which can easily come to conflict between management and the basic resource – an athlete (Jovanović, M. (2002)). since the ambitions of the two are the same. Conflicts within the sport organisation need to be avoided because human resources in this

case are not easy to replace because of the lack of adequate sport potential (Malacko, J., Rađo, I. (2006)). There are different models of performance of management in sport where different model is applied on a different sport organisation. Models of management which are commonly used in sport are:

- Model of strategic management and
- Model of management according to goals (MBO management)

Strategic management (Buble, M. (2005)) is the most common model of management which relays on the resources of the club and opportunities club has, based on information from the area. The aim of strategic management is to control strategic planning which defines long-term aims, strategies of development of organization and to hire employees for the job. Since program solutions are planned in advance this model, very little room for creative thinking of is employees is left and organisations need to be careful when applying this model. This model is recommended for sport organizations that are organized in a way where athletes are treated as employees.

Model management according to goals or MBO management is applied when direction of the organisational activity and work program needs to be defined. Model supports and initiates creative thinking of a large group of people (both managers and athletes) and its most important functions are

– control of process and elimination of destructive conflicts. The most important resource of MBO management is an athlete with his coach. This model is applied in sport organisations in which sport activities are developing and creative.

Methods

Sport organisations consist of certain subsystems, which by all its characteristics, function independently. Since sport organisations are different from one another by its aims and characteristics, there is no unitary organisational structure that can be applied to all organisations (Malacko, J. & Rađo, I. (2006). Sport organisations whether they are profitable or non-profitable are founded according to legal acts which define association or joint-stock company of a country they come from. Sport organizations can be:

Non-profitable organisations –private, mixed or public

Profitable organisations- founded by natural person, other sport organisations, associations or catering and touristic companies.

Sport organisations, whether they are profitable or not have economic and legal independence. Sport organisations receive profit from public budgets, memberships, sponsorships etc. The most successful sport clubs are usually privileged when it comes to public budget. Total incomes of the sport organisation present financial value of business activities at certain period. When it comes to expenses of sport organisations the most common are costs of material, energy, services, amortization and work (Bartoluci, M. (2003).

As previously said, there are different types of organisational structure of sport organisations.

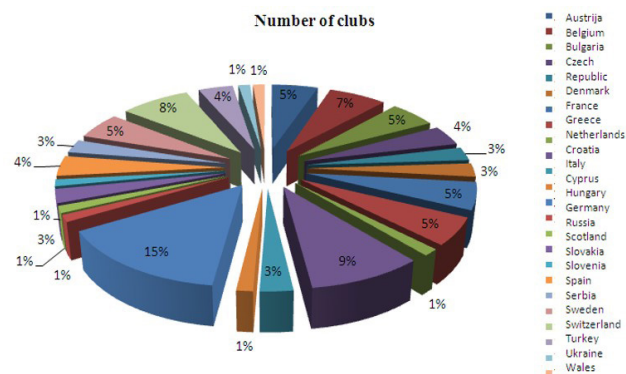
Subject of the paper is analysis of organization a structure of the clubs that compete in league of "five" and clubs which qualified for group phase of UEFA's competition and budget funds that clubs receive.

Problem of the paper is to analyse the work and organisational structure of football clubs considering their functionality, role of the individual and subsystems which and the funds for one competition season.

The aim of the paper is to analyze the work and organisation of football clubs in order to revise all segments that are necessary for achievement sport result and profit.

Sample subjects- 75 clubs

Analysis of the clubs that compete in league "five" and clubs that qualified for the group phase of UEFA's competition includes analysis of football clubs by their organisational structure, results in national and European competitions and leagues they come from. 75 football clubs were analyzed. Most of the clubs were from Germany (11), Italy (7) and Switzerland (6). The following graph displays percentage of clubs and the countries they come from.



Graph 1. participation of clubs and countries in overall number of analyzed clubs

Sport, in the last 100 years, experienced great development due to development of technology and science. Sport as a synonym for fun and play in its beginnings, developed into powerful industry and it improved other industries like textile industry (manufacture of sport equipment).

At the beginning, sport clubs were founded as associations, non-profitable clubs and schools. Later development brought national and international symbols so today we have top world competitions with representation from all over the world. The best indicator of development of sport is the number of sport international competitions. In 1986 only 13 of them were held and in 1996. 700 competitions were held. The biggest credit for popularisation and development of sport take sport organisations, and the best example of that are football clubs. Following text shows phases of development of football clubs during the process of development.

Phases of development of football clubs are (A.T. Kearney, (2004).:

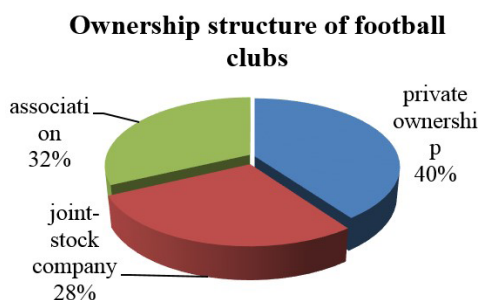
- Start phase- at this phase clubs survive due to support of local fans. The main sources of incomes were sales of talented players from football academies. Later, experienced players are sold to bigger clubs. Manchester United is the best example of a football club that passed this phase in 1990.
- National brand - at this phase club wins championships or it is at the top. Apart from participation in national scene, club participates in Euro competitions. At this phase number of fans is increased constantly as well as the incomes and the best players that play in these clubs are sold to other European clubs. Therefore, the competition is much bigger than it was at the beginning phase. Manchester United used to be at this phase in mid 90s of the last century.
- International brand - at this phase club is at the top and wins national and international competitions. Great stars play in the club and they have great support of the fans. The name of the club is recognizable and connected to world's sport brands. The aim of the clubs at this level is to maintain the continuance of winning and to gain profit at the international level.

Speed and structure of the club's progress depends on owner's structure and the management. The most common types of owner's structure in Europe are (Šurbatović, J. (2014).:

- Private ownership – in this type of structure owner of the club has a complete influence on financial decisions and on decision of sales and other decisions referring to the club. The way the club is functioning in private ownership is the same as in other companies and the owners are always in dilemma when it comes to profit and achieving sport results, respectively. An example of this relationship is when sheik Mansur covered over 103 million euros of loss of Manchester United for not winning the title.
- Club of public- private corporations- in this ownership structure clubs take business actions on a stock market and they are controlled by the committee. The committee makes decision on transfers, players' salaries, investments and other important issues. Members of the committee are usually families who own the shares of the club. Therefore the influence of the owners on the decisions of the board are present. An example of this structure is Juventus which is owned by family Anjeli with 60% of shares. The aim of management is to satisfy the needs of shareowners and to increase club's profit.
- Membership club – in this structure, associations of fans are dominant and clubs are non-profitable organisations managed by the selected committee. The fans are, above all, interested in sport result. The best examples of the clubs with this type of structure are Real Madrid, Barcelona and Bayer Leverkusen.

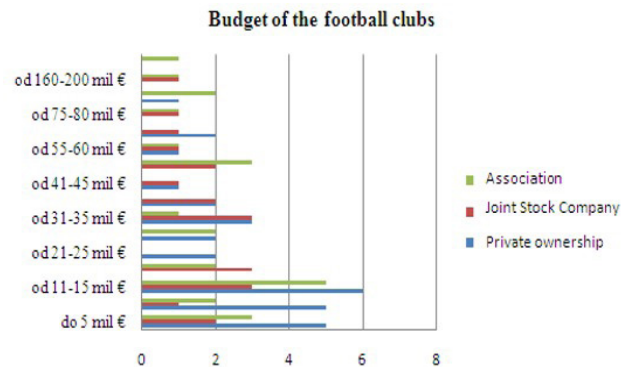
Results and discussion

30 (40%) clubs of 75 is in private possession, 24 (32%) clubs are founded as associations and 21 (28%) clubs are formed as joint-stock company. Most private clubs are from Belgium and Italy while clubs from Germany are registered as associations. Only two clubs from Germany (of 11) are registered as joint-stock company: FC Schalke 04 & 1.FC Köln. All clubs of Bundesliga are founded as sport association but they can select professional section as joint-stock company. The base of this German model is the rule of "50%+ 1". That means that if the clubs decide to select professional section the majority of shares (50% + 1 share) is controlled by the club/association. The doors are open for private investors but they cannot have majority shares of the club. The following graph displays ownership structure of analyzed football clubs.



Graph 2. ownership structure of analyzed football clubs

Football clubs have different budgets, depending on their ownership structure and the country the come from. The following graph presents the budget of the clubs in private possession, the clubs founded as joint-stock companies and the clubs founded as associations.

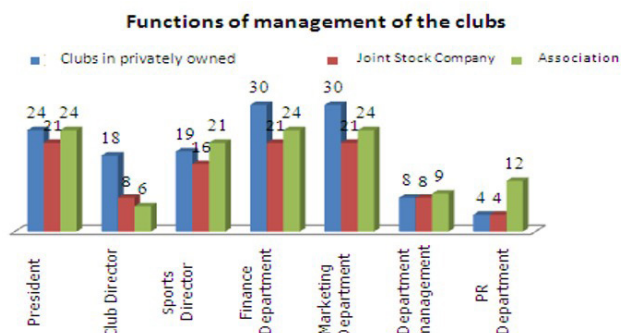


Graph 3. budget of the clubs

Previous graph shows that most of the clubs in private ownership have the budget of 11-15 million euros. However, although they are in private ownership, football clubs in Italy have much bigger annual budgets. The example of this is the football club Inter from Milan, which has access to the budget of 100 million euros. Football clubs which are founded as joint-stock companies have different budgets but that amount rarely crosses over 35 million euros. The exceptions are the clubs from Germany and Italy where investors invest a lot of money in football clubs. The best examples of dependence of the budget are the football clubs from Germany, Spain and Turkey. Although they are founded as associations almost all members have the right of vote and the annual budgets are over 50 million euros. Famous clubs like Herta BSC Berlin, SK Galatasaray and RCD Espanyol Barcelona enjoy great support from their members through season tickets and it directly affects the budget of the football club. Recorder in the highest budget is football club Barcelona, which is founded as association and has the budget of 420 million euros. Management body of the football clubs depend on ownership structure and the fact whether clubs is in private ownership or formed as an association. 17 clubs (out of 30 analyzed clubs that are in private ownership) in its organisational structure have the management body in form of presidency, management and executive and supervisory committee, which organises meetings in order to inform the owner about the situation in the club and its financial and sport results. Head of the management body is the owner of the club and the rest of the members are head of departments that are in charge of function and management of the club. Heads of departments make suggestions for development of business activities of the club and the owner makes all decisions for future development and business activities of the club. The owner of the club's management structure has the role of president of the club and the role of directors or heads of department of finances have the persons of trust. The example of such management is RB Salzburg in the ownership of Dietrich Mateschitz, the owner of Red Bull Company. Another example is Italian U.S. Sassuolo, the club in ownership of

Giorgia Squinzia, the owner of Mapai.

Football clubs which are founded as joint-stock companies have different management structure. 6 clubs (of 21 analyzed clubs) have the form of assembly as their management body and 7 football clubs have the presidency in form of management body. The rest of the clubs have the executive and management committees. Members of head management committee, regardless of the structure of organization, are the shareowners of the football club and they choose management bodies: members of supervisory committee, president and directors of the club. Clubs with presidency as their head management body and the members of the presidency are majority shareowners of the football club. Presidency makes all decisions about future development and work of the club. An example of such management is German football 1.FC Köln. Clubs which are founded as associations (24 analyzed clubs) have assembly or presidency as their management body. The difference between associations and joint-stock companies is that all members of associations have the right of vote and can be chosen for a certain function in the club (president, member of the club etc). The following graph displays the functions of the management of organisational structures of analyzed football clubs.



Graph 4. established functions of organisational structure of analyzed football clubs

Everyday management of the football clubs which are in private ownership is entrusted to directors of the clubs. 18 football clubs (of 30 analyzed clubs) have clear definition of the function of management within the club and they are divided on operative and sport section of management of the club. Director of the club is head of the operative section and sport director is the head of sport section. However the president of the club has the last word in making decisions. President of the club has the role of general manager in 12 analyzed clubs and management of the sport section is entrusted to head of coaching staff and to coordinator of young teams. 8 clubs have the separate department for management of sport facilities and only 4 clubs are in charge of PR.

Conclusion

Analysis of the work of the football clubs according their organisational structures, success on national and European competitions and the leagues they come from was conducted. Analysis of work of

football clubs was conducted in order to revise all segments necessary for achieving sport results and profit starting with the fact that all clubs have integrated subsystems (finances, young team, marketing etc) combined in one and that all subsystems have their price and significance and influence on sport and financial result of the football clubs. 75 football clubs were analyzed in this paper that come from the following countries: Belgium,, Greece, Austria, Czech Republic, Denmark, France, Holland, Croatia, Italy, Cyprus, Germany, Russia, Scotland, Slovakia, Slovenia, Spain, Serbia, Sweden, Switzerland, Turkey, Ukraine and Wales. 30 clubs (of 75) are in private possession, 24 clubs are founded as associations and 21 are founded as joint-stock company. Most private clubs are from Belgium and Italy while clubs from Germany are registered as associations. Analysis of organisation of football clubs showed that the clubs that are in private ownership don't have management body and that the decisions related to work and development of the football club depend on the owners of the club. Clubs that are formed as association or joint-stock company have formed body that manages the club and which was founded in a form of Assembly or Presidency. All clubs have established departments of finance and marketing and some clubs, apart from social networks and websites, have their own TV/ radio channel. Budget of the football club depends on owner's structure and the country it comes from and development of football as business activity respectively.

Budget of football club depends on ownership structure and the country club comes from and the country club comes from and if it is recognized as an investment by investors. Club like FC Inter has great financial funds which were used for investments and making decisions which lead to winning the competitions. Joint-stock companies, clubs from Germany have big budget because some of the shares were sold to the investors and the clubs had additional source of incomes but the process of making decisions of the club's activities hasn't changed. An example of the football club in private possession that has big budget and significant results on European competitions is FC Inter. Analyzed football clubs founded as joint-stock companies or associations that have even bigger budgets, like ACF Ajax, FC Schalke 04 or FC Barcelona have won titles of champions several times. The German model of management of the clubs has shown to be the most efficient. German model is the rule of "50% + 1. That means that if the clubs decides to register as association or joint-stock company the majority of shares (50% + 1 share) are controlled by the club/ association. The doors are open for private investors but they cannot have majority shares of the club. This model enables the clubs to come to necessary money to improve their business activities and to create conditions for acheiving sport results and to prevent dependence of the club to decisions of one individual.

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ANALIZA ORGANIZACIJSKE STRUKTURE I FINANSIJSKIH ASPEKATA USPJEŠNIH EURO KLUBOVA

Sažetak

Kreiranjem odgovarajuće organizacione strukture jedne sportske organizacije, obezbjeđuje se prije svega efikasnije ostvarivanje postavljenih ciljeva. Praćenje svjetskih trendova i promjena koje mogu utjecati na njihov rad je obaveza svih sportskih organizacija kako bi kreirali uslove u kojima sportaši mogu ostvariti svoj puni potencijal. Sportske organizacije se sastoje od određenih podsistema, koje po svojim osobinama i svojstvima, djeluju neovisno od drugih podsistema. S obzirom da se sportske organizacije razlikuju po svojim ciljevima i specifičnostima, ne postoji jedinstvena organizaciona struktura koja se može primjeniti na sve organizacij. S toga je problem rada je utvrđivanje rada i organizacione strukture nogometnih klubova uzimajući u obzir funkcionalnost, ulogu pojedinaca i podsistema koji djeluju unutar njih i sredstva koja se planiraju i obezbjeđuju za jednu takmičarsku sezonu, a cilj rada je analiza rada i organizacije nogometnih klubova, kako bi se sagledali svi elementi koji su neophodni da bi se ostvarili sportski rezultati i profit. Od ukupno 75 analiziranih nogometnih klubova, 30 (40%) klubova je u privatnom vlasništvu, 24 (32%) kluba je organizovano kao udruženje, a 21 (28%) klub je organizovan kao dioničko društvo. Najveći broj klubova u privatnom vlasništvu je iz Belgije i Italije, dok su klubovi iz Njemačke registrovani kao udruženja članova. Od ukupno 11 analiziranih klubova iz Njemačke, samo dva kluba su organizovana kao dioničko društvo: FC Schalke 04 i 1.FC Köln. U Njemačkoj su svi klubovi Bundeslige organizovani kao sportska udruženja građana, ali mogu izdvojiti profesionalnu sekciju i registrovati je kao dioničko društvo. Temelj ovog njemačkog modela je pravilo „50% + 1“. To znači da ako klubovi odluče izdvojiti profesionalnu sekciju, većinski udio (50% + 1 dionica) i kontrolu mora zadržati klub/udruženje članova. Analizom organizacije nogometnih klubova ustanovljeno je da klubovi koji su u privatnom vlasništvu nemaju osnovano glavno upravljačko tijelo i da odluke vezane za rad i razvoj nogometnog kluba ovise o odlukama koje donose sami vlasnici. Kod klubova koji su organizovani kao dioničko društvo ili udruženje članova jedinstveno tijelo koje upravlja klubom je oformljeno u vidu Skupštine ili Predsjedništva. Svi klubovi imaju uspostavljene odjele za finansije i marketing, a pored web stranice i prisustva na društvenim mrežama, pojedini klubovi u svom vlasništvu imaju vlastiti TV/ Radio kanal. Budžet nogometnog kluba zavisi od vlasničke strukture ali i države iz koje dolazi, odnosno koliko je nogomet trenutno razvijen i da li je prepoznat kao dobar poslovni poduhvat od strane investitora.

Ključne riječi: Nogomet, klubovi, organizacijska struktura, finansijski aspect.

Received: June 01, 2016

Accepted: June 15, 2016

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EVALUATION OF EFFICIENCY OF REPULSION IN SPEED-AND-STRENGTH TYPES OF ATHLETICS

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Original scientific paper

Abstract

Efficiency of repulsion in speed-and-strength types of athletics is an integral measure of skill, since the performance of repulsive movements involves interaction of almost all organs and body systems. Dynamic repulsion lays the foundation for high sports results and the conditions of effective interaction of internal and external forces. With the special test exercises, one can determine the level of functioning of individual systems, on which the result of an exercise depends, which during training sessions provides focused opportunity to influence the stimulation of individual systems, increasing their level of activity. The article presents an electromyographic evaluation of the effectiveness of repulsion during the high jump at a run. The implementation of this method will make it possible to objectively evaluate the level of technical skills of athletes and purposefully influence the improvement of basic biomechanical characteristics of sports exercises.

Keywords: Evaluation, efficiency, repulsion, technique, electromyogram.

Introduction

Summarizing the experience of numerous studies about high jump at a run, V.I. Bobrovnyk [3] notes that an important criterion of technical skill in a high jump is the ability to perform powerful repulsion combined with high speed and high takeoff trajectory. During the repulsion, there takes place a kind of transfer of horizontal speed of takeoff into vertical flight speed [3].

Repulsion in the high jump is one of the key elements that affect the result and, as remarked by V.G. Konestiapin, the violations of structure of jump occurs more often in time of reaction of a supporting leg. The great value of support reaction lies in its impact on the flight altitude of a jumper [5].

In the high jump some elements of movements are short-term (e.g. duration of repulsion totals in 0,13-0,19 s) so it is almost impossible to evaluate them even by the most experienced specialist. Apart from that, one should be aware, that a person only sees the spatial characteristics of motions and does not notice dynamic characteristics, and especially the inner picture of a muscle, which sometimes is a determining factor in the mastery of effective techniques [1, 2, 5-7].

Thus, the training process should include techniques that allow one to monitor the effectiveness of repulsion in jumping types of athletics.

This work presents an attempt to assess the effectiveness of electromyographic repulsion when performing the high jump at a run.

Research problem and objective

In modern sports training in some kinds of athletics (e.g. high jumping and long jumping at a run) athletic performance depends on the effectiveness of repulsion, because the development and use of adequate evaluation of the effectiveness of repulsion is one of the urgent tasks facing sports science [2, 7, 8].

Nowadays, a variety of athletic tests, based on the estimated effectiveness of repulsion (e.g., long jump and up jump from the place on two feet, triple jump from foot to foot, etc.) are offered [4, 5].

Despite the undoubted value of these tests, they have one common flaw that can be elucidated by the following: when using these tests, established is the fact that an athlete who showed the best result in the test exercise, has the best level of repulsion, which means that we get only the external characteristics of movement. However, during such testing, the information about what efficiency of a neuro-motor unit has been implemented in the performance of test exercises, is completely absent.

To address this shortcoming, we offer electromyographic evaluation of the effectiveness of repulsion of athletes. According to this methodological approach a numerical value ratio of electromyogram (EMG) is used as an indicator of the degree of realization of power possibility of athletes, which is registered in the repulsion to the maximal M-response, which is caused by indirect stimulation of the muscle. Indicator of time of implementation of repulsion is used as evaluation of speed parameters.

M-response is a simultaneous maximum reduction of motor units that are part of the muscle (at particular electrical stimulation mode). The value of M-response of a muscle is taken as 100% in the comparative analysis.

The aim of our study was to offer the electromyographic assessment of the effectiveness of repulsion in the performance of athletic jumps.

Research methods

High jump at a run was used in our studies as the motor model.

Registration of maximal M-response was carried out with the medial head of the gastrocnemius muscle. The nerve in popliteal fossa was influenced upon with

rectangular pulses of 2 ms. Registration of EMG was performed using telemetry equipment "Sport-4", and then recorded with recording magnetometer "Nikhon-Kokhden." EMG amplitude characteristics in this study are presented in standard units, i.e. integrated area of electromyogram instead of absolute values.

Before carrying out these experiments, there were created two experimental groups. The first group included highly skilled athletes – international class masters of sports in high jumping. The data obtained in studies of these athletes was accepted as the

standard in comparative analysis. The second group consisted of athletes who studied at the Faculty of Physical Education and Sports of Ivan Franko Zhytomyr State University with almost similar level of results.

Results

Time characteristics of electromyograms. Table 1 provides data of duration of electrical activity of four muscle groups while performing repulsion during the high jump.

Table 1. Comparison of electrical activity of muscles (ms) during the performance of repulsion in the high jump by athletes of different qualification

Groups	Statistical characteristics / muscle	M	%	$M \pm m$	σ	V%	t	P
(1) Reference n = 3	1. Calf muscle of a jumping leg	175	100	175 ± 3.3	10.3	6.0	-	-
	2. Four-headed muscle of a jumping leg	153	100	153 ± 2.3	7.2	5.1	-	-
	3. Tibial muscle of a jumping leg	182	100	182 ± 4.6	14.3	8.2	-	-
	4. Four-headed muscle of a swing-up leg	173	100	173 ± 5.8	17.7	11.0	-	-
(2) Experimental n = 12	1. Calf muscle of a jumping leg	209	113	209 ± 3.8	16.8	8.1	5.97	<0.001
	2. Four-headed muscle of a jumping leg	200	113	200 ± 3.8	16.3	9.1	10.8	<0.001
	3. Tibial muscle of a jumping leg	211	110.3	211 ± 3.2	13.4	7.2	5.4	<0.001
	4. Four-headed muscle of a swing-up leg	237	70.9	237 ± 8.3	35.2	10.6	12.5	<0.001

As we can see from the data, the reference group and studied experimental groups have significant differences in the duration of muscle activity while repulsing. The studied reference group's duration of activity for calf muscle, 4-headed muscle, tibial muscle of a jumping leg and 4-headed muscle of a swing-up leg was 175, 153, 182, 173 ms, respectively, the duration of phase of activity of the experimental group was much longer - 209, 200, 211, 237 ms respectively.

Amplitude characteristics of electromyograms. We shall remind, that amplitude characteristics or area of electromyograms in our study are given

in conventional units, i.e. the area of integrated electromyogram instead of absolute values.

Comparative analysis showed that the amplitude characteristics during the repulsion are different in different study groups. Thus, the second experimental group experienced significant reduction in the index of area of electromyogram in quantitative terms (357, 136, 305, 329 respectively), where it was approximately twice as low compared to the reference group (636, 305, 429, 477 respectively) (Table 2). These differences have a statistically significant character (p <0,001).

Table 2. Comparison of area of electrical activity of muscles when performing repulsion in the high jump by athletes of different qualification

Groups	Statistical characteristics / muscle	M	%	$M \pm m$	σ	V%	t	P
(1) Reference n = 3	1. Calf muscle of a jumping leg	636	100	636 ± 5.8	17.7	3.1	-	-
	2. Four-headed muscle of a jumping leg	305	100	305 ± 10.5	31.3	11.2	-	-
	3. Tibial muscle of a jumping leg	429	100	429 ± 4.6	14.5	4.3	-	-
	4. Four-headed muscle of a swing-up leg	477	100	477 ± 3.5	10.7	3.1	-	-
(2) Experimental n = 12	1. Calf muscle of a jumping leg	357	56.1	357 ± 14.6	63.2	9.3	17.3	<0.001
	2. Four-headed muscle of a jumping leg	136	44.3	136 ± 5.7	24.3	14.4	14.4	<0.001
	3. Tibial muscle of a jumping leg	305	70.9	305 ± 3.8	16.5	6.4	19.3	<0.001
	4. Four-headed muscle of a swing-up leg	329	68.8	329 ± 12.7	54.8	11.2	14.2	<0.001

Stage of using strength possibilities during repulsion. It is well known that the method of electric stimulation myography has a limited scope. This may be primarily explained by the fact that some motor fibers of muscle groups are located deep under the muscle and are not available for electrical activation. Therefore, to determine the degree of use of force possibility at repulsion, we chose only the calf muscle group, and, as shown by our study, its activity is highest during the repulsion in the high jump.

Comparison of electromyogram area of the medial head of the gastrocnemius muscle with of area M-response amplitude, extrapolated at a duration equal to the phase repulsion showed that athletes of reference group use from 38.9% to 43.4% of power capacity. On average it is 41.7%.

In the second studied group, this figure varies and ranges from 14% to 21%, and on average totals 17.9% (Table. 3).

Table 3. The degree of implementation of the power capacity of the studied groups during repulsion

(1) Reference group		(2) Experimental group	
K-o	43,4%	Z-v	21%
S-y	42,8%	G-v	20%
D-k	38,9%	S-v	19%
		M-v	15%
		K-k	14%
		S-v	18%
		A-n	17%
		F-o	20%
		B-n	21%
		Z-n	18%
		M-y	17%
		N-n	15%

Thus, the results of this part of our study indicate that the rational takeoff and repulsion are associated with the sustainable time structure of activity of various muscle groups and clear division by a degree of effort developed by athletes, displayed in the performance of electromyograms area during repulsion.

In those cases where technique of takeoff and repulsion are not trained, for example, in the second studied group, there appears instability of both qualitative and quantitative temporal and power characteristics of repulsion resulting from imperfect intramuscular coordination, which indicates a low technical skills. This, apparently, makes much smaller degree of realization of power capacity during the repulsion compared to subjects in the reference group.

Conclusions

Electromyographic method of evaluating the effectiveness of repulsion can be used for testing the level of technical skills of athletes and for preparing sports activities to improve the parameters of training exercises.

Prospects for future research are to design and implement new methods of control of sports practice that would enhance the efficiency of formation of technical skills in studies of all types of speed-and-strength athletics.

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ELEKTROMIOGRAFSKA EVALUACIJA EFIKASNOSTI REPULZIJE U BRZINSKO-SNAŽNIM TIPOVIMA ATLETIKE

Sažetak

Efikasnost repulzije u brzinsko-snažnim vrstama atletike je integralna mjera sposobnosti, budući da performansa repulzije pokreta uključuje interakciju gotovo svih organa i tjelesnih sustava. Dinamička repulzija postavlja temelj za visoki nivo sportskih rezultata i uvjete učinkovite interakcije unutarnjih i vanjskih sila. S posebnim testovima, može se odrediti razina funkcioniranja pojedinih sustava, od kojih rezultat vježbanja ovisi, gdje se tijekom treninga pruža prilika fokusiranog utjecaja na stimulaciju pojedinih sustava, te povećanje njihove aktivnosti. Članak predstavlja elektromiografsku procjenu učinkovitosti repulzije u skoku u vis na trčanje. Provedba ove metode, učinit će mogućim objektivno procijeniti razinu tehničkih vještina sportaša i namjerno utjecati na poboljšanje osnovnih biomehaničkih karakteristika sportskih vježbi.

Ključne riječi: *Evaluacija, učinkovitost, repulzija, tehnika, elektromiogram.*

Received: April 01, 2016

Accepted: June 15, 2016

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DIFFERENCES IN POSTURAL STATUS OF FOOT – PES PLANUS OF URBAN AND RURAL AREAS PUPILS

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Original scientific paper

Abstract

This research was conducted with the aim of determining the difference the posture status – pes planus of feet of pupils (third triad of nine-year elementary school), who attend school physical education and health by the same curriculum, and who are living in different environments (urban and rural). The study was conducted on a sample of 492 respondents, 492 male students from VII to IX grade, 250 male students from urban areas, 242 male students from rural areas. In this study there were four (4) variables for evaluating postural status feet. The study had transversal character. Applied tables of contingency show the frequency distribution of foot deformities (pes planus) of pupils in urban and rural areas. Crosstabs analysis and chi-square test determined representation and statistical significance of the difference between foot deformity of pupils in urban and rural areas and between pupils. The study results showed a statistically significant percentage of deformities of the longitudinal and transverse arch of the foot (pes PLANUS). Differences in the foot arches are mainly in the first degree of deformation, which allows a significant improvement of situation with the use of programmed Kinesiology treatments.

Keywords: Students, difference, postural status feet, chi-square test.

Introduction

Children of school age are considered to be the most active part of the population. However there is a justified fear that in the context of modern life, the level of physical activity of children is not satisfactory. The lack of adequate stimulation create can adversely affect physical growth and development of children, as with irregular eating habits, prolonged detention in forced positions, along with other factors creates a good foundation for health damage and postural status of the locomotor system (Kosinac., 2002).

The need for systematic implementation and quality physical and health education from the earliest days does not come only from lifestyle changes, but also from the fact that in modern conditions of life and work all the more vulnerable precisely the functions and capabilities of the organism that are physical and health education can quickly and effectively change, develop and improve. From this we can conclude that the value of physical and health education is not reflected only in satisfying the basic needs of students for physical activity, but it also has an important role in the transformation of the different characteristics of the anthropological status of students. Problems with postural disorders are very common. This suggests that the physical and health education in this period very delicate process and that, because of possible complications (especially health care) should be approached very carefully and seriously (Mikic et al., 2010).

The entire ontogenetic development of the child is the number of seconds of internal (endogenous) and external (exogenous) factors. The issue of this paper is aimed at studying the effects of exogenous factors on postural status of the foot - pes planus students of the same age who attend classes of physical and health education at the same Curriculum and live in different environments (urban and rural). The aim of this study was to determine differences in postural

status feet – pes planus students of urban and rural areas.

Methodology of work

Sample of respondents

The population from which the sample was derived can be defined as a population of students VII, VIII and IX grade, and third triad of nine-year elementary school in Tuzla Canton, ages 12, 13 and 14 years (+ - 6 months). The sample of respondents who seemed to 492 students divided into two sub-samples, and 250 school students from urban areas, 242 school students from rural areas.

The sample of variables to assess posture status of the foot - pes planus

- The normal state of the foot **PESNOR**
- PES planus Level I **PESPLA1**
- PES planus Level II **PESPLA2**
- PES planus Level III **PESPLA3**

After a visual observation of the foot with the front, rear and sides, as well as the dorsal and plantar sides approached the sampling footprint method plantografije, because it is routine practice in the most economical.

Plantogram is analizan Tomasenovom method, which in practice usually applied. This method indicates a change instep already in the initial stage, and the results are presented as percentage values which allows an accurate statistical analysis.

Statistical data analysis

Applying kontigencijskih table shows the frequency and the corresponding percentages of occurrence of foot deformity. We performed Crosstabs analysis of physical deformities students.

By using Chi-square test was determined representation and statistical significance of the difference between foot deformity students of urban and rural areas.

Results and Discussion

Analysis deformity posture status of the foot - PES PLANUS students of urban and rural areas

In Table 1. and Figure 1. shows the results of analysis deformity posture status foot-pes planus students of urban areas. Analysis is subjected to 250 students divided into three subsamples, and VII, VIII and IX grade.

Table 1. Contingency table of frequency distribution of foot deformities (pes planus) students of urban areas

Pes planus		The sample - PUPILS OF URBAN AREAS			
		CLASS			
		VII	VIII	IX	UKUPNO
PESNOR	F	58	54	59	171
	%	71	61	74	68
PESPLA1 ⁰	F	19	27	15	61
	%	23	31	19	24
PESPLA2 ⁰	F	5	7	4	16
	%	6	8	5	7
PESPLA3 ⁰	F	0	0	2	2
	%	0	0	2	1
UKUPNO	F	82	88	80	250
	%	100	100	100	100

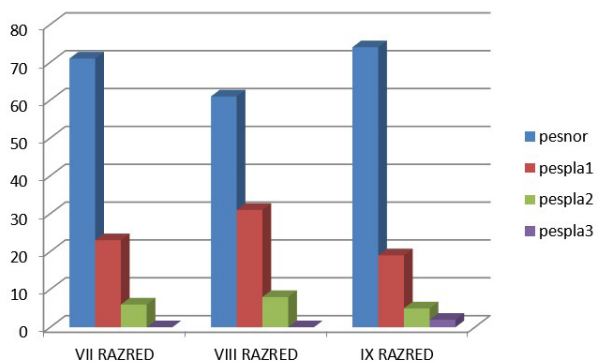


Chart 1. The degree of deformity after classes

From Table 1, which shows the frequency and the corresponding percentages deformity posture status stopala- it is evident that in the entire test sample of pupils normally foot has 171 student, or 68% of the sample. In terms of the percentage of representation of the deformities of the studied sample, we can conclude that the first degree of deformity has 61 student, or 24% of the sample, the second stage of 16 students or 7% of the sample and the third level 2 students or 1% of the sample.

Table 2 and Figure 2 shows the results of analysis deformity posture status foot-pes planus students of rural areas. Analysis is subjected to 242 students divided into three subsamples, and VII, VIII and IX grade.

Table 2. Contingency table of frequency distribution of foot deformities (pes planus) students of rural are.

Pes planus		The sample - PUPILS OF URBAN AREAS			
		CLASS			
		VII	VIII	IX	UKUPNO
PESNOR	F	61	57	70	188
	%	78	70	84	78
PESPLA1 ⁰	F	13	17	11	41
	%	17	21	13	17
PESPLA2 ⁰	F	4	5	2	11
	%	5	6	3	4
PESPLA3 ⁰	F	0	2	0	2
	%	0	3	0	1
UKUPNO	F	78	81	83	242
	%	100	100	100	100

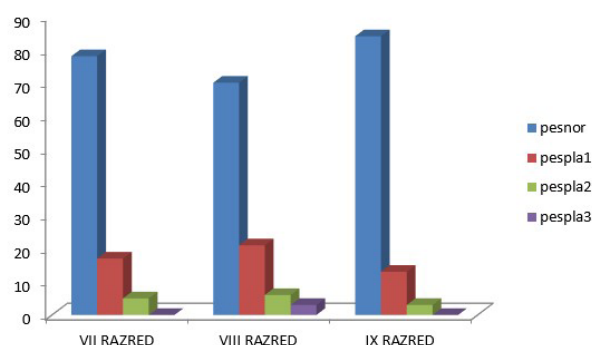


Chart 2. The degree of deformity after classes

From Table 2, which shows the frequency and the corresponding percentages deformity posture status foot-pes planus, it is evident that in the entire test sample of pupils normally foot has 188 students or 78% of the sample. In terms of the percentage of representation of the deformities of the studied sample, we can conclude that the first degree of deformity has 41 pupils or 17% of the sample, the second stage of 11 students or 4% of the sample and the third level 2 students or 1% of the sample.

Analysis of difference foot deformity - (pes planus) between students of urban and rural areas

Table 3. Contingency table of frequency distribution of the foot deformity (PES PLANUS) students of urban and rural areas.

PES PLANUS		UZORAK ISPITANIKA		
		UČENICI-Urbano	UČENICI-Ruralno	UKUPNO
PESNOR	F	171	188	359
	%	68	77	73
PESPLA 1	F	61	41	102
	%	24	17	21
PESPLA 2	F	16	11	27
	%	6	5	5
PESPLA 3	F	2	2	4
	%	2	1	1
UKUPNO	F	250	242	492
	%	100	100	100

This chapter presents and analyzes the results of the data on the descriptive statistical indicators based on Crosstabs analysis, and with the help of Chi-square test was determined statistically significant representation of the deformity of the foot-pes planus, between students of urban and rural areas. Significant value of statistical significance was researched at the 0.01 level.

Table 4. Crosstab analiza deformiteta "pes-planus"

		PES-PLANUS		Total
		0	1	
Učeni- urbano	f	171	79	250
	%	68,0%	32,0%	100,0%
Učeni- ruralno	f	188	54	242
	%	77,0%	23,0%	100,0%
Total	f	359	492	
	%	73,0%	27,0%	100,0%

Table 5.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16,750 ^a	1	,002

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 37,60.

Table 4. shows the results of crosstabs analysis of the distribution of postural deformities PES PLANUS with the study sample, students of urban and rural areas. When it comes to students of urban areas, a total of 250 students have been processed, and with 79 students or 32.0% of the registered dog-planus deformity of the first, second and third degree. It has been investigated 242 students of rural areas and this postural disorder dog-planus of the first, second and third degree was observed in 54 students, or 23.0% of the total sample.

The average representation of postural deformity of the first, second and third degree with respect to the total number of respondents was 27, 0%, respectively with 133 students.

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Table 5. shows the Chi-Square Tests, and by examining the size of the chi-square (Pearson Chi-Square) and 16,750 Asymp. Sig. (2-sided), 002 tells us that there is a statistically significant difference in the prevalence of deformities among students of urban and rural areas for the benefit of students of rural areas.

The results are within the limits of the average with respect to previous research in which they obtained significantly higher percentages foot deformity (Kosinac, 1995 Hodzic et al., 2008; Stevic and Pelemis, 2008, Bogdanovic et al., 2010; Mikic et al., 2010; Konicanin et al. 2011; Arnaut, 2013).

Conclusion

After examining the results of the state of the presence of postural deformities can be concluded that the registered presence of all three degrees of deformity in the treated segments posture status. Applying kontigencijskih tables and crosstabs analysis shows the frequency and the corresponding percentages of occurrence of foot deformity pupils.

The study results showed a statistically significant percentage of deformities longitudinal and transverse arch of the foot. Changes to the arches of the foot are mostly in the first degree of deformation, which allows correction of the situation by applying programmed Kinesiology treatment in work with children of this age.

The research results show statistically significant differences in postural status of foot-dog planus between students of urban and rural areas.

Overall, based on the results obtained, by itself, leads to the conclusion that it is extremely important to timely identify the occurrence of foot deformity.

Bearing in mind that the period of early adolescence-adolescence represents an important factor of the formation posturalnih deformities.

Also, through proper cooperation between teachers, parents and medical staff can very effectively act to reduce the incidence of these deformities as well as on the growth, development and motor efficiency students of this age.

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RAZLIKE U POSTURALNOM STATUSU STOPALA – PES PLANUS UČENIKA URBANOG I RURALNOG PODRUČJA

Sažetak

Ovo istraživanje je provedeno sa ciljem utvrđivanja razlika u posturalnog statusa stopala – pes planus učenika (treće trijade devetogodišnje osnovne škole), koji pohađaju nastavu tjelesnog i zdravstvenog odgoja po istom nastavnom planu i programu, a žive u različitim životnim sredinama (urbanim i ruralnim). Istraživanje je provedeno na uzorku od 492 ispitanika, i to 250 učenika škola iz urbanog područja i 242 učenika škola iz ruralnog područja. U ovom istraživanju primjenjene su 4 (četiri) varijable za procjenu posturalnog statusa stopala – pes plansu. Istraživanje je imalo transversalni karakter. Primjenom kontingencijskih tablica prikazane su frekvencije distribucije deformiteta stopala (PES PLANUS) učenika urbanog i ruralnog područja. Primjenom Crosstabs analize i Hi-kvadrat testa utvrđena je zastupljenost i statistička značajnost razlika deformiteta stopala između učenika urbanog i ruralnog područja. Dobijeni rezultati istraživanja ukazuju na statistički značajan procenat deformiteta uzdužnog i poprečnog svoda stopala (PES PLANUS). Razlike na svodovima stopala su uglavnom u prvom stepenu deformacije, što omogućuje značajno popravljavanje stanja uz primjenu programiranog kineziološkog tretmana.

Ključne riječi: Učenici, razlike, posturalni status stopala, Hi-kvadrat testa.

Received: May 15, 2016

Accepted: June 15, 2016

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EFFECTS OF HIGH-INTENSITY INTERVAL TRAINING ON REDUCTION OF BODY WEIGHT, BODY FAT AND LEVEL VO₂MAX OF MIDDLE AGED WOMEN

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Original scientific paper

Abstract

The aim of this research is to determine effects of model of high-intensity training (HIIT) on reduction of body weight, body fat and increase of aerobic capacity. Research was conducted on samples of 9 women of middle age. HIIT program lasted for 6 weeks and 18 trainings were performed. Period of high intensity was set at 90-100% while period of active rest was set at intensity of 60% of maximum speed of work of each subject. T-test (paired samples) showed statistically significant differences in favor of the final measurement ($p < .01$). Obtained results indicate that HIIT model of training in ratio 1:2 works efficiently on reduction of total body weight, body fat and increase of maximum oxygen consumption (VO₂max). EPOC effect caused by a model of HIIT training is followed by increased energy consumption after the training.

Keywords: Health, EPOC effect, aerobic capacity, anaerobic activity.

Introduction

Increased level of fat contributes to reduced work abilities of a man and presents a risk factor for numerous diseases and clinic complications. It is very important to determine deficient method of training in relation to the level of health and the level of condition abilities of a subject. In training practice, trainers often use models of interval of high intensity. High-intensity interval training (HIIT) is considered to be an advanced form of interval training which includes rotation of work interval of high intensity with the interval of rest or low-intensity work. Many studies show that continuous exercising brings positive effects on reducing body fat and increases work capacity. These trainings usually last 4-20 minutes and depending on selected model of training have positive effect on VO₂max, cardiovascular system, increase basal metabolism, metabolism of glucoses and burning fat (Tabata et al. 1996; 1997; King et al. 2001; Gibala et al. 2009; Timmons et al. 2009; Guiraud et al. 2010; Kim et al. 2011;). Training can be adjusted to all conditions of individual or group work and can be equally effective on a treadmill, bike and elliptic treadmills. Optimal volume of loadings in training can be achieved by increase of intensity loadings, but also with their equal influence. In this way, volume of heart, beat volume and oxygen consumption are increased (Malacko & Rađo, 2004). However, the largest effects occur during breaks and not during load (Malacko & Rađo 2004). Relation of physical activity and health is visible in optimal level of condition abilities which lead to high level of health. The aim of this research is to determine effects of HIIT model 1:2 on reduction of body weight and body fat and changes in level of aerobic capacity of women of middle age.

Methods

Sample subjects

Sample subjects of this research were women (n=9), aged 25-41, attendants of recreation exercising. All subjects were clinically healthy without any

obstacles that could endanger their health or the result of the study.

Tests and measurements

Tests used in this study are: Body weight, Body Fat (%) and VO₂max. Measurements of morphological characteristics was conducted by anthropometric set that included body weight and four skin folds (triceps, suprailliac, abdomen, suprapatellar) by which percentage of body fat was calculated. Body Fat (%) of total mass of the body (Jackson-Pollock, 1985). Aerobic capacity is measured by Shuttle run test 20m, with progressive increase of loadings (Beep test). VO₂max was calculated by proper formula.

Training program

HIIT model was used in the main part of the training with positive proportion of work and rest (1:2) with the combination of activities of high intensity and active rest. In 6-week period 18 trainings were performed (3 trainings a week). Number of intervals was increased after every other week. The aim of warm-up before every training was to raise work temperature and to prepare joints and muscles for high intensity interval work. The aim of the final part of the training was cooling the body and the recovery. The main part of the training is performed on orbitrack with mechanical control of resistance. Period of high intensity is determined at 90-100% while the period of active rest is determined at 60% of maximum speed working of a subject. Maximal test was performed in the first training of the week and it determined zones of intensity for that week. Individual diet with calorie reduction and reduction of consumption of carbohydrates was created for each subject included in the program.

Table 1. Program of 6-week HIIT model (1:2)

Warm-up				
Activity	Speed of work	Number of exercises	Duration of the exercise (sec)	Total time (min)
Orbitrack	50% of max.	-	-	10
Dynamic stretching	medium - high	8-12	5-15	5
The main part of training				
Week	Number of trainings	Time of active work(sec)	Time of active rest (sec)	Number of intervals
I - II	6	20	40	8
III - IV	6			10
V - VI	6			12
Cooling				
Activity	Speed of work	Number of exercises	Duration of the exercises (sec)	Total time (min)
Orbitrack	50% of max.	-	-	5
Static stretching	-	8-12	10-30sec.	10

Methods of data processing

Differences in arithmetic means of the initial and the final testing are calculated by student's T-test (paired samples) (sig. < .05).

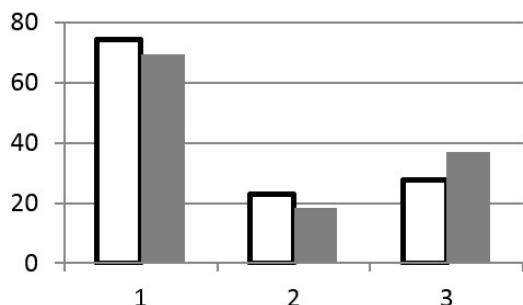
Results

Final measurement showed that subjects had better results of arithmetic means in Body weight and Body Fat (%) tests (table 2, graph 1). Results of t-test (paired samples) (table 4) point to the level of statistical significance (sig. < .01). Therefore, with certainty of 99% it can be concluded that 6-week HIIT model (1:2) is efficient.

Table 2. Values of arithmetic means and standard deviations of initial and the final measurement

Test	Initial	Final
1. Body weight	74,3 ± 6,3	69,6 ± 5,5
2. Body Fat (%)	23,1 ± 2,5	18,2 ± 2,4
3. VO ₂ max	27,6 ± 1,6	36,1 ± 1,1

Graf 1. Means of initial and final measurement



White column – initial measurement; grey column – final measurement

Table 3. Results of t-test

Par	t	df	Sig (2-tailed)
1. Body weight		8	0,000
2. Body Fat	9,46	8	0,000
3. VO ₂ max	-9,28	8	0,000

Discussion

After initial measurement of the subjects a 6-week HIIT model of training was designed, where 18 trainings were performed, after which the final measurement was conducted. Performed model of training with positive ratio (1:2) and with selected contents and loadings had positive effect on reduction of body weight, body fat and increased level of maximum oxygen consumption (VO₂max). Many studies have shown that aerobic and anaerobic activities have EPOC effect (excess post-exercise oxygen consumption). HIIT increases basal metabolism (RMR) in the next 24 hours after increased oxygen consumption after training (King et al., 2001). EPOC or after-burn effect mobilizes fat hours after HIIT training, burns up to 9 times more calories in relation to continuous model of training with low or medium intensity. During the recovery, the oxygen is consummated in order for the body to return to the condition of homeostasis and adapt to the training. Post-exercise oxygen is used for recovery of phosphate energy system and oxidation of lactic acid. Great amount of lactate is transported from lactate loaded muscles to non-loaded muscles. It is also distributed to kidneys, liver and heart. Non-loaded muscles can accept and burn the produced lactate by aerobic process or turn it into carbohydrates and deposited it into muscles or liver. Also, lactate can burn in heart muscle or kidneys as the energy fuel.

EPOC effect caused by HIIT model with positive proportion 1:2 is followed by increased energy consumption. As a response to HIIT reserved fat degrade into free fat acids (FFA) which go into blood stream. EPOC has the highest effect immediately after training. In the first 3 hours of exercising the consumption of calories is increased to 13% and after 16 hours drops to 4%. EPOC effects are also visible after 38 hours after training (Schuenke et al., 2002). It was considered, until recently, that increased degradation of fat is achieved only by aerobic training in the zones of low intensity with high volume, however, the latest research indicate completely opposite (Baker & Gleeson, 1998). During

the aerobic training due to long activity, the reserves of glycogen are used and muscles get energy by degradation of fat and they use more calories during the training but after this type of training EPOC is negligible. In case of aerobic training, EPOC effect is bigger with the increase of intensity of exercises and volume (Børsheim & Bahr, 2003). Anaerobic activity in form of HIIT burns less calories during the training but due to increased EPOC effect it burns more calories ultimately and reduces body fat (Schmidt, 1992). In conclusion, continued training of low intensity burns fat during its performance while HIIT burns fat in the following period.

The aim of cardio training in the area of low intensity is for body to use all reserves of fat as a source of energy. Some experiences show that it is better to perform cardio training of low intensity before the first meal or immediately after training. At that moment, reserves of glycogen are the lowest and the body uses fat as the fuel. However, energy processes of HIIT are different because the body immediately asks for reserves of glycogen and not reserves of fat. If the reserves of glycogen are low, body will direct itself toward muscles as source of energy which leads to catabolism. For that reason, it is best to eat a meal rich with carbohydrates of low glycolic index (GI) and proteins 60-90 minutes before HIIT. This way, body will fill its reserves of glycogen and it will be ready to endure the training of high intensity. In order to reduce body weight subject needs to be careful with the calorie consumption. After a long training and during EPOC effect body will use reserves of fat.

Essence of HIIT is rotation of work interval of high intensity with the interval of rest. Intervals of work and rest can be rotated in equal, positive and negative ratio. Ratios can change depending on effects subject wants to achieve through interval way of training and abilities which subject desires to develop. Equal ratio of work and break includes equal amount of work and rest (1:1). This type of work is commonly used in programming circle training if it is programmed on time. Negative ratio of work and presents type of work where interval of work is bigger than interval of rest (Tabata protocol; 2:1; 20 sec of active work HI & 10 sec of active recovery R). Positive ratio of work and rest means bigger break than work. Ratios often are 1:2 and 1:3. These models are considered to be efficient for reduction of body fat. However, in every version of the work of high intensity interval individual needs to give maximum effort to get desired results. Intensity of work should be more than 90% of $\dot{V}O_2\max$, which means from the lowest speed of movement which matches to $\dot{V}O_2\max$ at certain motor form, respectively. Higher intensity than this one leads to faster weariness and reduction of effective time of training. In conclusion, the aim of HIIT is work on the level $\dot{V}O_2\max$ as long as possible. The size of consumed oxygen can be several times bigger than the amount of oxygen which is used by an athlete during state of rest (Daniels, 2010). Size of $\dot{V}O_2\max$ is limited by central and local factors. Central factors transport the oxygen (O_2) to active muscles. Transportation of oxygen to muscles limit diffuse capacity of lungs, a minute volume of heart (beat volume x heart frequency) and the amount of haemoglobin (hb) in blood. On the other hand, the difference in levels of

oxygen between arterial and vena blood is limited by peripheral factors which include distribution of blood to active muscles, number of capillary, type and size of muscles, amount of myoglobin, number and size of mitochondria. Athletes can improve their $\dot{V}O_2\max$ by working on central and local factors of limitations.

Complexity of exercises and ratio of period of intensive work and the rest needs to be adjusted to the possibilities of each subject. Optimal time of recovery between trainings is 36-48 hours and it is not recommended to do more than three trainings a week. This is the way to achieve full potential of EPOC effect. HIIT demands longer warm-up and cooling phases since inadequate approach to the training could cause longer recovery between trainings and disturb performances of the future intensive loadings. In conclusion, it is very important to balance the time of intervals and the rest because it is the only way to achieve necessary balance between loadings and recovery.

Beginners are recommended to build desired form by continuous and interval methods of training in the area of low intensity. Experience has shown that inexperienced exercisers usually start interval series by intensity of activities that is too high. This approach can result with reduced number of planned interval repetitions in training or with too low intensity during the performance of the final interval of the work. Therefore the desired effects of training certain area of intervals cannot be achieved. That is why inexperienced exercisers need to start interval series on a lower intensity level and gradually increase intensity and running speed, respectively. An exerciser, in time, will get the experience and the feeling for determining adequate intensity of work and the rest.

Conclusion

Excessive accumulation of body fat is complex chronic disorder, and it is a consequence of imbalance of energy excessive food intake and reduction of consumption caused by complex generic, metabolic, hormonal and other factors, illnesses of locomotor system and reduced body activity. The aim of this research is to establish the effects of HIIT on reduction of body weight and body fat and changes on the level of aerobic capacity of middle aged women. 6-week program with 18 trainings (3 trainings per week) was conducted. 2-week preparation period of aerobic trainings in the zone of low and medium intensity preceded this program. HIIT model is selected for this experiment with the ratio 1:2 (20 sec. of activities of high intensity and 40 sec. of active rest). 8-12 intervals were performed during one training. When the program was finished results of t-test point to statistically significant differences in tests of Body weight, $\dot{V}O_2\max$, and Body Fat (%) (sig. < .01). It can be concluded that 6-week HIIT model with positive ratio of work and the break (1:2) and selected contents, loadings and organization is efficient model of training. Revising the results of all mentioned studies and comparing them to the results obtained in this experiment, it can be concluded that HIIT in ratio of work and the break 1:2 causes significant effect of increased oxygen consumption after training (EPOC) which results with increased burn of calories and

mobilization of fat metabolism up to 48 hours after training, and it may be a part of the program for reduction of body weight and percentage of body fat of middle aged women. It's important to design HIIT program according to scientific knowledge and personal needs of an individual. Before performing HIIT program, medical examination of the subject is mandatory. In case of cardiovascular or other diseases training shouldn't be avoided but it should

be adjusted and consulted with doctor. HIIT program can be equally efficient if performed in a group or individually. It is very important to respect the rules of diet in order for body to have enough energy and to prevent catabolism. This research is intended as initiation for future researches of this kind and promotion of „High Intensity Interval Training“ as very efficient mean for reducing body weight and body fat as well as increase of work ability.

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EFEKTI HIGH-INTENSITY INTERVAL TRENINGA NA REDUKCIJU TJELESNE TEŽINE, TJELESNIH MASNOĆA I NIVO VO₂MAX ŽENA SREDNJE ŽIVOTNE DOBI

Sažetak

Cilj ovog istraživanja je utvrditi efekte modela intervalnog treninga visokog intenziteta (HIIT) na redukciju tjelesne težine, potkožnog masnog tkiva i povećanje aerobnog kapaciteta. U istraživanju je učestvovalo 9 žena, srednje životne dobi. HIIT program je trajao 6 sedmica a ukupno je realizovano 18 treninga. Period visokog intenziteta je određen na 90-100%, dok je period aktivnog odmora određen intenzitetom 60% od maksimalne brzine rada svakog ispitanika. Korištenjem t-tetsa (paired samples) utvrđene su statistički značajne razlike u korist finalnog mjerenja (p<.01). Dobiveni rezultati ukazuju da HIIT model treninga u omjeru 1:2 efikasno djeluje na redukciju ukupne tjelesne težine, potkožnog masnog tkiva i poboljšanje nivoa maksimalnog utroška kisika (VO₂max). EPOC efekt izazvan modelom HIIT treninga praćen je povećanom energetsom potrošnjom nakon vježbanja.

Ključne riječi: Zdravlje, EPOC efekt, aerobni kapacitet, anaerobna aktivnost.

Received: June 01, 2016

Accepted: June 15, 2016

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DIFFERENCES IN THE LEVEL OF PHYSICAL ACTIVITY BETWEEN MALE AND FEMALE FIFTH GRADERS

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Original scientific paper

Abstract

Physical activity includes all movements or motions in everyday life, including work, recreation and sports activities. Physical activity is categorized according to the level of intensity from the low through moderate to high intensity. The main objective of this research is to determine the difference between the level of physical activity in relation to gender. The study was conducted on a sample of 285 respondents, fifth grade students in several Tuzla primary schools of both genders, aged 10 years \pm 6 months. The study used an anonymous questionnaire Physical Activity Questionnaire for Older Children - PAQ-C (Kowalski et al., 2004), designed for junior school children aged 8-14 years. The questionnaire is made up of particles valued on a 5 degree scale. Based on the Mann-Whitney U test, we determined the level of significance of differences in the level of physical activity between boys and girls. The obtained results show that there are statistically significant differences in 19 of 39 variables. The obtained differences are in favor of the male respondents in 10 variables, while in 9 variables there are statistically significant differences in favor of the female respondents. The general conclusion is that the fifth grade students report a significantly low incidence of engaging in physical activity.

Keywords: Students, primary education, survey, health.

Introduction

One of the primary functions of the human body is its physical activity. According to Caspersen et. al (1985), physical activity is defined as "any force that occurs using muscle activity whereby the energy consumption is above that at rest". This definition is widely accepted as a scientific definition of physical activity and is often cited (Jurakić, 2009 and Pedišić, 2011). The lack of physical activity is the subject of a series of scientific studies that have confirmed that regular physical activity and exercise are one of the necessary measures for prevention of the development of chronic cardiovascular and metabolic diseases. Inactivity is associated with a reduction in energy consumption, and it is causing an increase in obesity. Obese children are far more sedentary than children who are not obese (Duraković, Mišigoj-Duraković 2009). Unfortunately, many studies show an increasing trend of obesity in children.

The prevalence of insufficient levels of physical activity is a global health problem of our time (Jurakić and Heimer, 2012). Insufficient level of physical activity is stated as one of the risks for a decreased health status (WHO, 2006 and 2010).

The relationship between physical activity and the corresponding health status observed from various aspects is the subject of the study of the epidemiology of physical activity (Welk, 2002). The existence of a linear correlation between physical activity and health status has been established, according to which a further increase of the existing level of physical activity or physical fitness leads to further improvement of the health status (Warburton, Nicol and Bredin, 2006). A reverse linear relationship has been established between the volume of physical activity and the total mortality rate according to which the increase in the volume of physical activity reduces the overall mortality rate (Lee and Skerrett, 2001). Furthermore, acute and chronic

health effects occur in response to physical activity. The acute effects relate to positive health changes, and they occur in the period immediately following a physical activity. Chronic effects of physical activity occur after a certain period due to the change in the structure of the organ system functioning, and are independent of the acute effects (Howley, 2001). The main objective of this research is to determine the difference between the level of physical activity in relation to gender.

Method

The participant sample

The study was conducted on a sample of 285 fifth grade students in several Tuzla primary schools (Jala, Novi Grad, Brčanska Malta and Centar) of both genders, aged 10 years \pm 6 months.

The sample of variables

The study used a questionnaire called Physical Activity Questionnaire for Older Children - PAQ-C (Kowalski et al., 2004), designed for junior school children aged 8-14 years. The questionnaire is made up of 9 particles valued on a 5 degree scale. The questionnaire is very easy to use. Its questions are short and unambiguous. The questionnaire allows classification (level of physical activity) of the respondents, where 1 means "physically inactive", 2 means "not sufficiently physically active", 3 means "moderately physically active", 4 means "physically active" and 5 means "very physically active" according to the given criteria.

Data processing methods

To determine the difference between the level of physical activity among the students of different genders, we used the nonparametric Mann-Whitney U test for independent samples. This test is a nonparametric alternative to the t - test

for independent samples. Unlike the t - test that compares the mean (arithmetic average) values of two groups, the Mann-Whitney U test compares their median values.

Results

Tables 1 and 2 show the differences in the level of physical activity in relation to gender (Mann-Whitney U test), i.e., the level of significance of the differences. The level of statistical significance was set at inference by an error ($p = 0.05$). The obtained results show that there are statistically significant differences in the level of physical activity among the respondents of different genders in 19 of 39 applied variables.

The obtained differences are in favor of the first group (the male respondents) in 10 variables, while in 9 variables there are statistically significant differences in favor of the second group (the female respondents).

The first group (the male respondents) achieved better results in the following variables: MARTIAL ARTS, BASKETBALL, SOCCER, HANDBALL, STREET HOCKEY, SKATEBOARDING, TAZMO3, TAZVO4, TAPVI7 AND SUNDAY.

The second group (the female respondents) achieved better results in the following variables: TRACK AND FIELD, HIKING, GYMNASTICS, VOLLEYBALL, DANCING, ROPE SKIPPING, ROLLERBLADING, RYTHMICS/BALLET

Table 1. The differences in the variables for assessing the level of physical activity between boys and girls (Mann-Whitney U test)

Variable	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Mean Rank	Median	Group (N = 285)
AEROBICS	9808	19538	-0.96	0.34	140.56	1	1 (male) = 139
					145.32	1	2 (female) = 146
TRACK AND FIELD	8967.5	18697.5	-2.43	0.02	134.51	1	1 (male) = 139
					151.08	1	2 (female) = 146
BADMINTON	9879	20610	-0.76	0.45	144.93	1	1 (male) = 139
					141.16	1	2 (female) = 146
CYCLING	9633.5	20364.5	-0.82	0.41	146.69	1	1 (male) = 139
					139.48	1	2 (female) = 146
MARTIAL ARTS	8324	19055	-3.89	0.00	156.12	1	1 (male) = 139
					130.51	1	2 (female) = 146
HIKING	8660.5	18390.5	-2.27	0.02	132.31	2	1 (male) = 139
					153.18	4	2 (female) = 146
BASKETBALL	8272	19003	-3.17	0.00	156.49	1	1 (male) = 139
					130.16	1	2 (female) = 146
GYMNASTICS	8776.5	18506.5	-2.97	0.00	133.14	1	1 (male) = 139
					152.39	1	2 (female) = 146
SOCCER	5443	16174	-7.51	0.00	176.84	2	1 (male) = 139
					110.78	1	2 (female) = 146
VOLLEYBALL	7208	16938	-5.07	0.00	121.86	1	1 (male) = 139
					163.13	1	2 (female) = 146
DANCE	6478.5	16208.5	-6.7	0.00	116.61	1	1 (male) = 139
					168.13	1	2 (female) = 146
SWIMMING	9980.5	20711.5	-0.38	0.70	144.2	1	1 (male) = 139
					141.86	1	2 (female) = 146
ROPE SKIPPING	7697	17427	-4.67	0.00	125.37	1	1 (male) = 139
					159.78	1	2 (female) = 146
HANDBALL	8340	19071	-3.465	0.00	156	1	1 (male) = 139
					130.62	1	2 (female) = 146
ROLLERBLADING	6652.5	16382.5	-6.043	0.00	117.86	1	1 (male) = 139
					166.93	1	2 (female) = 146
TABLE TENNIS	9524	20255	-1.468	0.14	147.48	1	1 (male) = 139
					138.73	1	2 (female) = 146
TENNIS	10134.5	20865.5	-0.026	0.97	143.09	1	1 (male) = 139
					142.91	1	2 (female) = 146

HIKING	9602.5	19332.5	-0.821	0.41	139.08	2	1 (male) = 139
					146.73	2	2 (female) = 146
STREET HOCKEY	9782	20513	-2.308	0.02	145.63	1	1 (male) = 139
					140.5	1	2 (female) = 146
WATERPOLO	10068.5	20799.5	-0.496	0.62	143.56	1	1 (male) = 139
					142.46	1	2 (female) = 146
SKATEBOARD- ING	9413	20144	-1.926	0.05	148.28	1	1 (male) = 139
					137.97	1	2 (female) = 146
RHYTHMICS	8493	18223	-4.226	0.00	131.1	1	1 (male) = 139
					154.33	1	2 (female) = 146
OTHER	8790	18520	-2.572	0.01	133.24	1	1 (male) = 139
					152.29	1	2 (female) = 146

Table 2. The differences in the variables for assessing the level of physical activity between boys and girls (Mann-Whitney U test)

Variable	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Mean Rank	Median	Group (N = 285)
TATST 2	10103.500	19833.50	-.078	0.94	142.69	5	1 (male) = 139
					143.30	5	2 (female) = 146
TAZMO 3	8782.50	19513.50	-2.062	0.04	152.82	2	1 (male) = 139
					133.65	2	2 (female) = 146
TAZVO 4	7588.00	18319.00	-3.860	0.00	161.41	3	1 (male) = 139
					125.47	2	2 (female) = 146
TAONS 5	9681.50	20412.50	-.692	0.49	146.35	3	1 (male) = 139
					139.81	3	2 (female) = 146
TAUVS 6	9418.50	20149.50	-1.077	0.28	148.24	3	1 (male) = 139
					138.01	3	2 (female) = 146
TAPVI7	8845.50	19576.50	-1.938	0.05	152.36	3	1 (male) = 139
					134.09	3	2 (female) = 146
TATNO 8	9126.00	19857.00	-1.516	0.13	150.35	3	1 (male) = 139
					136.01	3	2 (female) = 146
BOLE10	9921.50	20652.50	-.578	0.56	144.62	2	1 (male) = 139
					141.46	2	2 (female) = 146
MONDAY	9046.50	19777.50	-1.62	0.11	150.92	3	1 (male) = 139
					135.46	2	2 (female) = 146
TUESDAY	10065.00	20796.00	-0.12	0.90	143.59	3	1 (male) = 139
					142.44	3	2 (female) = 146
WEDNS- DAY	9487.00	20218.00	-0.97	0.33	147.75	3	1 (male) = 139
					138.48	3	2 (female) = 146
THURSDAY	8954.00	19685.00	-1.75	0.08	151.58	3	1 (male) = 139
					134.83	3	2 (female) = 146
FRIDAY	9889.00	20620.00	-0.38	0.70	144.86	4	1 (male) = 139
					141.23	4	2 (female) = 146
SATURDAY	8970.50	19701.50	-1.82	0.07	151.46	5	1 (male) = 139
					134.94	4	2 (female) = 146
SUNDAY	8781.00	19512.00	-2.12	0.03	152.83	5	1 (male) = 139
					133.64	4	2 (female) = 146

Discussion

For the frequency of a specific sporting activity variable during spare time ("Have you engaged in any of the following activities in the past 7 days? If

yes, how many times a week?"), the studied group of male respondents had better results in 6 physical/sporting activities, which is perhaps to be expected because men compared to women generally prefer

martial arts and sports games, which is the case here with soccer, handball and basketball. Street hockey and skateboarding are also sports preferred by the male respondents.

The female respondents had better results compared to the male respondents in 9 applied variables regarding physical/sporting activities during free time. Rollerblading, dancing, rope jumping, and rhythmic activities are perhaps those activities which are expected to be more practiced by the female population. In terms of sports games, volleyball is perhaps the only activity more popular among girls, as shown by the results. Results which are obtained also show that girls practice gymnastics, track and field, and hiking more than boys.

Male respondents while in school, more precisely during breaks, are physically more active than the female respondents over a 1-week period, which is shown in the resulting differences in these two variables (TAZMO3 and TAZVO4).

As for physical activity during the weekend, the obtained results also show that male respondents are more active than female respondents (variable TAPVI7).

Sunday is the only day of the week that showed

statistically significant differences between male and female respondents. Given that this is a day of the week when certain sporting events are held, it is no wonder that there are statistically significant differences, and those are in favor of males.

Conclusion

The stated transversal research aimed to determine the difference between the level of physical activity in relation to gender. The study was conducted on a sample of 285 fifth grade students of both genders, aged 10 years \pm 6 months. The study used an anonymous questionnaire.

To determine the difference between the level of physical activity among students of different genders, we used the nonparametric Mann-Whitney U test for independent samples.

The obtained results show that there are statistically significant differences in 19 of 39 variables. The obtained differences are in favor of the male respondents in 10 variables, while in 9 variables there are statistically significant differences in favor of the female respondents. The general conclusion is that the fifth grade students report a significantly low incidence of engaging in physical activity.

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RAZLIKE U NIVOU TJELESNE AKTIVNOSTI IZMEĐU DJEVOJČICA I DJEČAKA PETOG RAZREDA OSNOVNE ŠKOLE

Sažetak

Tjelesna aktivnost obuhvata sve pokrete, tj. kretanje u svakodnevnom životu, uključujući posao, rekreaciju i sportske aktivnosti, a kategorisana je prema nivou intenziteta od niskog preko umjerenog do visokog intenziteta. Osnovni cilj ovog istraživanja jeste utvrđivanje razlika nivoa tjelesne aktivnosti u odnosu na spol. Istraživanje je provedeno na uzorku od 285 ispitanika, učenika V razreda određenih tuzlanskih osnovnih škola, oba spola, starosne dobi 10 godina \pm 6 mjeseci. U istraživanju je upotrijebljen anonimni anketni upitnik " Procjena nivoa tjelesne aktivnosti - PAQ-C (Kowalski i sar., 2004) ", konstruisan za djecu mlađeg školskog uzrasta od 8 do 14 godina. Upitnik je sastavljen od čestica, posebno vrednovanih na skali od 5 stepeni. Na osnovu Mann-Whitney U testa utvrđen je nivo značajnosti razlika u nivou tjelesne aktivnosti između dječaka i djevojčica. Dobiveni rezultati pokazuju da postoje statistički značajne razlike u 19 od 39 primijenjenih varijabli. Dobivene razlike idu u korist muških ispitanika u 10 varijabli, dok u 9 varijabli statistički značajne razlike idu u korist ženskih ispitanica. Generalna konstatacija je da učenici petog razreda osnovne škole iskazuju značajno nizak nivo učestalosti bavljenja tjelesnom aktivnosti.

Ključne riječi: : Efikasnost, pokazatelj, košarka.

Received: June 01, 2016, Accepted: June 15, 2016

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IMPACT OF THE ANTHROPOMETRIC CHARACTERISTICS ON SPECIFIC MOTOR ABILITIES OF YOUNG HANDBALL PLAYERS

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Original scientific paper

Abstract

The sample included 25 male respondents, aged 16-18 years, who have trained handball 8 to 10 years. The aim was to examine whether there is a statistically significant influence of some anthropometric measures on the specific motor skills of handball players. Anthropometric measures represented a predictor system of variables, and specific-motor abilities represented criterion. Based on the results of multiple correlation coefficients (*R*) and the parameters of the *F*-test and statistical significance of *P*, it was concluded that there is no correlation between the predictor system of variables, anthropometric measures and criteria, variables for assessing specific motor tests. Looking at the regression coefficients individual effects of some variables of the predictor system on one criterion variable were observed.

Keywords: Handball, impact, anthropometric measures, specific motor abilities.

Introduction

Handball is classified as a poly structural, complex sport with unpredictable activity dynamic of cyclic and acyclic type. Handball is a mosaic of anthropological abilities: strength, speed, endurance, coordination, flexibility, balance, precision and high level of motor skills of a handball player is a prerequisite for a successful resolution of technical and tactical tasks in the game. Achieving top results in handball depends on many factors, including the important role of morphological characteristics, basic and specific motor abilities. Handball is increasingly becoming a privilege for high and strong players as a result of contemporary games requests, and an accurate selection of handball players. There is a constant increase in body height for the participants in world and European championships in handball in particular for external strikers- quarterbacks, which with good explosive power of the upper and lower limbs is an advantage in the game, both in attack (counter jump shot) and in defense (blocking a shot, duel game).

There is a high degree of correlation between body height and body mass, length of the limbs, the size of a fist which is important for keeping and handling the ball. In handball game precision is of great importance - the ability of fine movement control at hitting stationary target - the goal, which with the ejection power of the ball makes a basis of the shot on the goal.

Previous studies have shown that there is an influence of anthropometric measures on the motor abilities of handball players, and they play a very important role for the successful practice of this sport. Through the research (Kuleš and Simenc, 1976; Goranović, Vukajlović, Lolić, Lolić, 2006; Đukić, Smith, M., Smith, J., 1997), which was conducted in order to determine which anthropometric measures are essential for the successful execution of technical and tactical tasks in handball the results show that anthropometric characteristics are an important factor in the players selection. The research of Mavrić and Mekić (2005), in which the relations between anthropometric characteristics and situational-motor skills have been tested, results indicate that there is a statistically significant correlation between anthropometric variables and situational

motor variables of selected young handball players. Kovač, M. and, Kovač, J. (1997) tested the relation between the system of morphological characteristics and specific motor abilities and the results show that a better development of morphological dimensions (longitudinal and transversal dimensionality of the skeleton, as well as the mass and volume of the body) allow a significant advantage in the expression of specific motor abilities of handball players and a particularly significant impact on the general specific motor skills has a size of a fist. The aim of this study was to determine the impact of basic anthropometric measures on the efficiency of the performance of specific motor skill tasks in handball.

The basic hypotheses of this research are:

- H1- There is a statistically significant effect of anthropometric measures on the specific motor skills of shooting a horizontal target;
- H2 - There is a statistically significant effect of anthropometric measures on the specific motor skills, throwing and catching a ball in handball;
- H3 - There is a statistically significant effect of anthropometric measures on the specific motor skills leading the ball 20m.

Methods

Sample of respondents

The sample included 25 male respondents, aged 16-18 years, who have trained handball 8 to 10 years in the handball club Spartak.

Sample of variables

To measure anthropometric measures and motor tests measuring instruments by IDB were used. For the measurement of anthropometric measures Anthropometer by Martin, medical scales and measuring tape were used. Anthropometric measures represent a predictor system of variables and they are formed through following measures:

- Body height (cm)
- Weight (kg)
- The width of the fist (cm)

- The length of the fist (cm)
- Maximum length of the forearm (cm)
- Maximum length of the lower leg (cm)

Specific motor tests, which were criterion variables:

- Shooting the horizontal target,
- Throwing and catching a ball 30 sec.
- Leading the ball 20 meters (sec.).

Throwing and catching a ball (test description): The subject is located 3 meters from the wall which is completely free. At the sign "now" subject alternately throws the ball against the wall with his right hand and then with his left hand during 30 seconds. Handling is done with both hands. The result represents the number of correctly and fully implemented throws of the ball. Each participant has 2 attempts. For processing the better result is taken.

Shooting the horizontal target (test description): The aim is horizontally placed on the floor size of 1x1 m. Inside it has 5 concentric circles of equal width (10cm). Respondent at a distance of six meters from the firing line to the edge closer to the target, shoots the target space with a tennis ball in an arbitrary way, but always from above the shoulder height, standing behind the firing line. Firing is executed nine times with three test firings. Results are recorded in points (hit on the line is estimated as a higher score) and the ratings are 5, 4, 3, 2 and 1 point.

Leading the ball 20 meters (test description): The player takes the ball past the cones which are arranged along a handball court of the length of 10 meters. Leading of the ball is performed first

with the dominant hand in one direction, and in the return with the change of hand which kept the ball. The task is repeated twice and the average value of the two attempts is taken, the result is expressed in seconds (0.1 sec.).

Description of the experimental research

The measurement was conducted in Subotica, in the sports hall, study is transversal, carried out during duration of the preparatory period for the competition season. Tests were carried out during the training, by the handball coaches and experts.

Methods of data processing

To determine the basic statistical indicators calculated were basic descriptive statistics for all variables, the arithmetic mean (As), standard deviation (SD), minimum value (Min), maximum value (Max), skjunis (Sk), kurtosis (Kz). Testing the normality of distribution was carried out with the Kolmogrom - Smirnov (K-S) test. By applying the regression analysis the impact of predictor variables on criterion was determined. For all statistical analysis the level of statistical significance is $p \leq 0.05$. Data processing is calculated by the statistical software package SPSS 20.0.

Results and Discussion

Based on the value of descriptive statistics (Table 1), it can be concluded that there were no significant deviations from normal values distribution shapes, as indicated by the value skjunis and kurtosis. As for the testing of normal distribution, we can see that there is no statistically significant differences in any of the analyzed variables.

Table 1. Basic descriptive statistics and the Kolmogorov-Smirnov test of normal distribution of variables

Variable	Min	Max	As	Sd	Sk	Kz	Ks	p
Height	169,0	199,0	184,48	7,97	-0,02	-0,34	0,43	0,99
Wight	75,0	102,0	85,80	8,28	0,54	-0,70	0,59	0,87
Fist width	8,1	11,5	9,46	1,09	0,86	-0,60	1,00	0,26
Fist length	17,0	24,5	20,24	2,01	0,50	-0,46	0,73	0,64
Max. scope of forearm	23,0	35,0	29,24	3,16	0,12	-0,49	0,46	0,98
Max. scope of lower leg	26,0	45,0	36,64	4,99	-0,14	-0,36	0,44	0,98
Shooting the ball	2	5	3,16	0,89	0,03	-1,06	1,12	0,15
Throwing and caching	29	42	34,12	3,94	0,48	-0,47	0,65	0,77
Leading the ball 20 m	3,10	4,20	3,60	0,32	0,32	-1,14	0,94	0,33

Legend: MIN - the minimum value of measurement results; MAX - the maximum value of measurement results; AS - arithmetic mean; SD - standard deviation; Sk - rate of asymmetry of distribution; Kz - elongation rate distribution; KS - Kolmogrov-Smirnov test for normality of distribution; p - statistical significance of K-S test.

Based on the results of regression analysis, we can conclude that there is no correlation between the predictor system of variables (anthropometric measures) and criteria (variables for assessing specific motor tests). Looking at the regression coefficients each impact of Fist width Fist length

of the fist on throwing and catching a ball were observed.

Table 2 Regression analysis of the impact of anthropometric measures and specific-motor skills of handball players.

Variable	Shooting the horizontal target		Throwing and catching		Leading the ball 20m	
	β	p	β	p	β	p
Height (cm),	0,51	0,49	0,42	0,51	0,08	0,91
Weight (kg),	0,04	0,91	0,54	0,16	-0,53	0,26
Fist width (cm),	-0,40	0,23	-0,56	0,05	0,21	0,53
Fist length (cm),	-0,13	0,74	0,66	0,05	0,13	0,75
Max. scope of forearm (cm)	0,04	0,84	0,01	0,95	0,09	0,71
Max. scope of lower leg (cm)	-0,33	0,20	-0,04	0,86	0,13	0,60
F	0,80		2,07		0,39	
R	0,46		0,63		0,34	
P	0,57		0,10		0,87	

Legend: β - regression coefficient; p - statistical significance of regression coefficient; F - F-test; R - multiple correlation coefficient; P - statistical significance of the F-test.

Conclusion

Based on the results, it can be said that anthropometric measures did not affect the specific motor skills in handball. Based on the results of regression analysis of individual anthropometric measures, two variables that were allocated are the Fist width and Fist length, which showed the influence of individual predictors of the criterion, or throwing and catching a ball, similar results came from Kovač, M. and Kovač, J. (1997). From the results, it can be concluded that players with long fist ($\beta = 0.66$), which is both narrower ($\beta = -0.56$), showed better results in the test throwing and catching.

The results are somewhat consistent with previous research, which suggests that there is the influence of anthropometric measures on the motor skills of

handball players, and they play a great significance for successful practice of this sport. Kuleš and Simenc (1976), indicate that anthropometric measures are a significant factor in the selection of players, Mavrić and Mekić (2005) indicate that there is a statistically significant correlation between anthropometric variables and situational-motor abilities of selected young handball players, which can be associated with the results obtained by this research.

The results provide useful information on the influence of anthropometric characteristics of players on motor skills. Based on these data, concrete measures in the treatment of athletes in the selection can be planned, choosing player positions and in the training process. Finally it should be noted that the research hypothesis before this research partially accepted or rejected H1 and H3 and H2 was accepted.

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UTICAJ ANTROPOMETRIJSKIH KARAKTERISTIKA NA SPECIFIČNE MOTORIČKE SPOSOBNOSTI MLADIH RUKOMETAŠA

Sažetak

Uzorak je obuhvatio 25 ispitanika muškog pola, starosti od 16-18 godina, koji treniraju rukomet od 8 do 10 godina. Cilj rada bio je da se ispita da li postoji statistički značajan uticaj nekih antropometrijskih mera na specifično-motoričke sposobnosti rukometaša. Antropometrijske mere predstavljale su prediktorski sistem varijabli, a specifično-motoričke sposobnosti kriterijske. Bazirajući se na rezultate koeficijentata multiple korelacije (R) i parametara F -testa i statističke značajnosti P , zaključilo se da ne postoji povezanost između prediktorskog sistema varijabli, antropometrijskih mera i kriterija, varijabli za procenu specifičnih motoričkih testova. Posmatrajući regresione koeficijente uočeni su pojedinačni uticaji nekih varijabli prediktorskog sistema na jednu kriterijsku varijablu.

Ključne riječi: : Rukomet, uticaj, antropometrijske mere, specifične motoričke sposobnosti.

Received: June 01, 2016, Accepted: June 15, 2016

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ANALYSIS OF THE CONTENTS OF TRAINING CAMPS OF EUROPEAN CLUBS

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Abstract

Training centres are the best areas where professional football teams do preparations for the matches, performing activities that are primarily focused on skills and physical preparation of the players. In some cases they are part of club's system which is very important and helpful for development of young players. Training centres are separated from stadiums, and isolated from the noise. This saves the field on the stadium and enables footballers to practice in peace. Training centres are built at academies for young players and they are very important segment of every club. Investments in centres reach up to 200 million pounds- like it is the case with Manchester City. Most clubs see investing in centres as perfect opportunity for making money on camp's name (Manchester United) or on attractive content.

Keywords: League of five, football, training infrastructure, training camp.

Introduction

The world of business is changing every day and spreading into processes of everyday life in search for profit. The great number of activities that were hobbies first, became "factories of money", and one of those examples is sport, especially football. The most important part of the football club is the team and the players, respectively. The players generate money and potential economic benefits for the clubs [1].

Like every other company, football clubs invest funds in buying resources. Clubs improve their teams by buying players and bringing the best coaches and improving their infrastructure. Infrastructures, including stadiums that fulfil all necessary conditions for receiving licence and training infrastructure are the important segment for team improvement [2].

Training infrastructure of the modern club is vital part of improvement of the team. More and more funds are directed to creating and improving conditions in training centres. Apart from improvement of training infrastructure there are also new modern technologies, which through sensors evaluate skills of footballers, their movements and dynamics. Improvement of training centres and their contents is especially visible at the richest clubs of Europe [3].

Daniele Tognaccini, long-time head of fitness team of AC Milan and the employee of "Milan laboratory" (the most sophisticated medical institution in football) explained that happens to a player's body during the long season: "performances are not optimal. The risk of injuries is high. The risk of injury during one game after a week of training is 10%. If the game is played after two or three days then the risk of injury is 20 to 30%. If 4 or 5 games are played constantly without adequate recovery, risk of injury is incredible. Therefore, in Milan, we invest in training centres and laboratories because it's the only way for players to get adequate relaxation and to prepare themselves for future obstacles" [4].

Training centres are potential sources of income, creating a brand and attraction for sponsors. „Abu Dhabi Travellers Welcome“, slogan which decorates

facade of the training centre of Manchester City is the ad that brings 10 million pounds a year [3]. Training centres are not related only to sport facilities but they have pools, restaurants, hotels, classrooms and academies for young people. Real Madrid, Paris SG, Bayern build their winter camps in Abu Dhabi and other gulf countries which, in return, give them great sponsorships.

Methods

Strategy of systematization of sources and literature:

Primary source of search apart from websites, were the following bases: Google scholar, Medline, Kobson. Apart from the mentioned base the sources of data collecting was conceptualized from books, financial reports, journal articles and other sources of publications. That included method of analysis of the content along with the theory analysis where the texts are studied and segmented according to authorship, authenticity and meaning and all important facts are overviewed. Also method of key words was used and the key words were: League of five, football/soccer, training infrastructure, training camp and other. The tendency was to find sources which in their contents had similar topics and problems. 33 references were found for this paper and most of them were written one to five years ago therefore we can say that all sources are fresh and updated.

The selection of sources and data collection

As for the technique of selection of quality sources, the selection was based on several criteria and the first was finding papers which had impact factor. Also we based our studies on finding studies that had enough references to assume that we are dealing with quality and well-know author.

The search identified 70 sources that were fulfilling the criteria of the study. However, 37 of them were eliminated and only sources containing the key words and data related to the topics were taken into consideration.

Results and discussion

Investments of certain football clubs were examined

and it was concluded that great financial funds are invested in creation and improvement of training centres.

England

In England, there is a great connection between improvement of training centre and development of young players. In order for young teams to compete in adequate leagues on national level club needs to have academy for young players. Conditions that need to be fulfilled are extent and they include open and closed facilities and special surfaces for training young categories. Academy of Light is training centre of football team Sunderland. It was built in period from 2001 to 2003 and it cost over 10 million pounds. It has 5 stars according to UEFA standards and it has 890 308 m². It contains: closed training field, medical, physiotherapy and hydrotherapy facilities, administration, education facilities, canteen, the main field with reflectors, 3 fields with football dimensions and a field with football dimensions but with artificial grass, field for goalkeeper's training (with equipment), surface for young teams. During the building of the centre they consulted ecologist David Bellami who helped in building systems for recycling water and 60 acres of wood was planted and it was turned into Animal Park, which is also touristic attraction [5].

Cobham Training Centre is a training centre of Chelsea football club located in the village Stoke d'Abernon. The first team of Chelsea trained in Stok D'Abernonu since 2005. But it wasn't open before 2007. Training facilities and training centres were considered as important parts of investment when Roman Abramović took over Chelsea. Finally, centre was open in 2008. [6]. It cost 20 million pounds and it takes surface of 566 559 m² and as a campus it hosts players of all ages, from the first team to academy, to replacement team and female team. It possesses the latest inventions from the area of training, rehabilitation, technology, medicine, technology of maintaining the field, and media technology [7]. It also contains 30 football fields (3 with under floor heating, medical centre, gyms, cold immersion pools, sauna, hydrotherapeutic pool [8].

Arsenal Training Centre, or London Colney (name based on geographical location) in Hertfordshire, is home of all representations of Arsenal since 1999. it is considered to be one of 5 the best training centres in the world and according to words of Arsen Wegner, the coach of Arsenal, one of the reasons why Arsenal is attractive to players [10,13]. It contains 10 fields in full dimensions, internal fields, medical and rehabilitation centre. Training centre cost 10 million pounds and it was paid of the transfer of the player Nicolas Anelka to Real Madrid. It takes the surface of 578 700 m². It contains basketball courts, sauna, gym, restaurants for staff and players, conference rooms, classrooms, TV studio, and 5 luxury houses for new players. [11]. Medical and rehabilitation centres were extended in a small hospital and the centre possesses antigravitational facilities and the latest screening equipment [12]. In the gym, the treadmill is 40m long and there are also rooms for yoga and pilates. There is an area for recreation and fans including Arsenal restaurant. With its content for recreation, the club covers up to 50% of costs of the training centre [12].

Manchester City, with its rich owners Abu Dhabi Group, owns the whole part of the city and Sportcity area in Manchester, respectively. That part is called Etihad Campus, and it includes Etihad stadium, City football academy (CFA), training centre and the main club building. The size of the complex is over 1,4 million m². Stadium is connected to the rest of the Etihad campus by 60 metre long bridge [14]. The construction of campus, without stadium, which was already there, only more modernized, cost 200 million pounds. Campus contains 16 football fields, 12 football fields for young players, stadium for academy has 7000 seats. Every week 450 players train at the academy and the share of young players in area of Manchester is 75%; 40 000 km of artificial fibre for surfaces is installed in 6 fields. Campus contains underground tank with the capacity of 8,1 million of litres for storing rainwater and technical water which recycles. Goalkeepers have special field, 1 dug into the ground where there is no influence of the wind, 3 gyms, 6 separated bases (from ice water and hot pools where the temperature is 36 degrees of Celsius). TV studio and TV auditorium with 56 seats [15,16]. During preparations of the national team of Argentina for friendly match with England, representation of Argentina stayed at City football academy and on that occasion Messi said: „ The first time I came here I was impressed by infrastructure and capacities of this camp. In Barcelona, we have top conditions but this centre is the most modern centre in the world.“ [17].

Trafford Training Centre (AON Training Complex) is training centre and the academy of English football club Manchester United FC. It is located in the village Carrington, wider area of Manchester. It was built in 2002. but it was extended during reconstruction in 2012-2013. when medical and science sport centre were built [18,19]. Total cost of construction was 60 million pounds. Centre contains main building, where the first team is accommodated, which was opened in 2000. and the academy building. Within the centre there are: treadmills, rehabilitation room, Jacuzzi, sauna, solarium, yoga rooms, offices, rooms, restaurant for 100 people (which can be visited by residents of the region at certain time), conference halls, clubs, game rooms, [20]. In 2013. medical centre worth 25 million pounds was opened and it contains hospital wing and science research wing. Manchester United is the first European club that has complete medical diagnostics in its training centre-equipment worth 13 million pounds. Total surface of the centre is 437 060 m²; 85 acres of it is centre and the rest of it is woods which ensures privacy. It contains 14 football fields of different sizes, 12 is grassy, one is for simulation of weather conditions, closed field of football dimensions. The important thing for this centre is that it possesses high security systems including 2,4 km long fence, 8 m tall, video surveillance and 24/7 private security. The only possibility when media can take pictures is before the games of UEFA Championships League [21]. In April 2013. Manchester United announced that the training centre, based on the contracted signed with AON PLC, will be called TRAINING COMPLEX, till 2021. With this name Manchester United will earn 180 million pounds (22,5 pounds per year). Also the most contemporary equipment is delivered due to sponsorship contract with corporation Toshiba worth 12 million pounds [22].

Italy

Training centres in most teams are outdated, built in 60's or 70's of the last century. Training centre of Inter from Milan is open 1963. and it has been modernized since then. Still two big centres are training centre AC Milan and Juventus. Milanello Sport Centre or in short Milanello is training centre of AC Milan. It was built in 1963. and it takes the surface of 160 000m², with smaller lake and alley. The importance of training centre is not shown only in trainings of Milan but in trainings of national team of Italy. It possesses 6 football fields, 1 field with artificial grass but with smaller dimensions, one with synthetic surface and the field enclosed by 5m tall fence and it is interesting that ball doesn't stop and it's used for training dynamic of changing direction. Running trails are 1,2 km long and they are located in the woods. There is the main building with the offices, locker rooms, TV studio, pools, a bar, kitchen, two dining rooms, press centre, conference centre, and the most contemporary medical centre [31]. In 2013 Juventus has announced that it starts with the project Juventus village and the first step was 99 year long concession on Continassa area in wider region of Torino. Village will be contained of Juventus training centre which include Media centre; new administration buildings of Juventus, J hotel, international schools and shopping arcade. Village will have its own source of energy. Complete project will be over by the year 2017. And it will take 140 000 m² of the surface [32]. Medical centre is already built and it is considered to be the most sophisticated diagnostic institution on the north of Italy and as such it is available to the residents of Italy [33]. Centre includes 9 football fields, of which two are with synthetic surfaces resistant to all conditions and one closed field, and in separate part of the centre there are physiotherapy rooms and offices, pools, gyms and a restaurant. The total cost of the whole project is over 250 million euros.

Spain

Ciutat Esportiva Joan Gamper is a training centre and the academy of Catalonia and a symbol- FC Barcelona. It was officially open on June,6 2006. And it was named after a founder of the club. It takes surface of 566 559 m² and the first team uses its facilities since January 2009. It is used for other sports as well like basketball, handball and futsal. Training camp cost 68 million Euros of which 25,6 million Euros were used for costs of urbanisation and land exploitation of the land and 42,5 million were used for costs of construction [21]. Because of this project, club has sold its private land and made 45,6 million Euros, while the rest of the money was collected from the members of the club. Training camp contains: 5 football fields with natural grass, 4 fields with artificial grass, 3 pavilions for basketball and handball, 3 gymnasiums for young players, 4 first aid facilities, management room, restaurants, and apartments for the players. La Masia was specially built, but not as a camp but as a dormitory for young players [23].

Ciudad Real Madrid (Valdebebas) is a training centre and a small town used by Real Madrid, respectively. It is named the same as the previous one which was sold for over 400 million euro's. It's located on the surface of over one million square metres but only

30% of it is built. The first phase of the construction was finished in 2013. and it included medical facilities (small clinics) and training facilities. The town contains 12 fields and small stadium for 6000 viewers. There is a TV station "Real Madrid TV" in the campus. In September 2013. buildings with private apartments of every player were finished [24]. The total cost of the construction was over 80 million euros. However Real Madrid builds a training camp and smaller town of 120 acres in Katar, as a part of global marketing campaign. The cost of this project is estimated over billion Euros and almost all cost will be covered by the investors of gulf states [26]. The apartments are unlocked by finger print of an "owner" of personalized apartment. A big restaurant, room for relaxation equipped with numerous game consoles, devices and baskets are only a small part of this camp. Club owns a movie theatre with 100 seats, locker rooms etc [25].

Germany

In Germany, most of the clubs have built its main facilities in their training centres. As an example of that we'll take Bayern Munchen and Dortmund.

Sabener Strasse is a training centre of FC Bayern in which all teams train, from Bundesliga seniors to players younger than 8. It has 5 grassy fields, of which two have underfloor heating. Training centre is located on a surface of 80 000 m², two fields with artificial grass of the third generation, volleyball courts and halls for different sports [27]. A characteristic of this centre is that all trainings, including Bundesliga, are open to public whether you are a member of the club or not. After closing American high school, FC Bayern bought all their sport facilities and made the training centre on that spot. In season 2007-2008. the training centre was fully renovated. The centre for performances, a gym, fitness areas, massage department, new locker rooms, the offices for coaches and conference hall, were built. Also a great number of catering facilities like cafes and family restaurants; libraries and e-classrooms were built [28]. With Pepa Guardiola's arrival in Bayern, they built new medical wing with the latest diagnostic equipment. Borussia Dortmund placed its training fields and the academy in Hohenbuschei in Brackel. There are 5 training fields, 2 with underfloor heating, one with artificial grass 2 less grassy fields and multifunctional arena are within the complex. Apart from that centre owns: a gym, fitness centre, rehabilitation robotized areas, physiotherapy and massage rooms, hydrotherapy and medical pools and sauna. The main academy includes great number of classrooms, conference hall, trainer's office, restaurant and TV studio. Training centre is located on 18 000m² [29]. Tom McGowan, in his article, describes speciality of camp Borussia Dortmund: robot "Footbonaut". Robot is simply controlled over a tablet. When the player enters in the space of a robot, it, with help of eight devices, centres to each player who needs to hit the ball in the highlighted corner. This is used for improvement of techniques of players of Borussia [30].

France

Of all teams only Monaco and Saint- Germain have modern and affirmed football centres. Camp des

Loges is a training centre of PSG since 1974. and extent reconstruction in 2008. when it was extended. It's used for training of the first team and replacement team and female team as well. The cost of the whole reconstruction of the centre was 5 million Euros. The complete centre with all its facilities is located on the surface 116 549m2 and it contains : 28 rooms,

hydrotherapy rooms, massage centre, rehabilitation centre, gyms, relaxation rooms, management office, president office, press zone, recreation zone, museum, are for socializing with fans. It has 9 fields and 3of them have reflectors [9].

Dislay and comparison of all training centres in table 1.

Name	Club/ Country	Cost	A year of built	Surface	Content
Academy of Light	Sunderland/ England	10 million£	2013.	890 308 m2	Closed training surface, medical physiotherapy and hydrotherapy facilities, administration, educational facilities, canteen, main field with lights, 3 fields with football dimensions, 1 field with football dimensions and artificial grass, fields for training goalkeepers, fields for young players.
Cobham Training Centre	Chelsea FC	20 million £	2008.	566 559 m2	30 football fields of different sizes (3 with under floor heating + 2 for goalkeepers, 5 closed fields), medical centre, gyms, cold immersive pools, TV studio, rehabilitation centre, relaxation room, hotel.
Arsenal Training Centre	Arsenal FC	10 million £	1999. + 2017.	578700 m2	10 fields in full dimensions, closed fields, medical and rehabilitation centre, basketball courts, sauna, gym, restaurants for staff and players, conference halls, classrooms, TV studio, 5 luxury houses
City football academy	Manchester City FC	200 million £	2016.	1 416399 m2	16 football fields, 12 football fields for young players, stadium with 7000 seats. Special fields for goalkeepers, 1 field dug into the ground where there is no wind influence, 3 gyms, 6 separated pools, TV studio and TV auditorium with 56 seats.
Trafford Training Centre (AON Training Complex)	Manchester United	60 million £	2013.	437 060 m2	14 football fields of different sizes, 12 of them are grass fields, one field for simulation of weather condition, closed field with football dimension, running paths, rehabilitation hall, basketball court, jacuzzi, sauna, yoga rooms, offices, rooms, restaurant for 100 people (which is available for residents of the region at certain period), conference halls, a pub, game rooms.
Ciudad Real Madrid (Valdebebas)	Real Madrid	400 million€	2013. - not finished	> 1 milion m2	12 fields and a small stadium for 6000 viewers, TV station "Real Madrid TV", private apartments for players, big restaurant, relaxation room with numerous game consoles, devices and baskets, movie theatre with 100 seats, classrooms and management building.
Ciutat Esportiva Joan Gamper	FC Barcelona	68 million €	2006.	566 559 m2	5 football fields with natural grass, 4 fields with artificial grass, 3 pavilions for basketball and handball, 3 gymnasiums for young players, 4 first aid facilities, management building, restaurants and apartments for players, La Masia as dormitory.
Camp des Loges	Paris Saint-Germain	5 miliona € 25 miliona €	1974. 2013. renovated	28 800 m2	28 rooms, hydrotherapy rooms, massage centre, rehabilitation centre, gyms, relaxation rooms, management offices, president office, press zone, recreation centre, museum, area for socializing with fans, 9 fields- 3 of them with reflectors

<i>Sabener Strasse</i>	<i>Bayern Munchen</i>	/	1974. -is renovating	80 000 m ²	5 grass fields, 2 of them have underfloor heating, 2 fields with artificial grass of third generation, volleyball courts, halls for different sports, center for performances, gyms, fitness area, massage department, new locker rooms, offices for coaches, conference halls, cafes and family restaurants, library and e-classroom, new medical wing with the latest diagnostic equipment.
<i>Hohenbuschei</i>	<i>Borussia Dortmund</i>	/	/	116 549 m ²	5 training fields, 2 with underfloor heating, a field with artificial grass, two smaller grassy fields and multifunctional arena, fitness centre, rehabilitation robotized areas, physiotherapy and massage rooms, hydrotherapy and medical pools, sauna, conference hall, coach office, TV studio, robots.
<i>Milanello Sportski Centar</i>	<i>AC Milan</i>	/	1963. 2012. renovated	160 000 m ²	6 football fields, a field with synthetic surface and the field enclosed with 5 m tall fence, running paths 1,2 km long, main building with offices, locker rooms, TV studio, pools, a bar, kitchen, two big dining rooms, press centre, conference hall, medical centre and dormitory for young players.
<i>Juventus selo</i>	<i>Juventus</i>	250 million €	2017.	140 000m ²	9 football field, 2 field with synthetic surface resistant to weather conditions, closed field, physiotherapy rooms and offices, shopping arcade, TV studio, gym, pool, dormitory, international school, academy, hotel and management building.

Conclusion

Training centres have the important role in modern football not only in development of players or sense of security but in marketing and financial benefit. Training centres become separate campuses in which the latest technology from the field of training, fitness, medicine, nutrition, and robotics

is implemented. Therefore, we can conclude that strategic planning of reconstruction of sport facilities on all levels, in order to become competitive, and to increase quality work in sports, is necessary. The achieved result is hardly tenable if it is based on improvisation and in conditions that are unreal and incompatible with the conditions in which processes and performances of big results are performed.

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ANALIZA SADRŽAJA TRENING KAPOVA NAJBOLJIH EVROPSKIH KLUBOVA

Sažetak

Trenažni centri su područja gdje profesionalni fudbalski timovi vrše pripreme za mečve, sa aktivnostima koje su primarno koncentrirane na vještine i fizičku pripremu igrača. U nekim slučajevima su i dio klubskog sistema za razvoj mladih igrača, što je od velike važnosti i pomoći u razvoju mladih igrača. Trening centri su uglavnom odvojeni od stadiona, te izdvojeni iz bučnih prostora. Tim se šteti podloga na stadionu, ali i omogućava potrebni mir za pripremu fudbalera. Trening centri se uglavnom grade sa akademijama za mlade igrače te su veoma važan segment u funkcionisanju svakog kluba. Ulaganja u centre dosežu i do 200 miliona funti - što je slučaj sa Manchester Citijem. Većina klubova ulaganje u trening centre vidi i kao savršenu priliku za zaradu na osnovu prodaje imena kampa (Manchester United) ili sadržajem koji će privući i zajednicu.

Ključne riječi: Liga petice, fudbal/nogomet, trenažna infrastruktura, trening kamp.

Received: June 01, 2016

Accepted: June 15, 2016

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THE STANDARD INDICATORS OF THE SITUATIONAL EFFICIENCY OF WHEELCHAIR BASKETBALL PLAYERS

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Original scientific paper

Abstract

The result of this research is that we got the facts of the case in terms of the teams in all segments of the game, team effectiveness, and efficiency difference depending on the outcome of the games. The sample consisted of the teams, their players and their efficiency. The variables were used to assess the efficiency in basketball (standard indicators of situational effectiveness in basketball). All these parameters, all the variables that were used in this study, and the ones that were intended to give us confirmation of the effectiveness of a team had the expected result. By analyzing the games and their descriptive parameters when it comes to the teams with a positive outcome in the end, and those with a negative outcome, we see that the indicators have a very important role in meeting the goal in almost all variables of the situational efficiency.

Keywords: Efficiency, indicator, basketball.

Introduction

Sports should not be a privilege of healthy people only, and we need to go about improving and adapting it for people with special needs as well. This paper will attempt to explain the essence of wheelchair basketball, from its creation to the modern way of playing, including wheelchair basketball in Bosnia and Herzegovina. The main goal will be the analysis of the player's position in the area of standard indicators and situational efficiency of wheelchair basketball in the clubs of the Bosnian and Herzegovinian league. Sports include both a bodily and physical activity used to perform the transformation of the body to a higher level, so this definition applies to persons with disabilities too. It is well known that athletes are less susceptible to some diseases than non athletes, and thus people with disabilities who practice wheelchair basketball are more resistant to certain diseases, or to put it differently, to the external factors. For example, weather conditions that affect the pain, or certain types of the flu.

The division of the sports of the persons with disabilities is as follows:

1. Competitive sports
2. Recreational activity

It is estimated that more than 100,000 people play wheelchair basketball, starting with recreational practicing of this sport to taking part in the clubs. Boys, girls, men and women play this type of sport. Wheelchair basketball has great competition and interest at international level. Wheelchair basketball is included in the group of Paralympic Games which are held every four years for athletes with physical disabilities.

Ciliga D. (1998) estimated that, with regard to the data of the World Health Organization of 1987, each country has about 10% of the disabled population. In countries with a high standard of living the author mentions a figure of 0.1% to 0.2% of disabled persons engaged in sports and recreation. In underdeveloped countries, this number is much lower.

Jagić M, Delibašić Z. (2004) quote research papers on recreational involvement of disabled persons in Croatia. The survey was conducted only in Zagreb,

and according to the results out of the 10% of the disabled population only 0.008% are physically active. It can be concluded that in other cities the situation is even worse because Zagreb certainly has the best material conditions for the recreation of disabled persons. (Quoted in Ciliga, Trkulja Petković, Delibašić, 2004, pg. 282-283).

Methods

The subject of this research are the participants/ persons with disabilities who actively practice wheelchair basketball, and the analysis of the player positions in the area of standard indicators of efficiency of wheelchair basketball players in the clubs in the Bosnian and Herzegovinian league.

The main problem in this research is to include as many statistical indicators of situational efficiency as possible that can be successfully registered during basketball games via the official statistics, which are kept for the match as a database of individual and team performance based on which the success of each individual players and team can be assessed.

The main goal is the analysis of the player's position in the area of standard indicators and situational efficiency of wheelchair basketball in the clubs of the Bosnian and Herzegovinian league. This research was conducted on a sample of eight games. The sample of participants consisted of the teams, their players and their efficiency. The variables were used to assess the efficiency in basketball (standard indicators of situational effectiveness in basketball). Data processing methods that were used; descriptive statistics - basic central and dispersion parameters.

Results and Discussion

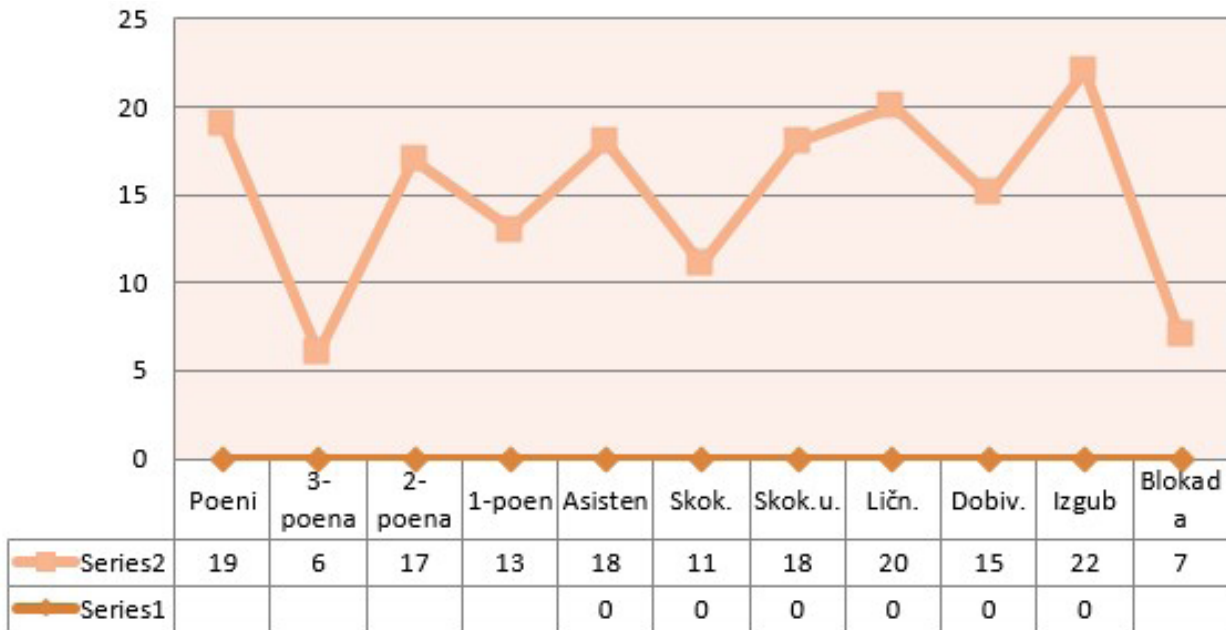
The Analysis of the Winning Teams

Table 1 shows the status of statistical parameters of individual teams in all elements, where statistical parameters of individual teams can be clearly seen. Table 4 shows how many players did not take part in the games and how many players did not take part in this analysis. First of all, the greatest effects of the players are in points, assists, and rebounds, and the negative parameters consist of turnovers and personal fouls. These results are as follows: personal fouls 20, turnovers 22, points 19, two points 20, three points 6, rebounds 18, assists 18, one point 13, offensive rebounds 11, blocks 7, steals 15.

Table 1.

		Points	3 pts	2 pts	1 pt	Assists	Offn. rebounds	Reb. s	Per. fouls	Steals	Turnovers	Blocks
N	Valid	19	6	17	13	18	11	18	20	15	22	7
	Missing	13	26	15	19	14	21	14	12	17	10	25
Median		14	3.5	12	3	2	2	2.5	2	1	3	2
Mode		2 ^a	3	12	2 ^a	2	1	1	1 ^a	1	2	1 ^a
Std. Deviation		10.68	2.422	6.894	2.581	1.955	3.233	3.029	.999	2.582	1.790	1.604
Skewness		.752	1.466	.801	-.418	1.083	1.072	1.841	.596	1.603	.796	.305
Std. Error of Skewness		.524	.845	.550	.616	.536	.661	.536	.512	.580	.491	.794
Kurtosis		.060	1.460	.882	-.323	.044	-.245	3.275	-.585	1.540	-.422	-.183
Std. Error of Kurtosis		1.014	1.741	1.063	1.199	1.038	1.279	1.038	.992	1.121	.953	1.587
Minimum		2	3	2	1	1	1	1	1	1	1	1
Maximum		39	9	28	8	7	10	12	4	9	7	5

Graph 1 shows a graphical overview of the winning teams and their situational parameters, where we can see a curve that vividly describes the level of certain segments of the game.

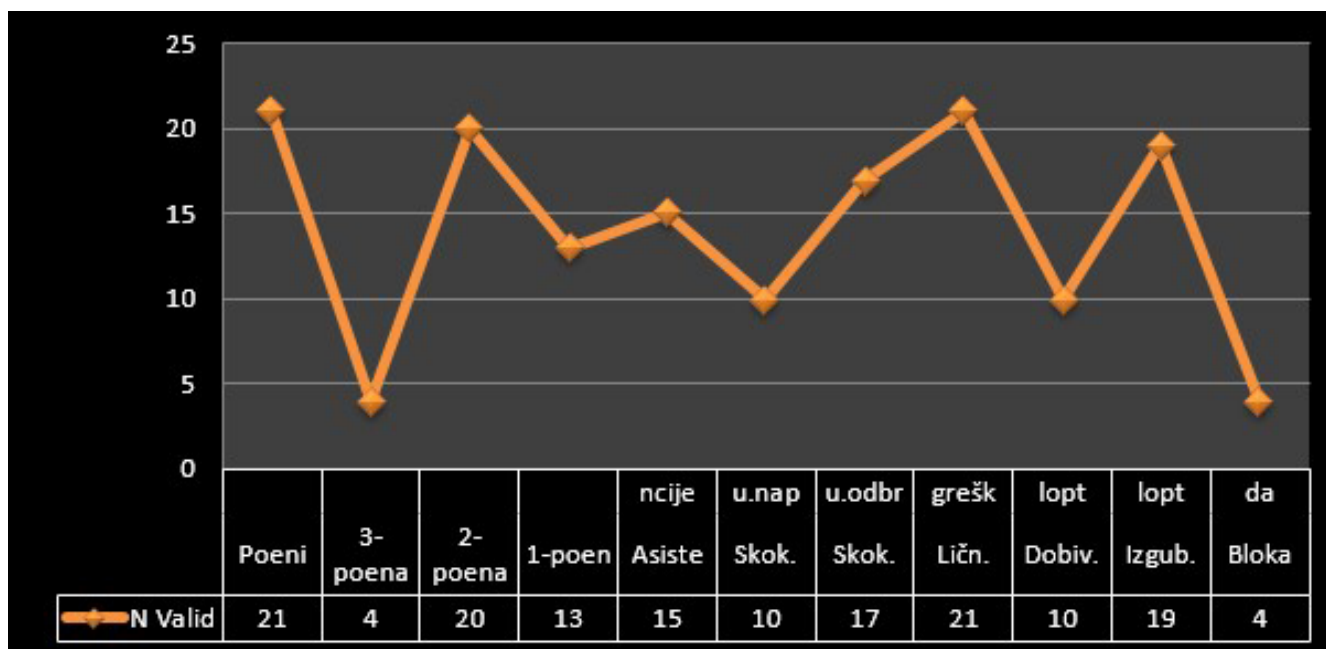


The Analysis of the Losing Teams Table 2 provides an overview of the losing teams, where we can see that personal fouls and turnovers lead in relation to other parameters. Median shows

the mean and the results as follows: personal fouls 21, turnovers 19, points 21, two points 20, three points 4, rebounds 17, assists 15, one point 13, offensive rebounds 10, blocks 4, and steals 10.

	Poi nts	3 pnt s	2 pnt s	1 p nt	Assi sts	Offn. rebou nds	R eb .	Pe r. fou ls	Stea ls	Turno vers	Bloc ks yes
N	Valid 21	4	20	1	15	10	17	21	10	19	4
	Missi ng 11	28	12	1	17	22	15	11	22	13	28
Median	8	3	6	2	2	2.5	1	3	1.5	3	1.5
Mode	2	3	4 ^a	2	2 ^a	1	1	3	1	2	1
Std. Deviation	8.02	1.5	5.4	2	1.50	2.759	2.	1.2	1.10	2.438	.957
	9	00	68	.	2		88	07	1		
				8			3				
				4							
				7							
Skewness	.947	2.0	1.0	1	1.82	.814	1.	.19	.863	.377	.855
		00	99	.	0		77	2			
				2			0				
				6							
				4							
Std. Error of Skewness	.501	1.0	.51	.	.580	.687	.5	.50	.687	.524	1.01
		14	2	6			50	1			4
				1							
				6							
Kurtosis	.229	4.0	.92	.	4.83	-1.183	2.	-	-	-1.296	-
		00	8	3	9		96	.87	.522		1.28
				9			9	9			9
				2							
Std. Error of Kurtosis	.972	2.6	.99	1	1.12	1.334	1.	.97	1.33	1.014	2.61
		19	2	.	1		06	2	4		9
				1			3				
				9							
				1							
Minimum	2	3	2	1	1	1	1	1	1	1	1
Maximum	29	6	22	9	7	8	11	5	4	8	3

Graph 2 also shows a curve where we see the situation parameters of the losing teams.



Conclusion

The result of this research was that we got the facts of the case in terms of the teams in all segments of the game, and team effectiveness depending on the outcome of the games. The median of the teams with positive results shows the mean and the results as follows: personal fouls 21, turnovers 19, points 21, two points 20, three points 4, rebounds 17, assists 15, one point 13, offensive rebounds 10, blocks 4, and steals 10. The median of the losing teams shows the mean and the results as follows: personal

fouls 21, turnovers 19, points 21, two points 20, three points 4, rebounds 17, assists 15, one point 13, offensive rebounds 10, blocks 4, and steals 10. The results tells us that all these parameters, all the variables that were used in this study, and the ones that were intended to give us confirmation of the effectiveness of a team had the expected result. Some results are in favor of the losing team, but still insufficient for an effective result, which shows that the overall situation on the court is not influenced by certain segments of the game but by the collective system of the game.

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STANDARDNI POKAZATELJI SITUACIONE EFIKASNOSTI ZA KOŠARKAŠE U KOLICIMA

Sažetak

Rezultat ovog istraživanja je u tome, da smo dobili činjenično stanje ekipa u svim segmenitma igre, njihovu efikasnost, razliku efikasnosti u zavisnosti od ishoda utakmica. Uzorak ispitanika je bio (ekipe odnosno igrači i njihova efikasnost). Varijable su bile za procjenu efikasnosti u košarci (standardni pokazatelji situacijske efikasnosti u košarkaškoj igri). Svi ovi parametri odnosno sve varijable koje su korištene u ovom istraživanju, koje su imale za cilj da nam potvrde efikasnost ekipa, imale su očekujući rezultat. Analizom utakmica i njenih deskriptivnih parametara, kada su u pitanju ekipe sa pozitivnim ishodom na kraju i sa negativnim ishodom, vidimo da pokazatelji imaju jako bitnu ulogu u ostavarivanju cilja, gotovo u svim varijablama situacione efikasnosti.

Ključne riječi: : Efikasnost, pokazatelj, košarka.

Received: June 01, 2016, Accepted: June 15, 2016

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INFLUENCE OF EXERCISES AND GAMES WITH BALL ON VESTIBULAR STABILITY OF STUDENTS WITH MUSCULAR-SKELETAL APPARATUS DISORDERS

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Original scientific paper

Abstract

Purpose: to work out approaches to increase of vestibular stability of students with muscular skeletal apparatus disorders by means of outdoor games and exercises with ball.

Material: in the research students with disorders of muscular-skeletal apparatus (n=63, age 16 – 19 years, boys and girls) participated. The research was being fulfilled during 1.5 years (three academic semesters). The students had disablement with mild or average disorders. All students were under medical observation and had no counter indications to physical education. Testing of vestibular stability was conducted by indicators of vegetative, somatic and sensor reactions to standard vestibular analyzer's irritations in Barany's armchair (5 rotations per 10 seconds).

Results: we determined directions of students' vestibular stability improvement and ways to acquiring confidence in own actions and higher adaptation to every day conditions. Characteristic features of cardiovascular system's reaction to vestibular apparatus irritation have been found. We have registered reduction of systolic blood pressure with multidirectional changes of diastolic B.P. and heart beats rate. When assessing space orientation with closed eyes under vestibular load we registered deviation to the side opposite to affected limb. During rotation in Barany's armchair we registered rather long dizziness; with it girls' indicators were significantly worse.

Conclusions: application of specially oriented exercises and games with ball weakened stress, caused by irritation of vestibular analyzer. We have worked out a system of specially selected exercises and games with ball for improvement of organism's resistance to vestibular load. Such exercises facilitate strengthening of belief in own forces, result in relaxedness in movements, improve adaptation to external conditions.

Keywords: *Students, muscular-skeletal apparatus, vestibular, ball, outdoor games.*

Introduction

Disorders of muscular-skeletal apparatus are rather widespread in society's life. That is why demand in young people's adaptation to future professional functioning requires targeted development of specific motor abilities; perfection of motor actions skills. In this aspect there is an opportunity of formation of motor actions' technique, development of moral-will sphere of disabled people (Phelan & Kinsella, 2014; Baril, 2015). Besides, with such approach favorable pre-conditions for life quality improvement of disabled people are created (Bolach & Prystupa, 2014; Makarova, 2014; Kozina, 2015).

During studying at school and in colleges such contingent of youth undergo changes of motor stereotypes. It results in de-stabilization of their life activity and social orientation (Druz, Klimenko, & Pomeshchikova, 2010). That is why creation of proper conditions in educational medium acquires special importance. Such approach brings good opportunities for realization of equal rights and opportunities, formation of personal significance feeling of disabled youth (Makarova, 2012). Problem of physical activity's formation, considering youth's psychic and physical condition is of special importance for future professional functioning (Leyfa, 2013; Podrigalo, Iermakov, Galashko et al.,

2015; Podrigalo, Iermakov, Nosko, et al., 2015). That is why adaptation of disabled people to life in society is closely connected with effectiveness of educational process in educational establishments (Eide et al., 2011; Soffer & Chew, 2015; Ilnytska, 2015).

Solution of different problems, connected with adaptation of people with muscular skeletal apparatus disorders is shown in: programs of rehabilitation and recreational trainings (Zhen, 2015), in sportsmen's trainings (Derkach & Yedinak, 2014), physical rehabilitation (Ilmatov, 2015; Lobko, 2015). The authors showed potentials of social rehabilitation and increase of comfort level of people with muscular skeletal apparatus disorders with the help of physical exercises of different orientation. Active participation in sports and health related measures, practicing of different kinds of sports restore psychic balance of disabled people and permit them to participate in active life (Bartik & Bolach, 2015; Sobko, 2015).

One of acute problems of social adaptation to future professional functioning is possibility of receiving of secondary and professional education for children and youth with disablement. It also permits to acquire skills in self-servicing; to prepare for labor activity, for family life. In this context physical exercises'

practicing at special educational establishments shall be oriented on development of important for students with muscular skeletal apparatus disorders physical skills (Pomeshchikova et al., 2016). In the first turn it is development of coordination: space orientation and vestibular stability. In such cases space accuracy of movements is of great importance (Liu, 2014; Singh & Agashe, 2015) as well as motivation for physical exercises' practicing (Kozina, Iermakov et al., 2016).

It is known that functioning of vestibular apparatus plays significant role in space orientation of both: healthy people and those, having health problems (Syshko, 2012; Voropay & Buryanovatiy, 2014). In other work (Strelec, 1996) it is noted that in human natural functioning main role is played by motor activity. Its effectiveness is determined by accuracy of space orientation. Orientation in space depends on effectiveness of vestibular analyzer functioning and complex system of vestibular reflexes. Therefore, development of vestibular somatic reactions is critically important for a person and can serve as specific indicator of differences in dynamic of physical exercises' influence on development of healthy and not healthy people's motor functioning.

Study of connections between vestibular and cardiovascular systems is one of important methods of assessment of organism's general condition (Syshko, 2009; Savina, 2010). Under influence of vestibular irritations indicators, characterizing organism's vegetative functions change. Types of vestibular-vegetative reactions are determined by morphological-functional characteristics, which formed owing to correlations between vestibular, motor and vegetative systems (Syshko, 2009). For stabilization and strengthening of vestibular stability in children with imbalance of muscular system many authors (Sharov & Andreeva, 1997; Sharov, 2001) offer to use autonomous dynamic stand. However, there is an opinion (Liakh & Sokolkina, 1997) that in inter-individual variable ability to keep vestibular stability important role is played by additive, genetic factors. As per the data of other authors indicators of cardio-vascular, respiratory and nervous systems after vestibular irritations depend on type of responding to such loads (Syshko, 2009). It witnesses about rather high conservatism of this ability, which reflect level of human motor potentials, depending on vestibular analyzer's fitness.

In natural and everyday life one of main roles is played by motor functioning, effectiveness of which is determined by accuracy of space orientation (Ilyin, 2003). Therefore, development and perfection of vestibular-somatic functions is principally significant for provisioning of human motor functioning.

Many works are devoted to study and assessment of vestibular somatic reactions (Syshko, 2009; Moiseenko, 2012). The authors used different means of physical education: exercises on specially worked out simulators (Bruder, Blessing, & Wandke, 2014; Hagberg et al., 2015), health swimming (Lee, Sanders, & Payton, 2014; Rovira-Beleta et al., 2015), massage (Hench et al., 2010), power-lifting (Zhen, 2015), hippotherapy (Shurtleff, & Engsborg, 2010) and etc. Selection of adequate tests for physical fitness is rather important in such cases Ivashchenko, Yermakova, Cieslicka, & Muszkieta,

2015; Ivashchenko, Yermakova, Cieslicka, & Zukowska, 2015; Khudolii, Iermakov, & Ananchenko, 2015; Khudolii, Iermakov, & Prusik, 2015). Usage of individual approach to students' training to different motor actions can be considered correct (Zhanneta et al., 2015; Kozina, Repko, Ionova et al., 2016). However, exercises and games with ball have not been widely spread yet in trainings of students with muscular skeletal apparatus problems.

In our researches it was found that students' variable motor activity in game with ball is accompanied by positive emotions (Pomeshchikova, 2010; Pomeshchikova, Yevtushenko, & Yevtushenko, 2012). Besides, we determined dependence between indicators of different space orientation manifestations (Pomeshchikova et al., 2012). Application of different exercises with ball permits to develop all motor qualities. In such trainings consideration of kind of disease is compulsory as well as degree of muscular skeletal apparatus disorder and individual ability to endure physical load (Druz et al., 2010). We found that application of system of exercises and games with ball increased indicators of movements' frequency in tapping test. We determined indicators of time of simple reaction to sound, to visual signal; complex reaction of choice. It is noted that changes of vestibular-sensor reactions' indicators, considering the character of disorders, have positive tendency with all kinds of disorders. We found that application of specially selected exercises reduced period of dizziness of boys and girls (Pomeshchikova & Lozuchenko, 2011; Pomeshchikova et al., 2016). In the course of our research we determined that outdoor games are a key element for students' motivation for regular physical functioning (Adamčá, Bartík, & Nemeč, 2014). In other our researches we found that control of physical load is very important in structure of physical exercises' practicing (Ivashchenko, Khudolii et al., 2015; Zaporozhanov, Borachinski, & Nosko, 2015) as well as recreational measures (Pupiš, Sližik, & Bartík, 2013; Iermakov, Arziutov, & Jagiełło, 2016).

Vestibular apparatus is an important sensor system, which permits for a person to keep balance. It points at position in space, realizes body coordination in motor functioning. Stability of vestibular apparatus is important in everyday life, even in fulfillment of the simplest forms of behavior. For students with muscular-skeletal apparatus disorders development of its sensor tools is an important function of their social adaptation. Training of sensor-motor functioning of students with muscular skeletal apparatus disorders is reflects most effectively in indicators of vestibular stability. It points at demand in assessment of vestibular stability level under influence of the worked out system of special exercises and games with ball.

As a hypothesis we can assume that application of specially selected exercises and games with ball at trainings can increase vestibular stability of students with muscular skeletal apparatus disorders. The purpose of the research is to work out approaches to increase vestibular stability of students with muscular-skeletal apparatus disorders under influence of outdoor games and exercises with ball.

Methods

Sample

In the research students with disorders of muscular-skeletal apparatus (n=63, age 16 – 19 years, boys and girls) participated, who studied in Account and economic residential college (Kharkov, Ukraine). Main group consisted of 40 students (19 boys and 21 girls); control group – 23 students (10 boys and 13 girls) with the same disorders of muscular skeletal apparatus. The research was being fulfilled during 1.5 years (three academic semesters). In the college, boys and girls with disablement of 1st and 2nd group and disabled children skilled in self-servicing study.

The research was fulfilled in compliance with WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. 2013.

Procedure

Analysis of medical records showed that students had disablement with mild or average degree of disease. All students were under medical observation and had no counter indications for physical education.

Functional state of vestibular apparatus was assessed by value and duration of vegetative, somatic and sensor reactions, appearing in response to vestibular irritation – rotational test by Voyachek V.I. (Gandelsman, 1973). The test was fulfilled in Barany's armchair with open eyes and forward head bent by 90°. In such position of the tested armchair rotated 5 times per 10 seconds. After 5 rotations armchair was stopped and pause of 5 seconds was kept. Then the tested took vertical position of head.

By results before and after rotational test we registered:

1. Vestibular-vegetative stability by methodic of Lozanov-Baychenko (Gandelsman, 1973), in which vegetative reflexes (heart beats rate and blood pressure) to rotational test were registered in points. By combinations of heart beats rate and B.P. changes by special table of Lozanov-Baychenko (Gandelsman, 1973) vestibular stability was assessed;
2. Vestibular-somatic stability was determined at 5 meters' segment by deviation from straight line (walking with closed eyes) before and after standard irritation (5 rotations per 10 sec.). Deviation was registered in centimeters;
3. Vestibular-sensor stability was assessed in seconds of dizziness period after standard vestibular irritation. Students registered duration of dizziness by pressing stopwatch button.

The trainings of main groups included the offered by us special exercises and outdoor games with ball, oriented on strengthening of vestibular stability (Pomeshchikova, 2010, 2011; Pomeshchikova et al., 2016).

Statistical analysis

Generalization of the studied characteristics was assessed by mean arithmetic value, standard deviation and error of mean arithmetic. Confidence of differences between mean values was stated by Student's t-criterion. Assessment of statistical hypothesizes based on 5% significance level. For statistical processing of data we used licensed program Microsoft Excel (2010). Statistical analysis of the received results was conducted, considering recommendations on Microsoft Excel tables' usage for computer data analysis. For determination of correlations between indicators we calculated correlation coefficient by Pearson.

Results

Analysis of vestibular-vegetative stability indicators showed that vestibular irritation in Barany's armchair caused insignificant changes of blood pressure. Systolic pressure mainly reduced. Change of boys' systolic pressure after rotation was 4.68 mm merc. col. (3,9%). Girls' indicator was 6.19 mm merc. col. (5.6%). Changes of boys' and girls' systolic pressure after rotation were not confident ($p > 0.05$). At the same time, under influence of vestibular irritation we found multidirectional change of diastolic pressure. Variations of boys' diastolic pressure indicators were within from increase by 3.26 mm merc. col. to reduction by 6.3 mm merc. col. Reaction of girls' diastolic pressure to vestibular irritation expressed in insignificant reduction from 0.46 to 2.86 mm merc. col. With it, changes of boys' and girls' diastolic pressure were not confident ($p > 0.05$).

Analysis of boys' and girls' vestibular stability indicators before and after vestibular irritation showed that boys had higher indicators of diastolic pressure. After rotation we observed confident differences between girls' and boys' systolic pressure indicators ($t = 2.06$; $p < 0.05$). Comparison of boys' and girls' diastolic pressure indicators before and after rotation did not show any confident differences ($p > 0.05$). Different orientation of systolic and diastolic pressure reactions to vestibular irritation characterizes the type of reaction, which is assessed by orientation of changes in blood pressure indicators. Analysis of reaction type permitted to find the following: boys have prevalence of pulse hypotension; girls have prevalence of pulse and general hypotension (see fig. 1).

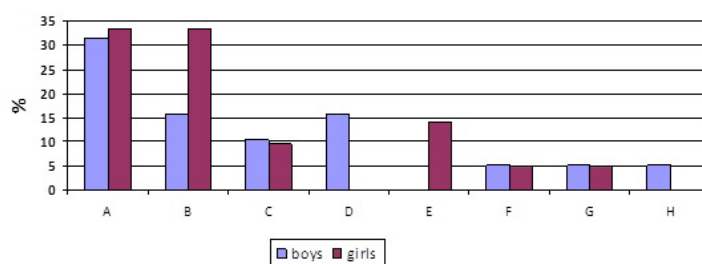


Figure 1. Distribution of students by orientation of blood pressure under influence of vestibular irritation: A – by type of pulse hypertension; B – by type of general hypotension; C – by type of systolic hypotension; D – by type of pulse hypertension; E – by type of general hypertension; G – by type of systolic hypertension; H – without changes.

Heart beats rate before and after rotations was determined in 10 seconds' segment of time. After rotation boys' and girls' heart beats rate changed insignificantly ($p > 0.05$). These changes were multidirectional. For example, boys' heart beats rate changed from increase by 0.68 bpm per 10 sec. to slowing by 0.7 bpm per 10 sec. Girls' heart beats rate insignificantly increased in response to vestibular irritation, in average by 0.05–0.7 bpm per 10 sec.

Changes of boys' and girls' heart beats rate before and after vestibular irritation were not confident ($p > 0.05$). By shifts of blood pressure and heart beats rate under influence of vestibular irritation (table of Lozanov-Boychenko was used) (Gandelsman, 1973) we made conclusion about level of vestibular stability of students. With primary study vestibular stability indicator of students was at level of 2.40–3.47 points (from 5 possible). It says about deficit of vestibular analyzer's stability (see table 1).

Table 1. Indicators of vestibular-vegetative stability of students before and after experiment (in points) ($\pm m$)

Contingent	Before experiment	After experiment	t	p
Boys (n=19)	3.22±0.24	3.99±0.16	2.64	<0.05
Girls (n=21)	3.17±0.17	4.00±0.15	3.67	<0.001
t	0.19	0.06		
p	>0.05	>0.05		

It was found that in indicators of boys' and girls' vestibular stability there were no confident differences ($p > 0.05$). Vestibular-motor reactions of students with muscular-skeletal apparatus disorders were studied by indicators of deviation, when walking with closed eyes before and after vestibular irritation. Analysis of deviation values after irritation of vestibular apparatus (see table 2) permitted to determine confident worsening of boys' and girls' results ($p < 0.05$). Comparison of boys' and girls' indicators before and after vestibular irritation showed no confidence differences ($p > 0.05$).

Table 2. Indicators of vestibular-somatic and vestibular-sensor stability of students before and after experiment ($\pm m$)

Contingent	Conditions	Before experiment	After experiment	t	p
<i>Walking along straight line with closed eyes (cm)</i>					
Boys (n=19)	Before rotation	59.21±8.00	49.84±7.57	0.85	>0.05
	After rotation	152.95±17.24	100.11±13.68	2.40	<0.05
	t	4.93	3.21		
	p	<0.001	<0.01		
Girls (n=21)	Before rotation	61.05±8.10	43.86±7.52	1.55	>0.05
	After rotation	140.14±14.97	82.05±10.51	3.18	<0.01
	t	4.65	2.95		
	p	<0.001	<0.01		
<i>Period of dizziness (sec.)</i>					
Boys (n=19)	17.00±2.24	12.32±1.90	1.59	>0.05	
Girls (n=21)	23.95±2.01	18.86±1.52	2.02	<0.05	
t		2.31	2.68		
p		<0.05	<0.05		

In primary studies of vestibular-sensor reactions to rotation in Barany's armchair we registered noticeable time of students' dizziness (see table 2). It should be noted that girls' indicators were worse than boys' ($p < 0.05$). Correlation analysis of vestibular stability indicators of main group students

showed that between girls' vestibular-vegetative, vestibular-somatic and vestibular-sensor stability there was no correlation (see table 3). In boys we found weak correlation between vestibular-vegetative and vestibular-somatic stability ($r = -0,483$).

Table 3. Indicators of correlation analysis of students' vestibular stability

Stability	Vestibular –vegetative	Vestibular-somatic	Vestibular-sensor
<i>Boys (n=19)</i>			
Vestibular –vegetative	1		
Vestibular-somatic	-0.483	1	
Vestibular-sensor	-0.076	0.124	1
<i>Girls (n=21)</i>			
Vestibular –vegetative	1		
Vestibular-somatic	0.307	1	
Vestibular-sensor	-0.117	-0.118	1

After application of specially selected exercises and games with ball, in main groups systolic blood pressure indicators in rest reduced insignificantly ($p>0.05$) (fig.2). Irritation of vestibular apparatus after experiment resulted in insignificant change of systolic pressure ($p>0.05$).

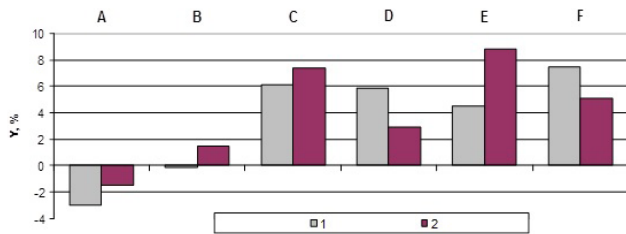


Figure 2. Change of blood pressure and heart beats rate indicators of main groups' students after experiment (%): Y - change of blood pressure and heart beats rate indicators (%); 1 - before rotation; 2 - after rotation A - boys' systolic pressure; B - girls' systolic pressure; C - boys' diastolic pressure; D - girls' diastolic pressure; E - boys heart beats rate; F - girls' heart beats rate.

After experiment, diastolic pressure in rest indicators of main groups' students reduced. With it, these changes were not confident ($p>0.05$) Irritation of vestibular apparatus resulted in insignificant change of diastolic pressure, which was not confident ($p>0.05$). Change of diastolic pressure after experiment was, practically, always less than in primary testing. Variations of girls' diastolic pressure after experiment were less than boys'. Thus, change of boys' diastolic pressure after experiment before and after rotation was a little higher than girls' (see fig.2). After experiment, heart beats rate in rest (in main groups) reduced. However, confident changes of heart beats rate in rest took place only in girls ($p<0.001$).

Irritation of vestibular apparatus before and after experiment resulted in insignificant variations of heart beats rate and were not confident ($p>0.05$). Heart beats rate indicators after vestibular irritation (after experiment) reduced in all groups, but these changes were not confident ($p>0.05$). It should be noted that after experiment heart beats rate under influence of rotation reduced practically in all cases, comparing with primary testing results (see fig.2).

Both: boys' and girls' heart beats rate indicators after experiment, before and after rotation, had no confident differences ($p>0.05$). Thus, insignificant increasing was found in girls before rotation and in boys after rotation. Boys' resistance of heart beats rate to vestibular irritation increased, in average, by 80.7%. Analysis of girls' resistance of heart beats rate to vestibular irritation did not show any improvement.

Study of blood pressure and heart beats rate indicators' change under influence of vestibular irritation in main groups after experiment showed confident improvement of vestibular stability in points (boys, $p<0.05$; girls, $p<0.001$). So, boys' vestibular-vegetative stability increased by 23.9%, girls' - by 26.2% (see fig. 3.).

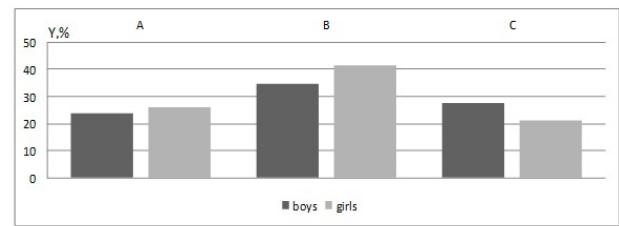


Figure 3. Changes of vestibular stability indicators of main groups' students after experiment (%): Y - changes of vestibular stability indicators (%); A - vestibular vegetative stability; B - vestibular-somatic stability; C - vestibular-sensor stability.

Analysis of main group students' straight-line walking results before and after vestibular load showed confident increment of somatic indicators after rotation: in boys - ($p<0.05$); in girls - ($p<0.001$) (see table 3). Analysis of these data showed that increment of indicators of deviation from straight line (walking with closed eyes) in main groups was: boys' (before rotation) - 15.8%; girls' (before rotation) - 28.1%; after vestibular load - 34.6% and 41.4%, accordingly (see fig. 3).

Analysis of vestibular-sensor indicators of main groups' students before and after experiment (see table 3) showed that confident increment was observed only in girls ($p<0.05$). By results of feeling dizziness period after rotation, increment of results in main groups was: boys' - 27.5%, girls' - 21.3% (see fig.3). Analysis of vestibular stability indicators by vegetative, somatic and sensor reactions in control groups after experiment showed that there were also some changes, though they were not significant ($p>0.05$).

Discussion

Our work has been fulfilled in direction of already existing researches of specialists, who study problems of physical fitness support and increase in youth with muscular skeletal apparatus disorders, for socialization of these people. In physical rehabilitation of this contingent, for improvement space orientation and vestibular stability authors offer to use autonomous dynamic stands (Sharov & Andreeva, 1997), suspended swing (Mittal & Narkeesh, 2012).

Results of our research continue a number of works devoted to perfection of disabled people's vestibular stability (Sharov & Andreeva, 1997; Mittal & Narkeesh, 2012). The tests for vestibular stability of different age physically healthy people are presented in a number of works (Voropay & Buryanovaty, 2014; Syshko, 2009; Moiseenko, 2012). Analysis of motor fitness initial data of students with muscular skeletal apparatus disorders and their comparison with healthy youth's indicators permitted to conclude that they are rather lower. All authors note that vestibular irritation significantly worsened motor potentials of the tested. Reduction of results after rotation was confident. It complied with results, received in contingent of students with

muscular skeletal apparatus disorders. Application of special exercises for vestibular apparatus irritation by the authors rendered training influence on it. It facilitated improvement of vestibular stability.

Solution of most of motor tasks to large extent is influenced by vestibular analyzer. In our research initial data of vestibular stability study by change of blood pressure and heart beats rate were: boys' 3.22 ± 0.24 ; girls' – 3.17 ± 0.17 points.

In other researches it was determined that vestibular irritators increase systolic pressure (Gruzhevskaja, 1978; Liashchuk, 1979). The data of our observations point at reduction of systolic pressure under influence of rotation loads and completely coincide with results of other research, received on healthy schoolchildren of 10–15 years' age (Malka, 1979).

Our results coincide with opinion that vestibular irritations cause significant worsening of space orientation. Results of vestibular-somatic reactions showed that standard vestibular irritation confidently worsens indicators of straight-line walking (before rotation boys' indicators was 59.21 ± 8.00 cm and after rotation – 152.95 ± 17.24 cm; girls' – 61.05 ± 8.10 cm and 140.14 ± 14.97 cm, accordingly) It was found that the least deviations from straight line before and after rotation were observed in students, who had disorders of shoulder girdle (paresis hands, amputation, abnormality of development). The highest deviations were observed in cases of lower limbs diseases (hemi paresis, lower paraparesis, dislocation of hip joint). In other cases and muscular skeletal apparatus disorders (chondrodystrophy, muscular dystrophy, rheumatoid arthritis, arthrogyrosis) we observed indicators, bordering with minimal and maximal deviations from straight line. In separate cases students with disorders of lower limbs demonstrated rather high results. In straight-line walking with closed eyes students with muscular skeletal apparatus disorders (connected with lower limbs) deviated to the side opposite to affected limb. For example disabled with right side paraparesis deviated to the left. In cases of other disorders we found no dependences.

In studies of vestibular-sensor reactions of different age children (Syshko, 2009) significant variability in feeling of dizziness is noted. The same we also observed in students with muscular skeletal apparatus disorders. Under influence of special training the author registered shortening of dizziness period. The data of dizziness feeling in our research were: boys' – 17.00 ± 2.24 and girls' – 23.95 ± 2.01 sec.

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Vestibular stability indicators in gender aspect differed confidently only in results of vestibular sensor reactions ($p < 0.05$). Our results comply with opinion that training of vestibular analyzer influences on reduction of vestibular-sensor reaction time.

Our research showed that exercises and games with ball substantially influence on development of vestibular stability. Application of such exercises resulted in significant perfection of general space orientation and correction of movements, according to situations' changes and different conditions of game. Regular exercises with ball and outdoor games (with turns, rotations, and head bents to different sides) facilitate training of vestibular analyzer.

After application of system of specially oriented exercises and games with ball we observed weakening of vestibular irritator influence on organism. After experiment we registered confidently improved indicators of vestibular-vegetative and vestibular-somatic reactions of boys and girls ($p < 0.05$ – 0.001). Results of vestibular-sensor reactions showed shortening of dizziness period feeling. However, confident improvement of this indicator was registered only in girls ($p < 0.05$). Results of control groups' students remained approximately at the level of primary measurements. Improvement of vestibular stability facilitates increase of students' motor experience and mastering of required life skills.

Conclusions

1. The worked out system of special exercises and games with ball improved vestibular stability of students with muscular skeletal apparatus disorders. It expressed in weakened influence of vestibular loads on vegetative indicators of cardio-vascular system, straight-line walking indicators and dizziness feeling time in this contingent of students.
2. The fulfilled research witnesses about positive influence of exercises and games with ball on vestibular stability of students with muscular skeletal apparatus disorders. We worked out system of specially selected exercises and games with ball for improvement of organism's resistance to vestibular load. As a result such system of exercises increase level of confidence in actions, causes relaxedness of movements, improves adaptation to external conditions.

Conflict of interests

The authors declare that there is no conflict of interests.

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UTJECAJ VJEŽBI I IGARA SA LOPTOM NA VESTIBULARNU STABILNOSTI UČENIKA S POREMEĆAJEM MIŠIĆNO-SKELETNOG SUSTAVA

Sažetak

Svrha rada: vježbati pristupe povećanju vestibularne stabilnosti učenika s poremećajima mišićno-skeletnog aparata pomoću igara na otvorenom i vježbi s loptom.

Metode: u istraživanju su učestvovali učenici s poremećajima mišićno-skeletnog aparata (n = 63, dob 16-19 godina, dječaci i djevojčice).

Istraživanje je realizirano tijekom 1,5 godine (tri akademska semestra). Učenici su imali nesposobnosti od blagih do prosječnih poremećaja. Svi studenti su imali liječnički nadzor i nisu imali kontraindikacije za bavljenje tjelesnim odgojem. Ispitivanje vestibularne stabilnosti sprovedeno je pomoću pokazatelja vegetativnih, somatskih i senzora reakcije na standardne analizatore vestibularnih iritacija u Bárány-jevoj fotelji (5 okretaja u 10 sekundi).

Rezultati: utvrdili smo pravce vestibularnog poboljšanja stabilnosti studenata i načine za stjecanje povjerenja u vlastite postupke i veću prilagodbu na svakodnevne uvjete. Pronađene su karakteristične reakcije kardiovaskularnog sustava ka iritaciji vestibularnog aparata.

Zabilježili smo smanjenje sistoličkog krvnog tlaka s višesmjernim promjenama dijastoličkog krvnog tlaka i srčanog ritma. Pri ocjeni orijentacije u prostoru zatvorenih očiju pod vestibularnim opterećenjem, registrirali smo odstupanje na suprotnoj strani od zahvaćenog ekstremiteta. Tijekom rotacije u Bárány-jevoj fotelji zabilježili smo dugotrajnu vrtoglavicu, s pokazateljima koji su kod djevojčica bili su znatno slabiji.

Zaključak: primjena posebno orijentiranih vježbi i igara s loptom slabi stres uzrokovan iritacijom vestibularnog analizatora. Razradili smo sustav posebno odabranih vježbi i igara s loptom za poboljšanje otpornosti organizma na vestibularna opterećenja. Takve vježbe jačaju samopouzdanje u vlastite snage, dovode do opuštenosti u pokretima, poboljšavaju adaptaciju na vanjske uvjete.

Ključne riječi: Učenici, mišićno-skeletni sustav, vestibularni, lopta, igre na otvorenom.

Received: February 06, 2016

Accepted: June 15, 2016

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ACHIEVEMENT MOTIVE OF ATHLETES

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Original scientific paper

Abstract

Considering the importance of achievement motive in sports, aim of this study was to raise consciousness of the importance of motivation for achievement and development opportunities for greater success in the sport. The paper presents the results of research of achievement motive in athletes and differences in achievement motive between athletes and non athletes. The research was conducted on a population of athletes and non-athletes aged 15 to 19 years. The results showed that athletes doesn't have developed higher than average achievement motive, but the difference was not found between athletes and non athletes, as well as the results also shown that the athletes do not show a higher level of anxiety.

Keywords: Achievement motive, anxiety, athletes.

Introduction

Every day the limits of human possibility are changing. Man of our time climbed the Himalayas, mastered the Andes descended into the ocean depths and the Earth's interior, he stepped on the moon, each of these feats also demanded the movement of the limit of his body. Before 1954, most of the people claimed that it is impossible to run the mile less than four minutes. Most of runners also agreed and claimed that it's physiologically impossible. R. Bannister was convinced that he could run faster than this invisible limits and did it. It was a feat, but the most interesting is that the next year more than twelve runners did the same thing. What kind of motivations is it, what moves one person to sacrifice, the answer can be found in the achievement motive.

Sport became the area where success, victory and glory motivate people to become active although a specific kind of human activity has its roots in the need for exercise and competition. According Hrnjica (2005), motivation is internal factor that stimulates, directs the, controls and integrates to or from the objective directed behavior. Only a small number of motives among the biological, but a much larger number of motifs is acquired during life the process of socialization. Socialization leaves, by Rota, complete and deeper effect on motivation rather than to the one from the other mental functions of man. All those motives expressed in relations with other people, are acquired by socialization. Dealing with a variety of sports activities, as well, it is hard to imagine without the social motives, and success in them. Selection of social motives suggested Roth (1990), is appropriate for the presentation and use in sport psychology. The social motives can be selected into two major groups: Social motives aimed at securing personal existence and the affirmation that include motive for achievement, motivation for recognition, status and prestige, motive for the acquisition, motive power, as well as the motive for self-assertion, and self-actualization, and so on. and social motives that focus on connections with other people, which include gregarni motive, motive for affective attachment, depending on motive, and so on. In contrast to motives, motivation, according to Rota (1990) is the process of initiating activities, guidance on certain objects and the regulation of activities in order to achieve certain goals. Taking into account the complex structure of dispositions

of athletes, sports psychologists have identified disposition which significantly influence the success of the sport. In the group of those dispositions are: emotional stability, emotional self-control and extravagant behavior, self-confidence, security. Among these dispositions are classified higher degree of perseverance, responsibility, group dependence, expressed the need for domination and competence, need for achievement, greater potency adaptation to successfully perform under stress (Lepir, 2002). This paper consider two dispositions that have proved significant in the sport that is motive of achievement and anxiety.

Motivation in sport is most often studied in terms of a relatively permanent disposition personalities which have direct factors of the individual sports activities. Motivational dispositions are determined of: straight-selectivity, target orientation, the energy level, strength and perseverance, a quality experiential feeling of success, satisfaction. Puni (1959) separates the sports motivation into two main stages: before sports and during sports. Within each has found by two development stages: a large number of needs where dominate the needs movement for fulfilling social demands and for specific types of sporting activities. The appearance of new cognitive quality make it possible to understand the place and role of physical culture and sports. Vanek and Krati (1974) point out four stages of the development of sports motivation: generalization, differentiation, specialization interests and revolution. Generalization implies the need for movement and proving, in the second phase are significant social and primary motives in the third positive and negative feelings about the competition until involution means that top athletes stay active as a result of weaker, while others continued to play sports as a side activities. If someone has the skills and the motivation it is a major determinant of his or her game - self confidence. During a crisis, unexpected twists, pressure and poor results react with a sense of love and challenges of fighting is not usual. The majority of athletes with the quantity of effort rises proportionately and the expectation that they achieve the best results, because otherwise they feel very ineffective, incompetent and even inadequate worth compared to all the other athletes and people from the environment (Tisma, 2008). The data showed that in active sportsmen, along with a higher degree of development motivasportskog

achievement increases the degree of emotional self-control, and stability, and declines the tendency to emotional inhibition and instability (Havelka and Lazarević, 1981). Sports psychologists point out that the success in the sport affects emotional stability, emotional self-control and extrovert behavior, self confidence and security.

They also say that successful top athlete should have the, low anxiety and neuroticism, a high expressed extraversion. As for the state mood, should have low anxiety, tension, depression, anger, fatigue and confusion, and high determination (Silva at all; Cox, 2005).

The most common motive for the general achievement defined as a focus for achieving success in life and krakterističan is economically highly developed society, in which the success of an individual is crucial to his or her status at work and in society. In the literature, achievement motive defined as a tendency to invest the effort to achieve and accomplish something that is considered valuable (McClelland, 1987; Mladenović, 2011).

Motive for achievement is a complex motive which consists of more simple - motive of fighting spirit, the need for prestige and respect, level of aspiration, etc.

Founders of the study of this problem are Mek Klilend and Atkinson. Between the authors there is agreement that the hypothetical concept of achievement motivation refers to the relatively stable disposition that with different people may be more or less pronounced and that is structurally sorted. Situations that determine this need are those that contain a challenge that can be overcome with an investment effort, include uncertainty regarding the success, situations where one can be more or less successful. Francesco et al (2002) considered that the two basic components of achievement motive involves investing effort for what is considered a valuable and which will be pointed out in front of others. The authors note three moments of particular importance for the development of achievement motivation:

- Consistently emphasizing and encouraging self-reliance and independence in achieving the goal,
- The early ages of setting different and challenging tasks with the expression of satisfaction in their achievement,
- The role of parents (expectations made by parents)
- Expression of feelings of pleasure in situations child achievements.

Other possibilities in the development of achievement motivation in athletes are given:

- From the earliest age the child pay attention to the emotional reward any progress, any shift in its attempt to take control over some skill or knowledge;
- Pay particular attention to those activities where the child is to achieve the success necessary to make an effort;
- Give him always a bit more difficult tasks;

- Do not work instead the child, he must develop his own independence (more they will learn with their own efforts);
- The ultimate goal is to explain the parts of the objectives which motivate the child to continue of his further activities;
- Use a variety of ways on the road to achieving the goals set in order to prevent the appearance of monotony and saturation in the work.

No matter what activity is done, there is a possibility that the conditions, if not the activity itself, make different and interesting.

The motivation for achievement is popularly called the competitive spirit. Basically competitive spirit is seen as behavior "achievements" in the context of competition, the social assessment as a key component. In the motive for achievement is important perseverance despite failure and feeling of pride in the achievement of the set. It is alleged that the motivation for achievement should focus on competition with ourselves and the spirit of competition affects behavior in social situations estimated. The difference in people at high and low achievement motivation is the task of choosing to be assessed, the efforts that are invested in the course of the competition, their perseverance and nihovog performance (Bajraktarević, 2008). High motive for achievement in athletes resulting from goals that are oriented to the task while the athletes with low motive for achievement judging their results by outcome goals. In sports, this is the area of human activity which for basic component has a competition and evaluation of performance and is very important as the main element for the motivation of athletes. Under the influence of the social factor and high performance in the sport is directly related to manifest the motives for achievement (Lepir, 2002). According to achievement motivation and competitive spirit are being developed in three phases: phase autonomous competence occurring before the fourth year where the child is focused on overmastering their environment, phase of social comparisons occurring around the age of five, the child directly compare their own performance with others. The third phase of integrative unites the first two, and there is no certain age for entering in it. mastering the these stages a person knows when is the perfect time to compete and compare with others, and when it is time for the adoption of standards. On environment that promotes achievement motive significantly influence have parents, teachers, coaches. It is very important to recognize the interaction effects on achievement motivation, emphasize individual main objectives, throwing the resulting targets, follow the feedback, discussing when the competition and social comparisons are necessary and when a self focus. Sport can often manifest anxiety of nervousness to a strong fear that may prevent an athlete to achieve good results. Anxiety may appear as structured personality traits and as a state caused by some complex situations. According Spielbergs concept, anxiety may occur as a state and as a characteristic. Anxiety as a state is transient and it appears when the perception of real or imagined stimulus that relating to that situation (Grgin, 1997). While anxiety as a characteristic represents the relative stabile factor personality. In the background of this anxiety is a multitude of

stimulus that are perceived as threatening, with tendency to respond to them with intensive anxiety state. Some researchers found that athletes who expressed anxiety has a greater ability to be found in a state of great excitement and fear what prevents him to accomplish its goals. Some authors point out that organized sports activity reduces anxiety and depression. Bungić, Baric (2009) point out that more anxious athletes are often concerned about the errors, often have a negative thoughts before the competition, and hardly were concentrated. Also the relation between the cognitive state anxiety and performance in physical activity being linear and negative, increasing cognitive state anxiety leads to a decrease in physical activity or sports achievement. In contrast to the results obtained, the relationship between the somatic state and anxiety is something different, its squares, and takes the form of an inverted U, from what we can conclude that to a optimal level of somatic anxiety state improves performance in physical exercise, but then with a further increase in somatic state anxiety success in physical exercise and sporting achievements that falling.

Methods

Problem and aim

The main problem of this study was to investigate and analyze the level of achievement motive and examine the difference between athletes and non athletes.

The aim was to raise awareness about the importance of achievement motive and development opportunities for greater success in the sport.

Subjects

The research was conducted on the sample of 58 athletes and 60 athletes aged 15 to 19 years.

Tasks

1. Examine the level of achievement motive of athletes;
2. Examine anxiety as a component of achievement motive of athletes;
3. Determine whether there were differences between athletes and non athletes at the achievement motive;
4. Examine the differences in anxiety between athletes and non-athletes;

Hypotheses

1. It is expected that athletes have above average levels of achievement motiv;
2. It is assumed that athletes are above average anxiety;
3. It is assumed that there is no statistically significant difference between athletes and non-athletes at achievement motive;
4. It is expected that there is no difference in anxiety between athletes and non-athletes;

Results

The first task was to examine the level of achievement motivation of athletes. The descriptive parameters are shown in the following table:

Table 1. Descriptive statistical parameters on a scale of achievement motivation of athletes

		Atlets	Statistic	Std. error
		Arithmetic mean	8.7759	.41744
		Confidence interval of arithmetic mean with 95% confidence	Lower limit	7.9400
			Upper limit	9.6118
		5% Trimmed Mean	8.7701	
		Median	9.0000	
		Variance	10.107	
achievement motive	Yes	Std. deviation	3.17912	
		Minimum	2.00	
		Maximum	15.00	
		Range	13.00	
		Interquartile range	5.00	
		Skjunis	.070	.314
		Kurtosis	-.662	.618

Scores on a scale of achievement motiv are distributed from the Xmin and Xmax = 2 = 15, and of the results lies in the upcoming M = 8.78. The standard error of of arithmetic mean indicates that the arithmetic mean of the population with 95% confidence is between the scores X1 = 7.94 and X2 = 9.61. The standard deviation is = 3.18 and variability is V = 36.22%. These data indicate that the arithmetic mean deviating from the middle of the scale in a positive direction, which represents possibility developed above average achievement motive. After testing the significance of differences between the obtained of arithmetic mean and the

middle of the scale were not statistically significant (t = 1.678; p> 0.01), with 99% confidence it can be argued that athletes have developed above average achievement motive, resulting difference is accidental. The most subjects achieved average scores on the scale of achievement motive. The difference in achievement motive between athletes and non athletes.

The second task was related to test differences in achievement motivation betweenathlets and non athletes. Results are shown in Table 2.

Table 2. Descriptive statistical parameters differences between athletes and those who do not on a scale of achievement motiv

	Athlets	N	Mean	Std. deviation	Std. error AS
Achievement motive	Yes	60	8.3833	2.91165	.37589
	No	58	8.7759	3.17912	.41744

The data showed that although the athletes showed higher motive for achievement, the differences between subjects who participate in sports and those who do not motive of achievement is very small, t-test shows that these differences are not

statistically significant (t = 0.70, p = 0.485).

Anxiety of athletes

The third task was related to explore anxiety of athletes, the results shown in the following table.

Table 3. Descriptive statistical parameters

	Athlets	Statistic	Std. Error
Anxiety Yes	Arithmetic mean	5.5862	.26380
	Confidence interval of arithmetic mean with 95% confidence	Lower limit	5.0580
		Upper limit	6.1145
	5% Trimmed Mean	5.5766	
	Median	6.0000	
	Variance	4.036	
	Std. deviation	2.00905	
	Minimum	1.00	
	Maksimum	10.00	
	Range	9.00	
Interquartile range	3.00		

At the scale of anxiety, respondents achieved scores between Xmin= 1 and Xmax = 10. The arithmetic mean of the scale anxiety is (Manx = 5.59; q= 2.01). After examining the descriptive statistics, it was found that the arithmetic mean of the results by 0.59 units from the middle of the scale (X = 5). Testing the relevance in compared to middle of the scale t test shows that there is no statistically

significant difference (t = -0.383; p = 0.702), a difference is coincidental.

The differences in anxiety between athletes and non-athletes

The next task was to "Examine the differences in anxiety between athletes and non-athletes," presented results are in Table 4.

Table 4. Descriptive statistical parameters

	Athlets	N	(M)	Std. Deviation (σ)	Std. error of arithmetic mean
Anxiety	No	60	5.3333	1.87460	.24201
	Yes	58	5.5862	2.00905	.26380

The results show that the respondents, who are actively involved in sports, the mild extent more anxious compared to those who are non actively involved in sports (SMEs / a = 5.59). T-test confirmed that this difference is statistically significant (t = 0.707, p> 0.05), real differences between athletes and non-athletes does not exist.

Conclusion

These results suggest the following conclusions. When it comes to the first task and the expectation that the athletes reach above-average score on the scale of achievement motivation, our expectations were not accomplished because the results showed

that athletes achieve average scores on a scale of achievement motive. Everything indicates the need to develop the achievement motive of athletes that would create the conditions for greater sporting achievement. There were no statistically significant difference between athletes and non-athletes at the achievement motive, although the athletes reach higher scores. Athletes showed moderate anxiety, justification for that can be found in the average Result motives for achievement. Athletes showed moderate anxiety and the reason for that is the average result of the achievement motive. There was also no significant difference between athletes and non-athletes in anxiety.

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MOTIV USPJEHA KOD SPORTISTA

Sažetak

Imajući u vidu značaj motiva postignuća u sportu cilj ovog istraživanja je bio podići svijest o važnosti motiva za postignućem, te mogućnosti razvoja za bolje uspjehe u sportu. U radu su prikazani rezultati istraživanja motiva postignuća kod sportista i razlike u motivu postignuća između sportista i nesportista. Istraživanje je urađeno na populaciji sportista i nesportista starosti od 15 do 19 godina. Rezultati su pokazali da sportisti nemaju iznadprosječno razvijen motiv postignuća, te nije pronađena razlika između sportista i nesportista u motivu postignuća i anksioznosti kao i da sportisti ne pokazuju viši stepen anksioznosti.

Ključne riječi: : Motiv postignuća, anksioznost, sportisti.

Received: June 01, 2016

Accepted: June 15, 2016

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DIFFERENCES IN MOTOR AND KINEMATIC PARAMETERS BETWEEN GROUPS OF BOYS FORMED BY RESULTS OF RUNNING AT 20M FLYING START

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Original scientific paper

Abstract

The study was conducted on a sample of 81 boys, aged 10-12. The sample was divided into three equal groups formed according to the placement of the subject to the criterion: Result of running the 20 meters-flying start (RTLS20m). Thus each of the three formed sub-samples consisted of 27 subjects, which define quality groups of above-average, average and below average respondents to the set criteria. Differences between groups formed according to the criterion are determined by applying the Analysis of variance – ANOVA and LSD test. Significant differences were determined in almost all variables of motor abilities and kinematic parameters of running between the formed quality groups. It can be concluded that the groups are formed, differ substantially in two treated areas. The results can be used to form the model of tests for the selection of boys aged 10-12 for athletics sprint, within the area of motor abilities and kinematic parameters of running.

Keywords: Motor abilities, horizontal and vertical jumps, running kinematic parameters, frequency and stride length.

Introduction

Sprinting is a complex motor skill which is generally related to speed. The most common running speed is defined as an ability to run a certain path in the shortest time. The basic speed is related to the ability of progression of running, and presents the basic cyclic component of the speed (Rado, 2002). Running speed is defined by three relatively independent components: latent time of motor reaction, speed of individual movement and frequency of movement (Smajlović 2010). Running speed is determined by neuromuscular, motor and energy factors. Running speed is performed through form of three-segmented model: speed, strength and coordination (Coh et al. 2009). Therefore running speed is determined by efficient neuromuscular coordination (Winfried, 1997).

Every sprint distance includes structure of four separate but integrating stages: start (phase of latent time of reaction to a start signal); start progression (phase of speed acceleration which lasts till the moment of reaching maximum speed on sprint distance); running at distance (phase of maintaining of reached level of maximum speed) and finish (phase of speed deceleration) (Smajlović, 2010).

Varying kinematic parameters which determine running speed are frequency and stride length, and duration of the contact with the ground and duration of flying (Coh et al. 2010 Mero et al. 1992). Relation of length and frequency of the stride during sprint is determined and automated individually (Babić et al. 2011, Kyrolainen et al. 2001).

Methods

The study was conducted on a sample of 81 subjects – boys, aged 10-12 (body height ABH = 145,3 ± 6,6 cm, body mass ABM = 39,7 ± 8,8 kg). The sample was divided into three equal groups formed according to the placement of the subject to the criterion: Result

of running the 20m-flying start (RTLS20m). Thus each of the three formed sub-samples consisted of 27 subjects, which define quality groups of above-average, average and below average respondents to the set criteria.

Sample of variables estimating motor abilities included a set of twelve variables: Standing long jump (cm) – MSDM, Vertical jump – Abalak test (cm) – MABL, Counter movement jump (cm) – MCMJ, Counter movement jump with free hands (cm) – MCMJH, Repetitive jumps over the right foot on the 20m (stride number) – MSD20B, Repetitive jumps over the left foot on the 20m (stride number) – MSL20B, Repetitive jumps over the right foot on the 20m (time) – MSD20V, Repetitive jumps over the left foot on the 20m (time) – MSL20B, Hand tapping on 15 seconds – MTAPR, Leg tapping on 15 seconds (number) – MTAPN, Medicine-ball throw backwards (weight 1 kg) from standing position over head (cm) – MSMEDS, Medicine-ball throw forward (weight 1 kg) from lying on back over head (cm) – MSMEDL.

Sample of variables for estimating running kinematic parameters included a set of six variables: maximum running speed (KVMAX), stride frequency (KFK), stride length (KDK), duration of contact (KTK) and duration of the flight (KTL). Counter movement jumps were registered on tensiometric platform (Ergo-Jump). Kinematic parameters were registered on tensiometric carpet (Ergo-Tester Bosco).

Structural differences between groups formed according to the criterion are determined by applying the Analysis of variance (ANOVA) and LSD test.

Results

The sample was divided in three equal sub-samples of 27 subjects defined as above average, average and below average group of boys. Table 1 show three quality groups formed according to the placement of the subject to the criterion: Result of running the 20 meters-flying start (RTLS20m).

Table 1. Formed groups according to the criterion: Result of running the 20 meters-flying start

RTLS20m	N	Range	Min.	Max.	AS	SD
Above-average	27	0,34	3,03	3,37	3,20	,105
Average	27	0,24	3,37	3,61	3,48	,063
Below average	27	0,55	3,62	4,17	3,77	,159

Statistical significant difference between three formed quality groups according to placement of the subject to the criterion variable result of running the 20m-flying start was tested by analysis of variance (table 2). Results of analysis of variance show that there are statistically significant differences between three formed quality groups of subjects according to determined criterion. In order to verify all results of

analysis of variance and to get exact evaluation of differences between each pair, statistical significance between formed quality groups according to criterion variable result of running at 20m-flying start (RTLS20m) is also tested by LSD test (table 3). Results of LSD test show that there are differences between each pair, on the highest level of statistical significance.

Table 2. Significance of the differences between formed groups (ANOVA)

Variable	df	F	Sig.
RTLS20m	2	162,084	,000

Table 3. Significance of the differences between formed groups by LSD test

Variable	Group	Grupa	Diff. AS (I-J)	Sig.
RTLS20m	1	2	-,28963*	,000
		3	-,57185*	,000
	2	3	-,28222*	,000

Table 4 shows average means in the area of motor abilities within three quality groups of boys according

to criterion variable result of running at 20m-flying start (RTLS20m).

Table 4. Characteristics of formed groups of boys according to criterion RTLS20m in the area of motor abilities

Variable	Above average		Average		Below average	
	AS	SD	AS	SD	AS	SD
MSDM	156,74	17,516	147,62	15,640	132,25	15,892
MABL	30,37	3,691	27,81	4,252	23,22	4,263
MCMJ	22,16	3,845	21,09	3,504	16,35	3,083
MCMJH	26,20	3,815	24,94	3,852	20,01	3,767
MSD20V	10,40	2,082	12,14	2,221	14,17	3,654
MSD20B	24,12	4,466	28,18	4,429	33,25	7,486
MSL20V	10,69	2,203	11,81	1,874	14,60	2,824
MSL20B	24,37	4,558	27,62	4,289	33,74	6,388
MTAPN	19,77	1,502	18,29	1,409	17,55	2,063
MTAPR	27,74	1,913	24,59	2,545	25,00	2,616
MSMEDL	5,39	1,031	4,85	,926	4,60	,777
MSMEDS	7,59	1,376	6,88	1,244	6,38	1,139

Statistical significance of the differences in the area of motor abilities between three formed quality groups according to criterion variable result of running at 20m-flying start (RTLS20m) is tested by analysis of variance (table 5). Results of analysis of variance showed statistically significant differences in the area of motor abilities between three formed quality groups according to determined criterion. Results of LSD test, in most variables showed statistically significant differences on higher level of significance (sig 0,001) within each pair of formed groups (table 6) in the area of motor abilities between three formed quality groups according to criterion (RTLS20m). Six variables in the area of motor parameters show the difference on lower level of statistical significance (sig 0.05) between above average (1) and average

(2) quality group isolated according to criterion (variables: MSDM; MABL; MSD20V; MSL20B; MSMEDL; MSMEDS).

Results of LSD test did not show statistically significant differences between variables of the area of motor parameters among each pair of isolated quality groups: Two variables which tested vertical jump, Counter movement jump (MCMJ) and Counter movement jump with free hands (MCMJH); and variable Repetitive jumps over the left foot on 20m (time) (MSL20V) are not different on level of statistical significance above average (1) and average (2) quality group. Variables Leg tapping on 15 seconds (MTAPN), Hand tapping on 15 seconds (MTAPR), Medicine-ball throw backwards from

standing position over head (MSMEDS); Medicine-ball throw forward from lying on back over head (MSMEDL) are not different on level of statistical

significance above average (2) and average (3) quality group.

Table 5. Differences between formed groups of boys in the area of motor parameters (ANOVA)

Variable	Df	F	Sig.	Variable	Df	F	Sig.
MSDM	2	15,424	,000	MSL20V	2	20,087	,000
MABL	2	21,303	,000	MSL20B	2	22,914	,000
MCMJ	2	21,188	,000	MTAPN	2	12,202	,000
MCMJH	2	19,855	,000	MTAPR	2	13,977	,000
MSD20V	2	12,707	,000	MSMEDL	2	5,191	,008
MSD20B	2	17,725	,000	MSMEDS	2	6,329	,003

Table 6. Differences between formed groups of boys in the area of motor parameters by LSD test

Variable	Group	Group	Diff. AS (I-J)	Sig.	Variable	Group	Group	Diff. AS (I-J)	Sig.	
MSDM	1	2	9,11111*	,044	MSL20V	1	2	-1,12370	,081	
		3	24,48148*	,000			3	-3,91074*	,000	
		2	15,37037*	,001			2	-2,78704*	,000	
MABL	1	2	2,55556*	,024	MSL20B	1	2	-3,25926*	,023	
		3	7,14815*	,000			3	-9,37037*	,000	
	2	3	4,59259*	,000		2	3	-6,11111*	,000	
		1	1,06667	,265			MTAPN	1	2	1,48148*
MCMJ	1	3	5,81111*	,000		2			3	,74074
		2	4,74444*	,000			MTAPR	1	2	3,14815*
MCMJH	1	2	1,25926	,228		2			3	2,74074*
		3	6,18519*	,000			MSMEDL	1	2	-,40741
	2	3	4,92593*	,000		2			2	,54074*
		1	-1,73926*	,023			MSMEDS	1	3	,78704*
MSD20V	1	3	-3,76444*	,000		2			3	,24630
		2	-2,02519*	,008				2	2	,71296*
MSD20B	1	2	-4,05556*	,010		1			3	1,21111*
		3	-9,12963*	,000			2	3	,49815	,149
		2	-5,07407*	,001						

Table 7 shows means in the area of kinematic parameters of running within three quality groups of boys formed to the placement of the subject to

the criterion: Result of running the 20 meters-flying start (RTLS20m)

Table 7. Characteristics of formed groups of boys in the area of kinematic parameters

Variable	Above average		Average		Below average	
	AS	SD	AS	SD	AS	SD
KFK	4,09	,1870	3,94	,227	3,86	,294
KDK	152,44	7,632	145,66	9,089	138,44	10,529
KVmax	6,23	,216	5,74	,163	5,33	,234
KTK	0,13	,009	0,15	,013	0,16	,012
KTL	0,105	,009	0,103	,0109	0,096	,015

Statistically significant difference in the area of kinematic parameters of running between three groups of boys formed by the placement of the subject according to the criterion: Result of running the 20 meters-flying start (RTLS20m) is tested by analysis of variance. Results of analysis of variance (table 8) show statistically significant differences between three formed groups of subjects. Results of

LSD test did not show differences between each pair of variables in the area of kinematic parameters of running in the following cases (table 9): in variable of frequency of strides (KFK) there is no differences between average (2) and below average (3) quality group on the level of statistical significance and variable of duration of contact (KTL) didn't show differences between above average (1) and

average (2) quality group on the level of statistical significance.

Most variables show statistically significant difference on higher level of statistical significance (sig 0.01) in the area of kinematic parameters of running between formed quality groups according to criterion (RTLS20m).

Variable of frequency of strides (KFK) shows statistical significance of differences between above average (1) and average (2) quality group on the level of statistical significance (sig. 0,05), while variable of duration of flying (KTL) shows differences between average (2) and below average (3) quality group on the level of statistical significance.

Table 8. Differences between formed groups of boys in the area of kinematic parameters of running (ANOVA)

Variable	Df	F	Sig.
KFK	2	6,222	,003
KDK	2	15,771	,000
KVmax	2	128,307	,000
KTK	2	30,315	,000
KTL	2	4,233	,018

Table 9. Differences between formed groups of boys in the area of parameters of running by LSD test

Variable	Group	Group	Diff. AS (I-J)	Sig.
KFK	1	2	,14407*	,031
		3	,22815*	,001
	2	3	,08407	,203
KDK	1	2	6,77778*	,008
		3	14,00000*	,000
	2	3	7,22222*	,005
KVmax	1	2	,49296*	,000
		3	,90259*	,000
	2	3	,40963*	,000
KTK	1	2	-,01144*	,001
		3	-,02526*	,000
	2	3	-,01381*	,000
KTL	1	2	,00222	,515
		3	,00944*	,007
	2	3	,00722*	,037

Discussion

Isolated quality groups of boys formed according to the placement of the subject to the criterion, Result of running the 20 meters-flying start (RTLS20m), in most variables in the area of motor abilities show difference on level of higher or lower statistical significance. Boys that belong to above average quality group according to criterion (RTLS20m), show higher level of motor speed-strength qualities presented in a form of vertical and horizontal jumps, repetitive jumps, innate speed of neuromuscular excitation and speed-strength potential of arms, which should be considered when selecting young individuals for an athletic sprint.

Analysis of means (AS) of variables in the area of kinetic parameters it is noticed that above average quality group isolated according to determined criterion (RTLS20m=3,20 s) shows the highest mean of maximum speed (KVmax=6,23 m/s). Above average quality group also has the highest means of frequency (KFK=4,09 k/s) and stride length (KDK=152,46 cm), duration of contact (KTK=0,13 s) and duration of flight (KTL=0,105 s) which is a bit higher in relation to the average group and considerably higher in relation to the below, which can be connected to the stride length

(KDK) in running. In support of this contention contributes the analysis of the average values of kinematic parameters of average and below-average formed group. It is obvious that inadequate level of kinematic parameters of running influences on the result of running at 20m-flying start (RTLS20m) in a negative way. Low level of achieving maximum speed of running (KVmax), low frequency (KFK) and length of stride (KDK), inadequate level and relation of duration of contact (KTK) and the duration of the flight (KTL) represent causal kinematic phenomena to the result of running the 20m flying start and achieved level of maximum speed potential.

The average means (AS) of kinematic parameters of running of above average group (27) are compared to the results of the study of Bračić et al. (2009) which was conducted on selected sample of boys. Selected sample of the study of these authors showed that boys aged 11-12 achieve maximum speed of 7,27 m/s, stride frequency 4,11m/s, stride length 171,9 cm and duration of the contact 0,127 s. By comparison of the results of both studies, it is noted that the average means of kinematic parameters of running were on a higher level in favour of the study on selected sample in relation to the study of this research, which could be a consequence of higher homogeneity of the samples.

However, considering that the complete sample of subjects in this research was divided in three sub-samples formed according to criterion (RTLS20m), it can be concluded that average means of kinematic parameters of running of above average group of boys show similar average means as the results of the study by Bračić et al. (2009), which is primarily reflected on stride frequency (KFK, 4,11 k/s). Various researches have shown that a good stride frequency in the case of the gifted young athletes is 4-4.5 steps per second, which is also noticed in the case of this above-average group of boys. Also it can be concluded that the results of this research match the results of previous studies (Babić et al. 2011; Čoh et al. 2001, 2004; Kyrolainen et al. 2001; Donatti, 1995) which also confirmed determining character of motor primarily speed-strength qualities, as well as kinematic parameters which refer to the frequency and stride length and duration of the contact with the ground in order to achieve the speed potential while sprinting.

Conclusion

Above average quality group of boys aged 10-12 formed according to criterion: Result of running the 20 meters - flying start (RTLS20m) has the highest means in total area of kinematic parameters of running and the best running speed (KVMAX), the best flying start (KTL20m), the highest frequency (KFK) and stride length (KDK), the shortest duration of the contact (KTK) and the longest duration of flying (KTL) respectively.

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Results of this study indicate that the stride frequency and length and the level of achieved maximum speed are components by which is easier to recognize the differences in the area of kinematic parameters of running of boys aged 10-12 years, in contrast to the parameters of contact and flight duration.

Above average quality group of boys has higher level of motor speed-strength quality in form of horizontal and vertical jumps, repetitive jumps and innate speed of neuron-muscular excitation and higher speed-strength potential of arms.

It can be concluded that this research showed statistically significant differences in variables of kinematic parameters of running and motor speed-strength abilities between groups of boys formed according to results of running at 20m-flying start, as well as that formed quality groups are considerably different within two treated areas.

Obtained results can be used for creating a model for testing and selecting talents for athletics and specially athletics sprint, in the area of motor abilities and kinematic parameters of running. When selecting talented boys, aged 10-12, for athletic sprint it is recommended to consider the test of running at 20m-flying start. In the same it would be advisable to investigate potential of running speed at the distance, and above all kinematic parameters of frequency and stride length. When selecting talented boys for the athletic sprint, simple forms of horizontal and vertical jumps should be also considered.

RAZLIKE U MOTORIČKIM I KINEMATIČKIM PARAMETRIMA IZMEĐU GRUPE DJEČAKA FORMIRANIH PREMA REZULTATU TRČANJA NA 20M S LETEĆIM STARTOM

Sažetak

Studija je provedena na uzorku od 81 dječaka, uzrasta 10-12 godina. Uzorak je podijeljen na tri jednaka sub-uzorka formirana prema plasmanu subjekta u odnosu na kriterij: Rezultat trčanja na 20m s letećim startom. Svaki sub-uzorak je činilo 27 subjekata kojima su definirane iznad-prosječna, prosječna i ispod-prosječna grupa dječaka formirana prema postavljenom kriteriju. Razlike između grupa su provjerene putem analize varijance i LSD testa. Statistički značajne razlike između formiranih grupa su utvrđene u gotovo svim varijablama za procjenu motoričkih sposobnosti i kinematičkih parametara trčanja. Stoga se može zaključiti da se formirane kvalitetne grupe značajno razlikuju unutar ova dva tretirana prostora. Rezultati studije mogu poslužiti za modeliranje testova pri selekciji za atletske sprint u prostoru motoričkih sposobnosti i kinematičkih parametara trčanja za uzrast dječaka 10-12 godina.

Ključne riječi: Motoričke sposobnosti, horizontalni i vertikalni skokovi, kinematički parametri trčanja, frekvencija i dužina koraka.

Received: June 01, 2016 Accepted: June 15, 2016

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COACHING STATUS AS A FACTOR OF JOB SATISFACTION

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Original scientific paper

Abstract

Coaching job is a specific professional education work and the most important factor in sports features in each sports organization. It is directly related to all the other key elements of this subsystem, training, competition and recovery of athletes. As for the coaching profession it is necessary to bear in mind the individual job satisfaction sports coaches get that includes several key dimensions - the satisfaction that comes from performing certain tasks, satisfaction of belonging to a workgroup, satisfaction of belonging to an organization, satisfaction with material position and with the status of the job. This empirical research was aimed at determining the coaching perceptions of job satisfaction, in the context of employment status they occupy in sports clubs in which they work. The sample of respondents consisted of 140 coaches, participants of the expert training program for operational coaches in Novi Sad and Subotica and was differentiated in space of subsamples according to the criteria of their coaching engagement in the club at: professional, part-time and volunteer. Using the questionnaire SCV (Satisfaction with Coaching Vocation) the results showed that in the latent space of coaching job satisfaction, generally, there are three relatively independent factors: (1) human resources, (2) financial satisfaction, and (3) organizational culture, which explains 64.415 % of the total variance. Club coaching status and its impact on job satisfaction in this study was shown as an important determinant.

Keywords: Coaches, job satisfaction, club's status.

Introduction

The issue of job satisfaction is an essential determinant in any organizational system. It can be, basically, viewed from two angles: (1) as the general attitude towards work, and (2) as satisfaction in relation to five specific dimensions of work performed (salary, activity during the performance of work, opportunities for personal promotion, superiors, colleagues, etc.). Although numerous studies, which dealt with the research of people's satisfaction in the performance of work, identify a relatively large number of different factors of satisfaction, however, as a common denominator in all approaches two factors that define Greenberg and Baron (Baron & Greenberg, 1998) are distinguished: (1) organizational determinants of job satisfaction (reward system, perceived quality control, decentralization of power, labor and social stimulation, pleasant working conditions); and (2) personal determinants of job satisfaction (dimensions of personality, status and length of service, compatibility of work and personal interests of the individual, general satisfaction with life). Modern literature about management, concept of job satisfaction is viewed through two theoretical approaches (Matanovic, 2009): (1) a holistic, that job satisfaction is considered one-dimensional construct (attitude of the person to work, a central feeling about the job that is not divided into individual aspects) and (2) an additive that job satisfaction is seen as multidimensional occurrence (job satisfaction makes satisfaction with specific aspects of the work).

Coaching job in sports is predominantly covered by professional and educational work, so that, in essence, is the most important factor for sports features in each sports organization and it is directly related to all the other key elements of this

subsystem, training, competition and recovery of athletes. So, it continues in the central part of the sports system - training process (Nešić & Fratrić, 2013). Therefore, in the context of the coaching job it can be talked about the applicability of the management standpoint that job satisfaction is viewed through five dimensions (Šušnjar & Zimanji, 2005): (1) satisfaction of performing certain tasks, (2) the satisfaction of belonging to a workgroup, (3) the satisfaction of belonging to the organization, (4) the satisfaction of material position and (5) satisfaction with the status of the job.

Past practice in the Serbian sport has proved that the commitment to the coaching call is primarily associated with the needs of individual achievement. In the training process remain longest coaches who have achieved some success with their athletes. Most coaches, especially those in the so-called "Unprofessional" sport, are defined for this job primarily because it is a creative process, where they feel a great pleasure in conducting training, work with athletes and their sporting achievements. Financial incentives, material factor is another reason for choosing the coaching profession as a business activity, while striving for affirmation (as a high-ranked motive) usually appears as a third reason for choosing the coaching job (Nešić, Fratrić & Vukašinić, 2013).

Identification of job satisfaction should be a significant activity of management of each organization, including sports organizations. However, in practice so far there is no evidence of such activities in sports organizations, especially those that have the character of non-professional sports clubs (so called amateur sports clubs), which in Republic of Serbia make up the largest part (around 98%) of overall number of registered sports organizations.

Method

This empirical research has an transversal character, which was conducted in the context of wider research study and was aimed at determining the coaching perceptions of job satisfaction, in the context of employment status they occupy in sports clubs in which they work.

Using a questionnaire whose basis is SCV scale (Satisfaction with Coaching Vocation) (Nešić et al. 2016) surveyed a total of 140 coaches (88 men and 52 women) who were participants of the expert training program for operational trainers at the Faculty of Sport and Tourism in Novi Sad and the College of professional studies in education of teachers and trainers, in Subotica. The questionnaire was composed of two groups of issues. The first was dominated by issues related to some personal attributes of respondents, who thus represented the space of independent variables (... coaching status in the club), while the second group consisted of 29 items of SCV scale (as space dependent variables) which identify coach perceptions of job satisfaction. Designed as a numerical Likert scale, with scalar

range of 1-6, where "1" means strongly disagree with this assertion ("strongly disagree"), while the value "6" means total agreement with the offered indicator ("I agree completely").

Although the psychometric properties of this scale were validated in previous studies, this time it is further validated through its internal approval. Applying Cronbach alpha coefficient (Ch. Alpha = 0.960) in the scale and on a concrete sample showed good internal approval, which is significantly higher than the recommended theoretical value of 0.7 (DeVellis, 2003). And also all 29 items had high internal approval (Table 1).

To test the significance of differences between means of answers different coaching status we applied Kruskal-Wallis H test, while in the area of identification of latent structures of satisfaction of the coaching job the factor analysis was applied. All statistical procedures were carried out by the application program SPSS, a conclusion was conducted at a significance level of 0,05 (Sig. ≤ 0.05).

Table 1. Scalar averages and coefficients of internal compliance SCV scale

RNo.	Questions	Mean	Cr. Alpha
1.	<i>I think I am adequately paid for the work I do at the club</i>	4,66	,915
2.	<i>In my club there is very little opportunity for advancement</i>	4,86	,917
3.	<i>My supervisor is competent enough for the job</i>	5,15	,917
4.	<i>I'm not satisfied /of the benefits offered by my employer / club</i>	4,28	,915
5.	<i>In my club the management gives full support to the participation of trainers in various educational programs</i>	4,19	,914
6.	<i>I think that many of the rules and procedures in my club linger work performance</i>	4,09	,912
7.	<i>I like the people I work with at the club</i>	5,34	,917
8.	<i>I think it is essential that the club pays attention to developing and motivating coaching staff for permanent education</i>	4,21	,916
9.	<i>I believe that communication in my club is good</i>	4,71	,915
10.	<i>Raises in my club are small and rarely given</i>	3,72	,915
11.	<i>I think all the employees in my club who are doing their job have equal opportunities to be promoted</i>	5,09	,915
12.	<i>I believe that my superior is not fair to me</i>	5,09	,917
13.	<i>Employee Benefits in my club are as good as in most similar sports organizations</i>	4,63	,913
14.	<i>I don't feel that the work I do is sufficiently appreciated in the club</i>	4,98	,911
15.	<i>I think that at the work I have to work harder because my colleagues are not able to</i>	4,68	,916
16.	<i>The objectives of my club are not clear enough to me</i>	5,06	,916
17.	<i>When I think about my financial compensation, I think the club does not appreciate me enough</i>	4,79	,909
18.	<i>Employees at my club are progressing as fast as employers in other similar sports organizations</i>	4,87	,915
19.	<i>The team management is very interested about the feelings of their employees</i>	4,72	,913
20.	<i>I think the package of benefits that we have at the club is justified</i>	4,45	,909
21.	<i>I think that the staff at my club is poorly rewarded</i>	4,62	,911
22.	<i>I often have the feeling that I do not know what's going on in my club</i>	4,99	,917

23.	<i>I am satisfied on the opportunities that increase financial compensation that we are offered in a club</i>	4,53	,913
24.	<i>I think there are benefits to employees in my club do not have, and they should</i>	4,07	,910
25.	<i>I love my superior</i>	4,50	,915
26.	<i>I believe that my effort is not rewarded as it should be</i>	4,54	,910
27.	<i>I am satisfied on the opportunities for advancement that are provided to me</i>	4,64	,912
28.	<i>In my club there are a lot of disagreements and quarrels</i>	5,00	,915
29.	<i>I think assignments in my club are not completely defined</i>	4,79	,917
		Σ 4,66	,960

Results and Discussion

In order to further assess the validity of the SCV scale, all 29 items were subjected to principal component analysis (PCA). Also, prior to its implementation the suitability of data was assessed for factor analysis. By examining the correlation matrix there were many coefficient values of 0.3 and more. Kaiser-Meyer-Olkin’s adequacy indicator (KMO) was 0,833 which exceeds the recommended value of 0.6 (Kaiser, 1970, 1974). Bartlett’s test of sphericity (Bartlett, 1954) also reached statistical significance (df=406; Sig.=0.000), indicating factorability of correlation matrix and validity of the application of factor analysis.

Principal component analysis obtained after Oblimin rotation, revealed the presence of three components with characteristic root (Eigenvalues) over one, which explains 64.415% of common variance. All 29 variables gave appropriate weight factor of extracted components which have been found to SCV questionnaire and have the correct validity on the tested sample. However, the valid factor scores involve a total of 25 items that defined latent space of satisfaction. This three-factor solution is differentiated and appropriate coverage of item indicators in separate factors. The first factor, which is saturated with a total of 13 items (1,3,7,9,11,12,13,16,18,19,22,25,28,29) explained most of the variance (47.80%). Through a relatively high overall scalar average of constitutive items (4.89) stressed the importance of this factor in overall satisfaction of coaches in their clubs. Especially in the context of the indicators with the highest weight factor (satisfaction competence line manager, colleagues with whom they work, opportunities for career advancement in the club, communication among staff, etc.). According to the semantics of indicators forming this factor as a logical name imposed itself - the human factor resources. Other isolated factor, which explains 9.63% of the variance, is structured out of 8 items (10,14,17,20,21,23, 24,26), explained 9.63% of the common variance, while item scalar average in this area was 4.48. Characterized by the items which are predominantly focused on the context of meeting the material (financial) needs of a coach. According to the semantics of the group of items this factor is named as - financial satisfaction. In the third factor, which is saturated with a total of 4 items (2,4,6,8) and explains 6.96% of variance, were found to be indicators that primarily indicate the space work environment trainers, those elements that are in the priority domain of the management of sports organizations (club rules and procedures, working environment, colleagues

at work, opportunities for advancement, etc.). In accordance with the item coverage, this factor is called - a factor of organizational culture.

The research results have been analyzed in the context of sub sampled categories of respondents, which is defined through the club’s coaching status under the criteria of character work engagement - (1) trainers who work professionally (employed with the club), (2) coaches who work part-time (non-working relations, but with the agreed monetary compensation) and (3) coaches at the club that do volunteer work (without payment).

The application of the Kruskal-Wallis test procedure identified statistically significant differences overall satisfaction coaching pole three different groups of trainers (professional, part-time and volunteer - $\chi^2 = 39.244$, $p=0.000$). A review of secondary averages rank group shows that the total satisfaction at the highest level with their club coaches who perform volunteer work (Md = 5.21), while the least satisfaction is seen in professional trainers (Md = 2.29) (Table 2).

Table 2. Overall satisfaction coached respondents of different coaching status

Coaching status	N	Mean	Mean Rank	Median
<i>professional</i>	14	2,38	7,64	2,29
<i>Part-time</i>	66	4,88	72,84	5,09
<i>volunteer</i>	60	4,96	82,59	5,21
Σ	40	4,66		5,03
$\chi^2 = 39,244$ Sig. = 0,000				

This result can be regarded as expected, given that the practice has shown that the human resources in the clubs, that their affiliation to the organization is predominantly based on “love” to a particular sport, and they perceive their satisfaction with the work through the status of membership in a sports organization. On the other hand, trainers that are working part time in sports clubs, are most often characterized by existential stability beyond sport. These are, most often, people who spend their professional engagement (and thus financial stability) implemented in a business environment that is outside the sports organizations. The work in this particular club is usually motivated by love for a particular sport (these are mainly former professional athletes of a club), as well as satisfying the need for additional financial profits. For the third the group - trainers who professionally work in sports clubs, may be conditionally said that they are the

most "vulnerable" human resources in sport. Their existence is "tied" to the sport and the specific club, so they are intensely aware of all the difficulties in the operation sports organizations, especially financial. On the other hand, their "destiny" is most often in the hands of volunteers (members of the management work of sports organizations that are in most cases constituted by people who are not "professionals" in sports) so their working environment is often, very negative, routine and dilettante conducted, resulting in existential insecurity and uncertainty (frequent changes in administrations clubs, irregular payment of financial compensation, financial instability, high and often unrealistic achievement expectations etc.).

In terms of the impact of coaching on the status of satisfaction of the coached, and in accordance with statistically significant differences among subsamples, the results of the analysis determined the size of the impact of specific coaching status on perceptions of job satisfaction. Acknowledging Cohen's criteria (Cohen, 1988) we identified the value of influence that may be considered medium ($r = 0.493$ and $r = 0.490$), especially when it comes to the relation of professional coaches to the coaches that work part-time or volunteer (Table 3.).

Table 3. Overall satisfaction with coaching respondents of different coaching status (multiple comparisons)

Coaching status	N	Mean	Mean Rank	Median	Z	Sig.	r
professional	14	2,38	7,64	2,29	-5,835	,000	,493
part-time	66	4,88	47,47	5,09			
professional	14	2,38	7,50	2,29	-5,807	,000	,490
volunteer	60	4,96	44,50	5,21			
Part-time	66	4,88	58,87	5,09	-1,494	,135	,126
volunteer	60	4,96	68,59	5,21			

Also, when one looks at the separate factors of satisfaction of a coaching career and coaching status they generate with their clubs, we can see a statistically significant difference between professional trainers in relation to trainers "volunteers" and "freelancers". Coaches "professionals" are in all three factors showed a trend of discontent club status and environment (human resources: $St = 1.36$; financial satisfaction: $St = 2.64$; organizational culture: $St = 2.93$), while the other two subsamples in all the elements had a positive and relatively high intensity of scalar values (Table 4).

Table 4. Factors satisfaction coached respondents of different coaching status (multiple comparisons)

Factor	Coaching status	N	Mean	Std. Err.	Sig.	
Human resources	professional	part-time	66	4,94	,401	,000
		volunteer	60	5,13	,404	,000
	part-time	professional	14	1,36	,401	,000
		volunteer	60	5,13	,243	,704
	volunteer	professional	14	1,36	,404	,000
		part-time	66	4,94	,243	,704
financial satisfaction	professional	part-time	66	5,23	,409	,000
		volunteer	60	4,97	,413	,000
	part-time	professional	14	2,64	,409	,000
		volunteer	60	4,97	,248	,546
	volunteer	professional	14	2,64	,413	,000
		part-time	66	5,23	,248	,546
organizational culture	professional	part-time	66	5,39	,263	,000
		volunteer	60	5,40	,265	,000
	part-time	professional	14	2,93	,263	,000
		volunteer	60	5,40	,159	,999
	volunteer	professional	14	2,93	,265	,000
		part-time	66	5,39	,159	,999

It can be concluded that coach satisfaction (implicit and other human resources) of performing work in a sports organization is a very important factor in its functioning. It can be said that, as in other service organizations, related to three important organizational outcomes: productivity, absenteeism and fluctuation. The high level of work satisfaction

of human resources (Judge, Thoresen, Bono & Patton, 2001; Koys, 2001) creates the conditions for an adequate labor productivity, less absenteeism and less abandonment (sports) organisation. In this context it is important to emphasize that the situation in the context of organizational hierarchy at the club (coach status) may represent an

important reference to the work engagement and job satisfaction.

In terms of satisfaction of a coaching career may be said that this is the least explored area in sports management, as opposed to business organizations, where this approach is one of the most studied in terms of employees (Alotaibi, 2001, Parnell & Crandall, 2003). The knowledge that is satisfied employee is also the productive worker, should be correspondent managerial standpoint and in sports. For the success of a sports organization as a whole can't be achieved with the disgruntled human resource, especially coaches as key factors that govern the central part of the sports system - training process of athletes.

Conclusion

The choice of a sports coach profession, as well as a selection of adequate coaching staff in sports organizations in Serbia, has not set an appropriate and adequate systematic level, as it is in the current sports practice very noticeable. On the other hand a modern concept of sports activities represents a system that takes place within an organization, so that every sports club is a very complex, dynamic and open management system consisting of various subsystems and elements as interdependent parts of the continent. The training process is the basis (core) of the sport system, and sports trainers are central headquarters of its functioning. Time and basic human resource sports organizations.

Empirical research, which was aimed at determining the individual perceptions of satisfaction with the coaching job, and in the context of employment status they occupy in sports clubs in which they are engaged, has identified, for sports practice, important information. The sample, which consisted of a total of 140 coaches, participants of the expert training program for operational trainers in Novi Sad and Subotica, was differentiated in space subsamples according to the criterion of their coaching engagement at the club at: professional, part-time and volunteer. Using the questionnaire SCV (Satisfaction with Coaching Vocation) the obtained results showed that the latent space satisfaction of coaching job, generally, can speak of the existence of three relatively independent factors. The target areas are: (1) human resources, (2) financial satisfaction, and (3) organizational culture, which is explained 64.415% common variance.

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Club coaching status and its impact on job satisfaction was shown in this study as an important determinant. Coaches who realized their activity through professional working arrangement, expressed, in general, a certain degree of dissatisfaction with their club status, as well as through all three latent space satisfactions. On the other hand, the coaches that work in the clubs part-time or volunteer, have a positive perception of their coaching status and are more satisfied with the job they do, in relation to their fellow "professionals".

The results of this study should be viewed in a broader context that is important for the development of sports management. Today in the operationalization of questions pleasures work in organizations, there are two approaches: a holistic and facet approach (Wright, 2006). Both can be applied and in the context of performance of the management of sports organizations. The holistic approach to job satisfaction is seen as a one-dimensional construct (representing generalized attitude of individuals towards work, or one central emotion attached to the job which is the result of experience on the job). Facet approach to job satisfaction is seen as a multidimensional construct (viewed from the aspect of the work situation, and includes examination of the relevant aspects of the job that contribute to overall job satisfaction, for example, wages, mode of governance, relationships with co-workers, opportunities for promotion, etc.). Most modern research in the business environment benefits facet approach (Mirković & Čekrljija, 2015), since it provides a more detailed and complete insight into the reasons for (not) job satisfaction.

Modern sports environment requires a new approach to the creative skills of sports coaches, given that it represents a significant competitive advantage in today's conditions of existence of sports. One gets it, first of all, through continuous learning, which is aimed at creating and gathering new knowledge in all aspects of primary value chain of sports. In our terms coaches have a great responsibility and influence in almost all organizational processes, especially in achievements of athletic performances of the organization (the Club). Therefore, the issues of their job satisfaction, which include a whole range of factors (remuneration, work and social environment, the sports organization management characteristics, its goals and ambitions, organizational physiognomy, ownership structure, and etc.) must devote much more attention than before.

114.

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TRENERSKI STATUS KAO ČINILAC ZADOVOLJSTVA POSLOM

Sažetak

Trenerski posao predstavlja specifičan stručno-pedagoški rad i najbitniji je činilac sportske funkcije u sistemu svake sportske organizacije. On se nalazi u direktnoj vezi sa svim ostalim ključnim elementima ovog podsistema, a to su - trening, takmičenje i oporavak sportista. Kada je reč o trenerskom zanimanju neophodno je imati u vidu individualno zadovoljstvo poslom sportskog trenera koje obuhvata nekoliko ključnih dimenzija - zadovoljstvo koje proizilazi iz obavljanja određenih poslova, zadovoljstvo pripadanjem radnoj grupi, zadovoljstvo pripadanjem organizaciji, zadovoljstvo materijalnim položajem i zadovoljstvo statusom posla. Ovo empirijsko istraživanje imalo je za cilj utvrđivanje trenerske percepcije zadovoljstva poslom, u kontekstu radnog statusa koji zauzimaju u sportskim klubovima u kojima rade. Uzorak ispitanika je sačinjavalo ukupno 140 sportskih trenera, polaznika programa stručnog osposobljavanja za operativne trenere u Novom Sadu i Subotici i bio je diferenciran u prostoru subuzoraka prema kriterijumu njihovog trenerskog angažmana u klubu na: profesionalan, honoraran i volonterski. Primenom upitnika SCV (Satisfaction with Coaching Vocation) dobijeni rezultati su pokazali da u latentnom prostoru zadovoljstva trenerskim poslom, generalno, egzistiraju tri relativno samostalna faktora: (1) ljudskih resursa, (2) finansijske satisfakcije i (3) organizacijske kulture, koji objašnjavaju 64,415% ukupne varijanse. Klupski trenerski status i njegov uticaj na zadovoljstvo poslom pokazao se u ovom istraživanju kao bitna odrednica.

Ključne riječi: : Treneri, zadovoljstvo poslom, klupski status.

Received: June 01, 2015

Accepted: June 15, 2015

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DIFFERENCES IN GAME EFFICIENCY OF VOLLEYBALL PLAYERS OF THE FIRST AND SECOND SERBIAN LEAGUE

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Original scientific paper

Abstract

The aim of this research is to define the differences in game efficiency between the first and second Serbian volleyball league players. The sample of respondents consists of 100 senior volleyball players of the first and second Serbian league, season 2011/2012. The analysis of game efficiency is based on the evaluation of four technical-tactical elements: serve, receiving the serve, setting and smash. After completion of the T-test, we defined a statistically significant difference in game efficiency between the first and second league players at five variables: winner serve (SEp), successful serve (SE+), unsuccessful serve (SE-), winner smash (SMp) and wrong receiving (PS=), while other 10 variables, such as wrong serve (SE=), correct setting (DI-), safe setting (DI+), ideal setting (DI=), ideal receiving (PSi), correct receiving (PS+), negative receiving (PS-), successful smash (SM+), unsuccessful smash (SM-), and wrong smash (SM=) didn't show a statistically significant difference in game efficiency between the first and second Serbian league players.

Keywords: Differences, game efficiency, volleyball players.

Introduction

Volleyball is an attractive, interesting, complex and dynamic sports game which implies continuous and rapid action transfer from one to the other half of the court. Teams aim at achieving as much "aces" successful spikes and "dinks" as possible. Volleyball involves specific sports activities, as well as various types of movement which create two categories of activities: activities with the ball and activities without the ball (Nejic, 1998).

Paper subject, goal and tasks

Having in mind that practical experience has proven that the second Serbian league volleyball teams which transfer to the first Serbian league usually return to the second league after one season, this paper shall attempt to offer explanation for such situation, i.e. compare efficiency and success of first and second league players, and offer statistical comparison of game efficiency at players of two leagues.

This paper uses one of the most frequent analyses of game efficiency, i.e. game efficiency analysis used on World Volleyball Championship in Italy 1978. This system was developed by Strahonja in 1972. However, the system was first mentioned by Stojanovand Gigov in 1970. Grading system used in this work has been taken from Strahonja. The system implies three or four levels of grading each element on ordinal scale.

- Sign (+) stands for successful action which results in direct point, or the change of ball possession
- Sign (0) stands for a point which neither brings point nor the change of ball possession, action which resulted in keeping the ball in the game
- Sign (-) stands for unsuccessful action which results in the loss of point or the change of ball possession (Strahonja, 1978)

Paper subject is analysis of game efficiency at volleyball players who play in the first and in the second league.

Paper goal is defining the differences in efficiency between volleyball players who play in the first Serbian league and second Serbian league in season 2011/2012.

Paper task is to define statistical differences in element efficiency at players of the first and the second league.

Hypothesis:

The following hypothesis has been set up based on paper subject, problem and goal:

X1: There are differences in efficiency between volleyball players of the first Serbian league and the second Serbian league.

Methodology

Subject sample

The research implied 100 examinees- active volleyball players who were divided in two subgroups:

- The first subsample consisted of 50 examinees- active volleyball players who play in three first league teams.

- The second subsample consisted of 50 examinees- active volleyball players who play in three second league teams.

FIRST LEAGUE	SECOND LEAGUE
Volleyball Club "Nis"- Nis	Volleyball Club "Millenium"- Nis
Volleyball Club "Zeleznicar"- Belgrade	Volleyball Club "Desetka"- Nis
Volleyball Club "VGSK"- VelikoGradiste	Volleyball Club "Dubocica"- Leskovac

Variable sample

Variable for monitoring volleyball team play during the games and analysis of team efficiency. Player efficiency analysis is based on assessing efficiency of minimum four technical-tactical variables:

1. Serve
2. Setting
3. Serve receive
4. Spike

1. Serve (SE)

- SEpwinner serve
- SE+ positive serve
- SE- negative serve, and
- SE=wrong serve

A serve which results in direct point is labelled by SEpand is called winner serve. This means that the ball touches the opponent's area- including the lines- right after the serve, is out right after the reception ("ace"), or when the opponent cannot keep the ball, i.e. the referee gives point to the attacking team.

The following points are relevant for a serve:

1. server
2. way of serving
3. serve direction, and
4. result (success) of the serve

Grading the serve:

Symbol SE+ marks the serve that the opponent cannot receive properly, and thus is unable to organize rapid attack. This is called a positive serve. Symbol SE- marks the serve which enables the opponent to organize rapid attack. This is called a negative serve (serve which facilitates opponent's attack). Symbol SE=marks a wrong serve after which a team loses a point.

2. Setting (DI)

- DI- corrected setting,
- DI+ safe setting, and
- DI= ideal setting

Setting efficiency is of crucial importance for attack realization. Specific aspect of monitoring the setter is the fact that the number of total setting is recorded only in three setting situations.

The following items are relevant for setting:

1. the setter
2. zone that the ball has been set for the spike, and
3. way of setting (fingers, forearms)

DI- marks the setting which is performed after a bad reception. The setter sets the ball from the back zone (mostly balls with high arch- corrected setting). DI+ marks the setting which implies that the setter has to make three additional steps from the setting zone. The setter is still able to set the ball, but cannot play a combination- safe setting. DI= marks the setting which is performed after an ideal passing of the ball to the setting zone. There is a possibility of rapid and combined attack- ideal setting. After collecting all the necessary information, one can establish an appropriate playing model and prepare tactical concept for a specific game.

3. Serve reception (PS)

- PSi ideal reception
- PS+ positive reception
- PS- negative reception
- PS= wrong reception

Ideal serve receive is marked by PSi and implies that the libero is in ideal position to organize combined attack.

The following items are recorded at serve reception observation:

1. libero
2. ball reception zone, and
3. direction of ball bouncing and its efficiency

PSi ideal reception is recorded when a team can organize a rapid attack, as well as combined attack, which implies that the libero does not have to make a single step outside his zone in order to set the ball. PS+ marks a positive reception which implies that the team can organize a rapid attack, but without combinations. The libero has to make 2-3 steps outside his zone in order to set the ball. Imprecise reception is marked by PS- when a team is able to organize an attack, but only with high ball (tempo III). PS= marks wrong reception which results in point loss.

4. Attack- spike (SM)

- SMpspike winner
- SM+ positive spike
- SM- negative spike
- SM=spike error

Attack winner (spike) which results in direct point is marked by SMp.

The following items are recorded at hitting and spiking:

1. hitter
2. assigned zone
3. zone that the player set the ball for spike
4. way of spiking
5. direction of the hit and spike success
6. sequence of the ball (first, second or third)

Spike winner is marked by SMp and is recorded whenever the ball hits the surface area of the opponent's half (including the lines) after the spike, as well as when the ball is out after the block ("block-out"), i.e. the referee gives a point to the attacking team.

Symbol SM+ marks positive spike, i.e. situation which does not allow the opponent to organize rapid and combined attack. Negative spike SM- is recorded when the opponent can organize rapid counter-attack. Symbol SM= refers to spike error, i.e. when

the opponent wins a point. After collecting all the necessary information, one can establish an appropriate playing model and prepare tactical concept for a specific game. As for the above mentioned example, tactical preparation includes two stages:

1. the entire team watches the video of opponent's game and makes a verbal tactical preparation,
2. the team imitates the opponent's game, practices specific situations and plays control games with teams which have similar tactics.

We analyzed efficiency statistics of six games played by the first and the second league.

Data processing

We used statistical program SPSS 12,0 to calculate basic descriptive indicators, as well as T-test which calculates differences in game efficiency between the players of the first and the second league.

Results

Overview, interpretation and discussion of the results of basic statistical parameters of variables for assessing game efficiency of volleyball players of the first and second league

Table 1. Descriptive statistics of efficiency of volleyball players who play in the second league

Variable	N	Mean	Min	Max	Range	Varia	SD	CV	Error	Skew	Kurt
SEp	50	0.19	0.00	3.00	3.00	0.27	0.52	271.50	0.05	3.06	9.94
SE+	50	1.67	0.00	6.00	6.00	2.59	1.61	96.60	0.14	0.57	-0.74
SE-	50	2.55	0.00	7.00	7.00	3.23	1.80	70.50	0.16	0.09	-0.86
SE=	50	0.99	0.00	3.00	3.00	0.86	0.93	93.26	0.08	0.45	-0.87
DI-	50	0.63	0.00	9.00	9.00	3.13	1.77	278.63	0.16	3.19	9.81
DI+	50	0.90	0.00	14.00	14.00	5.80	2.41	266.16	0.21	3.06	9.89
DI=	50	2.63	0.00	26.00	26.00	47.48	6.89	262.31	0.61	2.49	4.70
PSi	50	2.52	0.00	11.00	11.00	12.46	3.53	139.86	0.31	1.02	-0.44
PS+	50	1.44	0.00	9.00	9.00	4.20	2.05	142.66	0.18	1.33	1.15
PS-	50	0.74	0.00	7.00	7.00	1.97	1.40	190.20	0.13	2.36	5.85
PS=	50	0.58	0.00	6.00	6.00	1.03	1.01	175.14	0.09	2.18	6.35
SMp	50	2.19	0.00	9.00	9.00	4.88	2.21	100.80	0.20	0.85	0.17
SM+	50	1.40	0.00	5.00	5.00	1.76	1.33	95.01	0.12	0.57	-0.58
SM-	50	0.76	0.00	4.00	4.00	0.85	0.92	121.35	0.08	0.99	0.24
SM=	50	1.00	0.00	4.00	4.00	1.37	1.17	117.09	0.10	1.04	0.29

Table 1 shows the results of central and dispersion parameters for volleyball players of the second league. The analysis of the table shows that the results of all arithmetic mean (Mean) are correct, as the standard error of arithmetic mean (Error) at all variables is five times less than the mean value. The value of basic, central and dispersion parameters of used criteria variables at minimum (Min) and maximum (Max) results have approximately 4 or more standard deviations (SD), which confirms significant sensitivity of the applied tests. However, the results of all applied criteria variables are rather

heterogeneous, which points to high coefficient variation (CV). Optimum curvature (symmetry) of distributions around arithmetic mean zone (Skew) is present at majority of variables, except at serve winner variable (SEp), setting at weak serve receive (DI-), safe setting (DI+), ideal setting (DI=), serve receive (PS-) and wrong reception (PS=) where distribution curve is oriented to the right. Data distribution is divided to compacted results (results significantly higher than 2,75) and rather loose results (results less than 2,75).

Table 2. Descriptive statistics of efficiency of volleyball players who play in the first league

Variable	N	Mean	Min	Max	Range	Varia	SD	CV	Error	Skew	Kurt
SEp	50	0.46	0.00	3.00	3.00	0.67	0.82	177.34	0.07	1.74	2.14
SE+	50	2.33	0.00	10.00	10.00	4.67	2.16	92.92	0.19	0.99	0.75
SE-	50	3.80	0.00	11.00	11.00	8.71	2.95	77.66	0.26	0.53	-0.42
SE=	50	1.28	0.00	8.00	8.00	2.33	1.53	119.47	0.14	1.80	4.48
DI-	50	0.82	0.00	16.00	16.00	5.13	2.26	276.97	0.20	4.09	19.78
DI+	50	1.37	0.00	16.00	16.00	11.64	3.41	248.53	0.30	2.79	7.06
DI=	50	3.26	0.00	36.00	36.00	66.61	8.16	250.21	0.73	2.54	5.40
PSi	50	3.40	0.00	16.00	16.00	23.73	4.87	143.08	0.43	1.08	-0.29
PS+	50	1.10	0.00	8.00	8.00	3.04	1.74	157.98	0.16	1.61	2.03
PS-	50	0.99	0.00	8.00	8.00	3.00	1.73	174.59	0.15	1.98	3.49
PS=	50	0.25	0.00	4.00	4.00	0.40	0.63	248.71	0.06	3.03	10.99
SMp	50	3.05	0.00	14.00	14.00	11.84	3.44	112.89	0.31	1.14	0.59
SM+	50	1.08	0.00	6.00	6.00	1.98	1.41	130.29	0.13	1.17	0.59
SM-	50	0.87	0.00	7.00	7.00	1.47	1.21	138.96	0.11	1.89	5.00
SM=	50	1.16	0.00	11.00	11.00	3.43	1.85	159.85	0.17	2.37	7.28

Table 2 shows the results of central and dispersion parameters for volleyball players of the first league. The analysis of the table shows that the results of all arithmetic mean (Mean) are correct, as the standard error of arithmetic mean (Error) at all variables is five times less than the mean value. The value of basic, central and dispersion parameters of applied prediction variables at minimum (Min) and maximum (Max) results have approximately 4 or more standard deviations (SD), which confirms significant sensitivity of the applied tests. However, the results of all applied criteria variables are rather heterogeneous, which points to high coefficient

variation (CV). Optimum curvature (symmetry) of distributions around arithmetic mean zone (Skew.) is present at some variables, while the distribution curve is oriented to the right or extremely to the right at majority of other variables. Data distribution is normal at winner serve variable (SEp), positive serve receive (PS+) and (PS-), while other variables may be divided to compacted results (results significantly higher than 2,75) and rather loose results (results less than 2,75).

DIFFERENCES IN GAME EFFICIENCY BETWEEN THE FIRST AND SECOND LEAGUE PLAYERS

Table 3. T-test of differences in game efficiency between the first and second league teams

Variable	N1	N2	Mean 1	Mean 2	SD1	SD2	F-ratio Varian	p-- Variances	t-value	df	p
SEp	50	50	0.46	0.19	0.82	0.52	2.49	0.00	3.1	250	0.00
SE+	50	50	2.33	1.67	2.16	1.61	1.80	0.00	2.7	250	0.01
SE-	50	50	3.80	2.55	2.95	1.80	2.70	0.00	4.1	249	0.00
SE=	50	50	1.28	0.99	1.53	0.93	2.72	0.00	1.8	250	0.07
DI-	50	50	0.82	0.63	2.26	1.77	1.64	0.01	0.7	250	0.48
DI+	50	50	1.37	0.90	3.41	2.41	2.01	0.00	1.3	250	0.21
DI=	50	50	3.26	2.63	8.16	6.89	1.40	0.06	0.7	250	0.51
PSi	50	50	3.40	2.52	4.87	3.53	1.90	0.00	1.6	250	0.10
PS+	50	50	1.10	1.44	1.74	2.05	1.38	0.07	-1.4	250	0.17
PS-	50	50	0.99	0.74	1.73	1.40	1.52	0.02	1.3	250	0.20
PS=	50	50	0.25	0.58	0.63	1.01	2.58	0.00	-3.1	250	0.00
SMp	50	50	3.05	2.19	3.44	2.21	2.43	0.00	2.4	250	0.02
SM+	50	50	1.08	1.40	1.41	1.33	1.12	0.52	-1.8	250	0.07
SM-	50	50	0.87	0.76	1.21	0.92	1.72	0.00	0.8	250	0.41
SM=	50	50	1.16	1.00	1.85	1.17	2.50	0.00	0.8	249	0.42

Table 3 shows differences between the first and second league players. The analysis shows statistically significant differences only at winner serve variable SEp, positive serve SE+, wrong serve SE-, winner spike SMp and wrong reception PS, where the first league players have better results. The second league players show better results at wrong reception variable PS=. Other variables show no statistically significant differences. Statistically significant differences at winner serve (SEp), positive serve (SE+) and negative serve (SE-) lead to the conclusion that the first league players are more efficient in serving than the second league players. Additionally, first league players have more negative serves, which is very common in volleyball as the players serve aggressively and thus the error percentage is higher (they serve and risk to make a mistake). The same refers to winner spike variable (SMp) where the first league players have better results which can be expected for the first league players, having in mind technical-tactical aspect. This also explains statistically significant differences in wrong serve variable (PS=) which is in favor of the second league players.

Conclusion

The goal of this paper is to determine the differences in playing efficiency, i.e. success at performing volleyball elements during the game at players of the first and the second Serbian league, season 2011/2012. Game efficiency has been observed

through the success in performing four volleyball elements: serve, serve receive, setting and spike.

Based on the obtained results, statistical data processing and interpretation, we may conclude the following:

After completing T-test, we have defined statistically significant difference in efficiency between the first and second league players at five variables: winner serve (SEp), positive serve (SE+), wrong serve (SE-), winner spike (SMp) and wrong reception (PS=), while other variables, such as wrong serve (SE=), corrected setting (DI-), safe setting (DI+), ideal setting (DI=), ideal reception (PSi), positive reception (PS+), negative reception (PS-), positive spike (SM+), negative spike (SM-), and spike error (SM=) have shown no statistically significant difference in game efficiency between the first and second league players.

Having in mind that some variables have shown statistically significant differences in game efficiency between the first and second league players, while other variables have shown no differences, hypothesis X1: There are differences in efficiency between volleyball players of the first Serbian league and the second Serbian league can be partly accepted.

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RAZLIKE U EFIKASNOSTI IGRE ODBOJKAŠA U UTAKMICAMA PRVE I DRUGE LIGE SRBIJE

Sažetak

Cilj ovog istraživanja je utvrditi razlike u učinkovitosti igrača u utakmicama prve i druge lige Srbije u odbojci. Uzorak ispitanika sastoji se od 100 odbojkaša seniora iz prve i druge srpske lige, sezona 2011/2012. Analiza efikasnosti igre temelji se na ocjenjivanju četiri tehničko-taktička elementa: servisa, primanja servisa, postavljanja i smeč. Nakon završetka t-test-a, definirali smo statistički značajnu razliku u učinkovitosti igrača u utakmicama prve i druge lige na pet varijabli: winner servis (SEP), uspješan servis (SE +), neuspješan servis (SE-), uspješan smeč (SMP) i pogrešno primanje (PS=), dok ostalih 10 varijabli, kao što su pogrešan servis (SE =), ispravno postavljanje (di-), sigurno postavljanje (DI +), idealno postavljanje (di =), idealno primanje (PSI), ispravno primanje (PS +), pogrešno primanje (PS), uspješan smeč (SM +), neuspješan smeč (SM-), pogrešan smeč (SM =) nije pokazala statistički značajnu razliku u učinkovitosti igrača u utakmicama između prve i druge lige Srbije.

Ključne riječi: Razlike, učinkovitost igre, odbojkaši.

Received: May 15, 2016

Accepted: June 15, 2016

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INSTRUCTIONS TO THE AUTHORS OF PAPERS

Aim and purpose of the journal

Sport science – is an International scientific journal, in the previous editions it has been related to the area of Kinesiology, and from this issue it is open to the areas of education, development and new achievements that are not related exclusively to the area of kinesiology. It is issued twice a year.

The Abstract

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