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HOMO SCIENTIFIC JOURNAL OF SPORT AND PHYSICAL EDUCATION

SPORTICUS

UDC 796.011 **VOLUME 13 - ISSUE 2 - DECEMBER, 2011**

ISSN 1512-8822



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FACULTY OF SPORT AND
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HOMO SCIENTIFIC JOURNAL OF SPORT AND PHYSICAL EDUCATION **SPORTICUS**



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HOMO SCIENTIFIC JOURNAL OF SPORT AND PHYSICAL EDUCATION **SPORTICUS**

ISSN: 1512 – 8822 (print)
ISSN: 1840 – 4324 (online)
UDC 796.011

Published by

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University of Sarajevo

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Text editing

Faculty of Sports and Physical Education

Desing, layout & DTP

Y Studio d.o.o. Sarajevo

Printed by

„ŠTAMPARIJA FOJNICA“ d.o.o. Fojnica
Printed in 100 copies

Indexed in: COBISS.BH, Index Copernicus, EBSCOHost, SPORTDiscus™
with Full Text, SPONET, getCited, CABI, Genamics Journal Seek,
NewJour, Open J-Gate, Ulrichweb

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Ventilation characteristics of young soccer players

¹ Faculty of Kinesiology, University of Split, Croatia

Original scientific paper

Abstract

The basic goal of this research was to determine differences in ventilation characteristics of soccer players in different age groups. The research was conducted on a sample of 66 soccer players competing in the Croatian First Soccer League. The subjects were divided into three age groups: U-15, U-17 and U-19. Along with height, weight, and body mass index, the following ventilation variables were measured: maximum minute ventilation, minute ventilation at anaerobic threshold, respiratory frequency, respiratory frequency at anaerobic threshold, forced vital capacity, forced expiration volume in the first second, the Tiffeneau index, peak expiration flow and forced expiration flows at 50%FVC and 25%FVC. Factorial ANOVA with Fischer LSD post-hoc test was used to determine the differences between groups of soccer players. The load required by a large respiratory minute volume stimulates growth and development of the thorax in young soccer players, thus making the thorax wider, longer and with more capacity. This is how the "athlete's lungs" are developed, having a larger volume of air, but also blood, and an enlarged surface of pulmonary alveoli. Soccer training strengthens and leads to the hypertrophy of the muscles of respiration, as well as to more economical breathing with lower frequency. Physical strain results in the increased capability of the respiratory airways to conduct air, i.e. the increase of the ventilation function of lungs. Obtained results suggest that the size and function of lungs increase with the increase in the size of the body.

Key words: **maximal ventilation, spirometric parameters, soccer**

Sažetak

Osnovni cilj ovog istraživanja bio je utvrditi razlike ventilacijskih osobitosti između nogometaša različitih dobni skupina. Istraživanje je provedeno na uzorku od 66 nogometaša koji se natječu u Prvoj hrvatskoj nogometnoj ligi. Ispitanici su podijeljeni u tri dobne kategorije: pioniri, kadeti i juniori. Osim visine, težine, indeksa tjelesne mase, izmjerene su sljedeće ventilacijske varijable: maksimalna minutna ventilacija, minutna ventilacija na anaerobnom pragu, respiratorna frekvencija, respiratorna frekvencija na anaerobnom pragu, forsirani vitalni kapacitet, forsirani ekspiracijski volumen u prvoj sekundi, Tiffeneau index, vršni ekspiracijski protok kao i forsirani ekspiracijski protoci pri 50%FVC i 25%FVC. Za utvrđivanje razlika između skupina nogometaša korištena je Factorial ANOVA s Fischer LSD pos-hoc testom. Opterećenje koje zahtijeva veliki minutni volumen disanja potiču rast i razvoj prsnog koša kod mladih nogometaša, te na taj način grudni koš postaje širi, dulji i ima veću zapreminu. Tako se razvijaju „sportska pluća“ s većim obujmom zraka, ali i krvi, te povećanom površinom plućnih alveola. Nogometni trening jača i dovodi do hipertrofije dišne muskulature, kao i do ekonomičnijeg disanja s manjim frekvencijom. Fizički napor ima za posljedicu povećanje provodljivosti dišnih puteva, odnosno povećanje ventilacijske funkcije pluća. Dobiveni rezultati sugeriraju kako se povećanjem veličine tijela povećava veličina i funkcija pluća.

Ključne riječi: **Bodovni pravilnik FIG, preskok, sportska gimnastika, biomehanika**

Introduction

Diagnostic procedures in sport consist of determining the health status of an athlete, the level of fitness, abilities and characteristics important for success in sport. With the help of functional abilities diagnostics, through integrative cardiopulmonary load testing in controlled conditions and gas exchange measurement, i.e. spirometric parameters, the capacities of the cardiovascular and respiratory systems can be precisely evaluated. Ventilation is the exchange of gases between the external area and alveolar areas in lungs and vice versa. It is tested by methods of spirometry and body pletismography. These methods measure pulmonary volumes and capacities and the amount of air flow (the resistance to air flow) in the respiratory airways. Breathing is a process that consists of ventilation, diffusion of oxygen and carbon dioxide through the alveolar membrane and the corresponding blood flow through the pulmonary capillaries. Breathing, i.e. the exchange of oxygen and carbon monoxide between a cell and the atmosphere changes with physical activity. The integral part of function diagnostics is also the testing of the pulmonary ventilation function. The testing of pulmonary ventilation in practice comprises the measurement of lung volume and capacity, as well as the amount of the air flow. Pulmonary volumes are basic capacities of the lungs, i.e. capacities of air that the lungs contain in different breathing positions. Two or more pulmonary volumes make up the capacity of lungs. Spirometry is a method that measures the capacity of air which the lungs breathe, and it

is used in measuring static and dynamic pulmonary volumes and capacities. Obtained results are compared with reference (normal, theoretical) values according to sex, age, height and body weight. There is an entire series of other physiological parameters used in the training process and during diagnostic procedures, such as: maximum minute ventilation (VE_{max}), minute ventilation at the anaerobic threshold (VE_{VP}), respiratory frequency (RR_{max}), respiratory frequency at the anaerobic threshold (RR_{VP}), as well as many others. The amount of air we can ventilate in one minute is the respiratory minute volume (RMV). During physical activities both the depth and frequency of breathing increase, so the respiratory minute volume, i.e. minute ventilation increases proportionally to the intensity and duration of work. Ventilation at maximum loads reaches values of the so-called maximum respiratory minute volume. When measuring ventilation, we actually measure respiratory minute volume. Breathing frequency is the number of respiratory cycles in one minute. The respiratory frequency while resting amounts to between 12 and 20, while it increases to 50-60 cycles per minute at maximum load, and even more. The interpretation of functional abilities of soccer players is more difficult than in individual sports, where results are more easily and more correctly predicted based on functional abilities. In spite of this, determining functional abilities of soccer players results in numerous useful information, both for the team and the individual.

Method

Sample of the examinees

The research was conducted on a sample of 66 soccer players competing in the Croatian First Soccer League. The subjects were divided into three age groups: U-15 (N=22), U-17 (N=22) and U-19 (N=22). The majority of subjects play for national U-15, U-17 and U-19 teams, so we can say that the sample is representative.

Sample of the variables

Except for height (cm), weight (kg), and body mass index, maximum minute ventilation (VE_{max}), minute ventilation at anaerobic threshold (VE_{vp}), respiratory frequency (RR_{max}), and respiratory frequency at the anaerobic threshold (RR_{vp}) were also measured. VE_{max} , VE_{vp} , RR_{max} , as well as RR_{vp} , were obtained through spirometric testing of progressive load on the spirometric system Quark PFT 4ergo (COSMED, Italy) which enables a continuous on-line, breath-by-breath monitoring of all ventilation and metabolic parameters. Procedures for measuring spirometric parameters and parameters at the ventilation anaerobic threshold were defined according to Wasserman et al., 1999, Green and Dawson, 1996; Brisswalter et al., 1996. Spirometric procedure on the spirometric system MicroQuark PC-based spirometer (COSMED, Italy) was used to measure static and dynamic volumes, as well as the flow-volume curve. The forced vital capacity (FVC) was measured from the group of static capacities, and the forced expiration volume in one second (FEV1) and the Tiffeneau index (TIFF) were measured among the dynamic capacities. The flow-volume curve measured the peak expiration flow (PEF), as well as the forced expiration flows at 50%FVC (FEF50) and 25%FVC (FEF25). Measurement procedures were conducted according to well-known standards (Knudson et al., 1976, and Miller et al., 2005).

Data processing methods

Factorial ANOVA with the Fischer LSD post-hoc test was used to determine differences between groups of soccer players.

Results and Discussion

Table 1 shows that there is a rising trend of morphological variables towards the older age group of soccer players. The U-17 soccer players are slightly taller than the U-15 group, but these differences are not statistically relevant. The U-19 soccer players are significantly taller than both the U-15 and the U-17 players. Considering the weight and body mass index it is evident that there are statistically significant differences between all the stud-

ied groups of soccer players. The U-15 soccer players from this research are anthropometrically most similar to Belgian soccer players from the same age group (175 cm, 65 kg, Segers et al. 2002). The heights of Brazilian U-17 soccer players (Dourado et al. 2007, Da Silva et al., 2008) range from 173 to 177 cm, and the weights between 60 and 71 kg. Furthermore, the U-17 soccer players from Japan are within the stated ranges (173 cm, 65 kg, Tahara et al., 2006), while the U-17 players from Switzerland (177 cm, 69 kg, Rico-Sanz, 1998) are anthropometrically the most similar group to the studied sample of the U-17 soccer players. A partial overview of past research of anthropometric characteristics in Brazilian U-19 soccer players recorded results for height in ranges of 174-181 cm, and for weights between 66-77.5 kg (Da Silva et al. 2008). Similar values for heights and weights in the stated ranges were recorded in players of the same category from Tunisia (Chamari et al., 2004), Greece (Metaxas et al., 2005), Switzerland (Rampinini et al. 2007), Singapore (Aziz et al. 2005), Great Britain (McMillan et al. 2005) and Norway (Helgerud et al., 2001). According to their morphological characteristics (Table 1), the studied sample of the U-19 soccer players is very similar to Italian football players (181 cm, 73 kg, Di Salvo and Pigozzi, 1998), and the Spaniards (180 cm, 75 kg, Mujika et al., 2000). The body mass index values for the U-15, U-17 and U-19 categories of soccer players are very similar to Brazilian soccer players (Dourado et al. 2007). The average height value of a U-15 player (176.40 cm) is considerably higher than the reference values, and is found above the 75th percentile in comparison with the results from previous studies. The average height of a U-17 (178.04 cm) and U-19 (181.88 cm) player goes along the line of the 75th percentile. The value of the average U-15 player's weight (63.52 kg) is considerably higher as compared with the reference values, and is located above the 75th percentile in comparison with the results from previous studies. The average weight of the U-17 (69.00 kg) and U-19 (75.05 kg) player is on the line of the 75th percentile. When observing soccer players from this research, it can be concluded that the U-15 players "deviate" from the stated scope. The probable reasons for that should be looked for in the fact that a lot of the studied U-15 soccer players are ones who experienced accelerated growth, i.e. they matured earlier. The changes in size and composition of the body occur and increase with puberty and maturation (Malina et al. 2004). The differences between boys of different maturity (equal chronological, but different biological age) are most obvious between the age of 13 and 16 (Malina et al. 2004). The growth and maturation of young soccer players may affect the selection processes, which is probably the case with the U-15 soccer players from this research. The soccer players were selected based on their size and maturity. At the time of selection they were probably the best players because of their size, strength and power, which is connected to the early maturation in U-15 soccer players.

Table 1. Comparative analysis of the morphological variables applied to the soccer players of various age groups

	U-15 (N = 22)	U-17 (N = 22)	U-19 (N = 22)
Variables	AM (SD)	AM (SD)	AM (SD)
H (cm)	176,40 (5,60)	178,04 (4,98)†	181,88 (4,72) ²
W (kg)	63,52 (7,41)*	69,00 (6,53)††	75,05 (6,07) ³
BMI (kg/m ²)	20,35 (1,63)**	21,72 (1,24)†	22,67 (1,49) ³

Key: analysis of variance - Factorial ANOVA with Fisher LSD post-hoc test; (AM – arithmetic mean; SD - standard deviation);

*p<0.05; **p<0.01; ***p<0.001 – significance of differences between the U-15 and U-17 group of soccer players

†p<0.05; ††p<0.01; †††p<0.001 – significance of differences between the U-17 and U-19 group of soccer players

¹p<0.05; ²p<0.01; ³p<0.001 – significance of differences between the U-15 and U-19 group of soccer players

This research recorded an increase in the minute ventilation (Table 2) towards the older age group. U-15 and U-17 players achieve similar values, while the ventilation values achieved by U-19 soccer players are however slightly higher. Differences between different age groups of soccer players exist, but they are not statistically relevant. A similar rising trend is found in the values of ventilation at the anaerobic threshold. The U-19 players have statistically higher values than both the U-15 and U-17 players. The U-15 soccer players achieve higher values of minute ventilation than U-15 soccer players from Belgium (Segers et al. 2002). The U-17 players have similar minute ventilation values as the soccer players from previous studies (Tahara et al. 2006), while the U-19 players achieve higher values of minute ventilation with regard to the soccer players from Greece (Metaxas et al. 2005) and Singapore (Aziz et al. 2005). Maximum ventilation can be increased by training, e.g. the average ventilation of a group of Danish players increased from approximately 142 to 148 L/min after four weeks of intensive training (Bangsbo, 1994). Pulmonary ventilation on the increase during the load is in direct proportion with metabolic needs of the body. Maximum minute ventilation depends on the size of the body. Ventilation values of around 100 L/min are common for "smaller" individuals, whereas the values of 200 L/min can be found in "larger" individuals. Pulmonary function changes significantly with age. Minute ventilation increases with age up to physical maturity, after which it decreases with the age increase. These changes are connected with the growth of the entire pulmonary system. As the body size increases with growth and development, the size and function of lungs increase accordingly, which explains the obtained differences in minute ventilation of the studied soccer players. During the exercise, i.e. load, the ventilation increases due to the increased demand of muscles for oxygen, reaching up to 100 L/min for untrained individuals, and over 200 L/min for extremely fit athletes.

The recorded values of the maximum respiratory frequency / breathing frequency are similar in the U-15 and U-17 players, while the U-19 players have statistically significantly lower values in comparison with the U-17 group. The values of respiratory frequency

in the U-19 soccer players (53.7) are somewhat lower than those of the Greek soccer players of the same age group (55.3-59.8; Metaxas et al. 2005). The values of the respiratory frequency at the anaerobic threshold are similar in all three groups of soccer players and there are no statistically significant differences among them. The breathing frequency continuously decreases during growth and development, which is evenly continued during puberty as well. The decrease of the breathing frequency with age is the sign of a more economical breathing in the older age group of soccer players.

The overview of spirometric variables (Table 2) shows an evident rise in relative values of all applied variables towards the older age group. It is noticeable that the U-15 and U-17 players statistically significantly differ in the FEV1, PEF and MEF50 variables. In the FVC, Tiff and MEF25 variables there are no statistically significant differences between the U-15 and U-17 soccer players. It is interesting to note that there are no statistically significant differences in the studied spirometric variables between the U-17 and U-19 soccer players. The U-15 and U-19 players statistically significantly differ in 4 out of 6 spirometric variables. The differences are not statistically significant in the Tiff and MEF25 variables. Furthermore, it can be said that soccer players achieve above-average values in almost all parameters with regard to the predictive values. The obtained results are very similar to the results of athletes of the same age (soccer players and handball players) from the research by Goić-Barišić et al. 2006. The U-17 soccer players have above-average results of spirometric parameters in relation to the standardized values of the U-17 male population. The FEV1 (forced expiration volume in one second – 113.61%) values are higher than those of elite Scottish swimmers (83.9%; McKey et al. 1983). Furthermore, it is noticeable that the U-19 soccer players also have above-average results in comparison with standards for the U-19 age group. The achieved FEV1 values amount to 116%. Elite Scottish U-19 swimmers have FEV1 value of 93.4% (McKey et al. 1983). The studied soccer players have higher values of all spirometric parameters in relation to competitive sailors (Uljević et al. 2008), while the results are very similar to the achieved values of the U-19 soccer players from the same

Table 2. Comparative analysis of the ventilation variables applied to the soccer players of various age groups

	U-15 (N = 22)	U-17 (N = 22)	U-19 (N = 22)
Variables	AM (SD)	AM (SD)	AM (SD)
RR _{max} (1/min)	57,06 (6,76)	59,18 (6,45)†	53,68 (8,08)
VE _{max} (L/min)	142,28 (21,99)	141,83 (16,72)	149,29 (21,70)
RR _{vp} (1/min)	43,74 (7,55)	42,43 (7,74)	45,25 (8,44)
VE _{vp} (L/min)	88,07 (19,31)	83,95 (12,01)†††	102,66 (16,53)²
FVC (%)	99,73 (7,74)	103,67 (7,47)	104,74 (6,96)¹
FEV1 (%)	106,56 (4,84)**	113,61 (7,87)	116,00 (9,09)³
TIFF (%)	108,67 (10,98)	112,28 (8,30)	111,55 (6,39)
PEF (%)	101,98 (23,46)**	122,65 (12,59)	132,79 (20,35)³
FEF50 (%)	108,46 (18,95)*	123,35 (21,58)	132,45 (26,11)²
FEF25 (%)	120,64 (31,61)	119,96 (26,58)	140,23 (42,77)

Key: analysis of variance - Factorial ANOVA with Fisher LSD post-hoc test; (AM – arithmetic mean; SD – standard deviation);

*p<0.05; **p<0.01; ***p<0.001 – significance of differences between the U-15 and U-17 group of soccer players

†p<0.05; ††p<0.01; †††p<0.001 – significance of differences between the U-17 and U-19 group of soccer players

¹p<0.05; ²p<0.01; ³p<0.001 – significance of differences between the U-15 and U-19 group of soccer players

research. When comparing the individual spirometric parameters of U-19 soccer players with Gaelic football players of similar anthropometric characteristics, it can be stated that the studied soccer players have higher values of the FEV1 (116%) and PEF (133%) variables than Gaelic football players (FEV1-112%, PEF-114%; Watson 1995). Gaelic football players have higher values of the FVC variable (115%; Watson 1995) than the studied U-19 soccer players (105%). Competitive cyclists and triathletes (Kippelen et al. 2005) achieve somewhat higher FVC values (117%) than the U-19 soccer players from this research (105%). However, the values of the FEV1 (116%) and the Tiffeneau index (112%) are higher in the studied soccer players than in competitive cyclists and triathletes (FEV1-112%, Tiff-81%; Kippelen et al. 2005). Table 2 shows that the studied U-15, U-17 and U-19 soccer players have considerably higher values of the FEV1 variable (107%, 114%, 116%) than elite adult (19+) soccer players from Hong Kong (Chin et al. 1992). The lung volume in young soccer players depends on body size and it changes approximately as the height changes up to around 25 years of age. In late childhood and adolescence, the abovementioned changes happen mostly through the widening of the existing alveoli and respiratory airways. However, the effect of training on the respiratory system is extremely significant. Exercises which require a large respiratory minute volume stimulate the growth and development of the thorax in young soccer players, thus making the thorax wider, longer and with a larger capacity. The so-called "athlete's lungs" develop in the larger thorax, with a larger volume of air, but also blood, and an enlarged surface area of pulmonary alveoli. In addition, the training strengthens and leads to the hypertrophy of the muscles of respiration, as well as to more economical breathing with a lower frequency. In healthy people physical strain results in the increased capability of the respiratory airways to conduct air, i.e. the increase in the ventilation function of lungs. This effect of the physical strain is based on the increased number of functionally active small respiratory airways and dilation of bronchi and bronchioles, and is probably the result of a decreased tone of the parasympathetic nervous system. The size and function of lungs increases with the increase in body size, which explains the differences found in studied soccer players.

Conclusion

The results of this research confirm the thesis that changes in body size and structure, as well as functional capacities occur and increase with puberty and maturation. The growth and development of children last continuously until the adult age. Entering puberty is marked with a significant acceleration of body dimensions growth. Children continue to grow after puberty, but at a considerably slower pace. The beginning of the adolescent accelerated growth and the year of highest height increase are indicators of the child's maturity. The increase in body dimensions is followed by the growth and development of cardiovascular and respiratory systems. If soccer training is performed throughout a longer time period, functioning of the system for transport and usage of oxygen improves. Naturally, the abovementioned changes are connected with the growth of the entire pulmonary system as well. As the body size increases with growth and development, so does the size and function of lungs, and this explains the differences found in the studied soccer players. Soccer training has a major effect on the development of functional abilities, and the results get progressively better towards older age so it can be expected that the U-15 and U-17 players will reach similar values in the U-19 age group.

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Submitted: November 13. 2011.

Accepted: November 30. 2011.

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Effect of acute exercise on uric acid serum levels in the experimental model

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Original scientific paper

Abstract

Increased oxygen consumption during aerobic exercise is one of the main cause of accompanied oxidative stress. Oxidative stress is a condition of a disturbed balance between reactive oxygen species (ROS), reactive nitrogen species (RNS) and antioxidative defense. Antioxidants are substances that reduce the damage caused by oxidative stress. Uric acid is one of the most important antioxidant. The aim of this study was to estimate the influence of acute exercise on uric acid serum levels in rats. Adults Wistar rats weighting between 280-330 g were divided into two groups: control group (n = 8) and exercise group (n = 8). Exercise group was exposed to acute bout of exercise (swimming), after short accommodation period. Control group was consisted of animals housed in the same condition without exercise sessions. Animals were sacrificed and blood sample was taken from the abdominal aorta to determine uric acid levels. Levels of uric acid in serum samples were determined by spectrophotometric method.

Acute exercise (swimming) significantly increased average concentration of uric acid in exercise group (246.5 ± 19.1 mmol / l) when compared to control group (226.11 ± 7.8 mmol / l) ($p = 0.03$).

Acute exercise increases the concentration of uric acid in serum probably as an antioxidant response to enhanced oxidative stress

Key words: stress, swimming, uric acid

Sažetak

Povećana potrošnja kisika u toku fizičkog opterećenja aerobnog tipa jedan je od glavnih uzroka povećanog oksidativnog stresa. Oksidativni stres je stanje poremećene ravnoteže između reaktivnih vrsta kiseonika (ROS) i reaktivnih vrsta azota (RNS) sa jedne i antioksidativne zaštite sa druge strane. Antioksidansi su tvari koje u organizmu pomažu u smanjenju oštećenja nastalih pri oksidativnom stresu. Jedan od najvažnijih antioksidansa je urična kiselina. Cilj istraživanja je bio da se ispita uticaj fizičke aktivnosti na koncentraciju urične kiseline u serumu štakora.

Odrasli Wistar štakori težine 280-330 g, bili su podijeljeni u dvije grupe: kontrolna grupa (n=8) i grupa štakora koji su vježbali (fizički aktivni) (n=8). Grupa fizički aktivnih štakora bila je izložena akutnoj sesiji vježbanja (plivanje), nakon kratkog perioda adaptacije. Kontrolnu grupu su činile životinje koje nisu bile izložene fizičkoj aktivnosti, a držane su u istim uslovima. Nakon posljednje sesije vježbanja životinje su žrtvovane, a uzorak krvi za određivanje urične kiseline uzet je iz abdominalne aorte. Koncentracija urične kiseline u serumu određena je spektrofotometrijskom metodom.

Fizička aktivnost je dovela do statistički značajnog porasta koncentracije urične kiseline u serumu, te je koncentracija urične kiseline u serumu u grupi fizički aktivnih štakora bila značajno veća u odnosu na kontrolnu grupu štakora ($246,5 \pm 19,1$ mmol/l vs. $226,11 \pm 7,8$ mmol/l; $p = 0.03$). Fizička aktivnost (plivanje) dovodi do porasta koncentracije urične kiseline u serumu, najvjerojatnije kao odgovor na povećan oksidativni stres.

Ključne riječi: stres, plivanje, urična kiselina

Introduction

Exercise is activity which affects practically every organ and tissue in our body, contributing to human health, while sedentary lifestyle is in relation with many chronic health problems. However, many studies have shown that acute aerobic exercise increased consumption of oxygen and leads to oxidative stress, which depends on type and intensity of exercise and general body status.

It has been shown that antioxidative status during acute exercise varies on type of the exercise (1). Two mechanisms connect acute aerobic exercise with oxidative stress: increased pro-oxidative activity and inadequate antioxidative defence (2). On the other hand, some studies have shown that daily training (30 min, 60%VO₂max) increases resistance to lipid peroxidation caused by reactive oxygen species, decreases accumulation of oxidative proteins and decreases DNA damage, diminishing therefore the risk of many diseases, where oxidative stress is involved in their pathophysiological mechanism. It has been shown that sedentary subjects have less effective antioxidative system comparing to physical active subjects (3,4).

Oxidative stress is defined as damage in cells and tissues, caused by reaction of reactive oxygen species (ROS) and reactive nitrogen species (RNS) and impaired antioxidative defence mechanisms on the other side(5). Antioxidants are compounds, presented in all body fluids and tissues, which play role in protecting organism against endogenous produced free radicals, respectively oxidative stress.

Uric acid is strong endogenous antioxidant in our body (6) and presents final product of purine bases (adenine and guanine). Its concentration in human blood depends on age, gender, body area and body weight, ethnic group and geographical position. It has also been considered as main salivary antioxidant, because it participates in approximately 70% of total antioxidative capacity of saliva (7,8).

Considering the fact that the main characteristic of human is their ability to protect themselves against excessive and uncontrolled oxidation, we believe that oxidative stress could activate defence systems and make them more resistant to possible impairments. It is possible that oxidative stress associated with exercise pres-

ents „trigger“ of adaptation mechanisms, such as synthesis of antioxidative and reparative enzymes, with development of antioxidative defence mechanisms as their final result. This is the way we could explain positive effects of exercise.

The aim of our study was to estimate the influence of swimming exercise on concentration of uric acid in the serum of rats.

EXPERIMENTAL ANIMALS AND METHODS

Experimental animals

Adults Wistar rats, weighting between 280-330 g, were divided into two groups: control group (n = 8) and exercise group (n = 8). All animals were kept under the same laboratory conditions of relative air moisture (45-55%) and room temperature. All the rats were given standard rat chow and tap water *ad libitum*.

All the experimental procedures were performed at Medical faculty Sarajevo, Department of Physiology and previously approved by the Ethic Committee of Medical Faculty Sarajevo.

Exercise protocol

Before we performed acute bout of exercise we exposed rats to daily swimming session aimed to the acclimatization to water conditions and swimming, as type of exercise. Exercise group was exposed to swimming exercise daily, between 10.00 AM to 11.00 AM, for 6 days. Duration of each swimming session progressively increased from 5 minutes on the first day to 30 minutes on the sixth day. The rats were swam in plastic tanks (width 90 cm, depth 120 cm), containing tap water (temperature of $\approx 25^{\circ}\text{C}$). The depth of water was 40 cm. A maximum of two rats, same sex, were allowed to swim together.

Seventh day we performed acute bout of swimming exercise. Rats swam 40 minutes until exhaustion at the same conditions as in the period of adaptation. The body weight of each rat was measured before starting of accommodation period and after the last swimming session.

Determination of uric acid in the serum of rats

The blood sample is taken from the abdominal aorta and centrifuged 5 minutes at 3000 rpm. Serum was stored at -80°C until determination of uric acid levels.

Concentration of uric acid in the serum samples was determined by spectrophotometric method using commercial kits (Bio-Systems S.A. Spain). The method is based on determination of colour intensity of the complex, resulting from uricase reaction.

Statistical analyses

Data are analysed with standard statistical methods using computer program Excel (Microsoft Office Excel 2003) and SPSS computer package 13.0 (SPSS-Statistical Package for Social Sciences). Results are presented as mean (X) and standard error

of the mean (SEM). Kolmogorov-Smirnov test was used to test the significance of differences in deviation of normal distribution. Data are analysed using parametric test, after determination of uniform distribution of variables. Value $p < 0,05$ was considered significant.

Results

There were no statistically significant differences in body weight or food intake between control and exercise group at the beginning of the experiment. (Table 1).

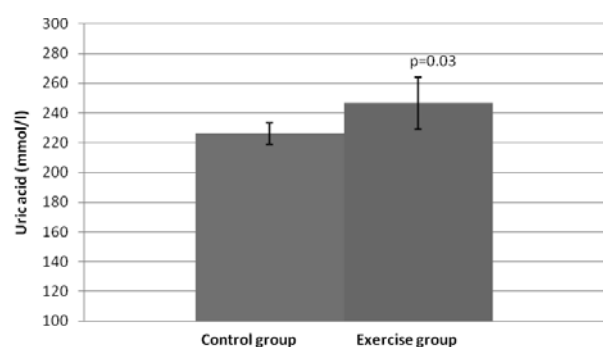
Table 1. Mean values of body weight, daily food intake and concentration of uric acid in control and exercise group before and after exercise

	Control group (n=8)	Exercise group (n=8)	
		Before	After
Body weight (g)	291,4 \pm 13,7	296,3 \pm 14,1	272,8 \pm 21,4
Food intake (g/d)	21,7 \pm 2,3	22,4 \pm 1,4 (1. day)	21,4 \pm 2,3 (7. day)
Uric acid (mmol/l)	226,11 \pm 7,8		246,5 \pm 19,1

Results are presented as means \pm SEM.

Swimming slightly decreased body weight in the exercise group of rats comparing to the values before the start of experiment (296,3 g vs. 272,8 g), but this difference was not statistically significant (Table 1). Exposure to daily exercise didn't affect daily food intake in stress group (Table 1).

Chart 1. Uric acid levels in control group and in exercise group after exercise



In the control group average concentration of uric acid in the serum was 226,11 \pm 7,8 mmol/l. Average values of uric acid in the exercise group after acute bout of exercise was 246,5 \pm 19,1 mmol/l.

Statistically significant difference was determined in concentration of uric acid in the serum between control and exercise group ($p=0,03$) (Chart 1).

Discussion and Conclusion

Oxidative stress induced tissue damages may be the cause of many disorders which occur after exposed to the stress situations. Today, there are more than fifty diseases whose pathophysiological mechanisms are associated with production of free radicals and oxidative stress, also including the two most expanded chronic diseases - atherosclerosis and cancer, as well as a whole variety of chronic degenerative diseases, such as arthritis, vasculitis, autoimmune diseases, early aging, etc. Reactive oxygen species can be involved in formation of so-called clastogenic factors (factors who ravage the hormones), appearance which is lately connected to process of cancerogenesis (9).

Several studies have shown that exercise causes oxidative stress accompanied by oxidative cell damage, whose range prior depends on type and intensity of exercise and general body conditions.

However, the appearance of free radicals doesn't mean the appearance of the disease at the same time, because there are protective defence mechanisms in the body, so-called antioxidative system. Antioxidants are compounds, presented in all body fluids and tissues, who play role in protecting organism against endogenous produced free radicals. Therefore the main role of antioxidants is the prevention or reduction of oxidative damages in biological systems, without interfering with physiological functions.

Antioxidants, endogenous (present in our diet) and exogenous (made in our body), include several enzymes (superoxid dismutase, glutation peroxidase), proteins, vitamins C and E, β -carotene, uric acid, bilirubin and albumin. Thus uric acid presents one of the the most important endogenous antioxidant of the body.

Evaluation of different antioxidants during stress is important for identification of mechanisms involved in oxidative stress.

The aim of our study was to determinate influence of exercise on the uric acid serum levels as an serum antioxidant.

Results of our study have shown significant differences in concentration of uric acid in the serum of rats in control and exercise group after acute bout of exercise (swimming). Our results are consistent with the results of previous studies, which explain this increase in concentration of uric acid by activation of antioxidative protection, as a reaction to incurred oxidative stress.

The increase of uric acid serum levels during exercise was confirmed also by Groussard et al. (10), who noticed that short-term exercises, among other things, stimulate purine catabolism and lead subsequently to increase of uric acid concentration. In addition Aguilo et al. (11) demonstrated in their research how exhaustive exercise (mountain bicycling) causes the increase of uric acid concentration, with the increase of glutation reductase activity and decrease of glutation peroxidase activity. Based on biochemical findings, it is considered that uric acid removes reactive oxygen species and thereby reduces ROS mediated damages in the body (12).

Many studies have shown that high intensity exercise can increase the production of free radicals and cause oxidative tissue damages (13,14). The impact of acute exercise on production of free radicals and antioxidative system is being explored inten-

sively (15, 16). F2- isoprostane concentration (marker of oxidative stress) is significantly higher after moderate exercise (38%), exhaustion (45%) and 1 hour after recovery (31%) (17). Mastaloudis et al. (18) also established that the F2 isoprostane level significantly increased during 50 km long ultramarathon, returning to initial levels after the race.

Leeuwenburgh et al. (19) in their study showed that acute exercise causes higher levels of oxidants and oxidative stress in untrained animals. However, long-term exercise can cause opposite effect, increasing the activity of antioxidative enzymes and decreasing the production of oxidants. In fact, they showed that animals, after long-term exercise, had lower levels of oxidative stress markers in muscles and in urine.

McIntosh and Sapolsky (20) believe that increased level of reactive oxygen species in stress situations, like acute exercise, could be conditioned by increased concentration of glucocorticoids. In their research, mentioned hormones lead to increased production of reactive oxygen species in the body.

In exercise group, we measured levels of uric acid only in blood samples taken after animal sacrifice, assuming that taking the blood sample before exercise would cause additional stress which could affect tested values. Besides, we believe that, in that case, levels of uric acid taken from rat's tail vein would differ from levels measured in abdominal aorta. In fact, taking sample from rat's tail vein, part of extracellular fluid is retroceded, which attenuates the sample and decreases the concentration of examined substances.

Our study shows that acute bout of 40-minutes swimming exercise leads to increase uric acid serum levels in rats, as possible antioxidative reponse to increased oxidative stress.

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Submitted: November 21, 2011.

Accepted: November 28, 2011.

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Position-related differences in the amount, intensity and speed of movement in elite football players

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Original scientific paper

Abstract

The objective of this study was to determine position-related differences in the amount, intensity and speed of movement in elite football players. The variables describe the amount, intensity and speed of movement of the players when in possession of the ball, when not in the possession of the ball, and when the ball is out of play. A random selection of 150 players (30 for each playing position, goalkeepers excluded) from a population of 226 players drawn from the 32 national teams that have participated in the 2010 World Cup finals in South Africa, and have played at least 250 minutes in 3 matches. Univariate analyses of variance revealed significant positional differences in total distance covered, the greatest distance being covered by defensive midfielders (10.50 km) and offensive midfielders (10.39 km). Defensive midfielders (4.2 km) and forwards (4.0 km) covered the greatest distance when their team is in possession of the ball, and defensive midfielders (4.45 km) when their team is not in possession. When the ball is out of play there are no statistically significant differences between particular types of players. With respect to the intensity of activity, we observed that the forwards spend the most time in low intensity activities (54.01 min), defensive midfielders in the medium intensity activities (6.20 min), while the offensive midfielders spend the most time in high intensity activities (6.51). These results could be useful to coaches and performance specialists when designing position-specific training and conditioning programs.

Key words: **football, movement, playing position**

Sažetak

Osnovni cilj ovog istraživanja bio je utvrditi razlike između centralnih i bočnih defanzivnih, veznih defanzivnih i ofanzivnih igrača te napadača u varijablama koje opisuju količinu, intenzitet i brzinu kretanja nogometaša u posjedu i bez posjeda lopte te dok je lopta izvan igre. Istraživanje je provedeno na slučajno odabranom uzorku od 150 igrača (30 za svaki tip igrača) iz populacije igrača koji su odigrali najmanje 250 minuta u 3 utakmice (226 igrača) iz 32 nacionalne reprezentacije koje sudjelovale na završnici Svjetskog nogometnog prvenstva 2010. godine u Južno Afričkoj Republici. Za utvrđivanje razlika između pojedinih tipova igrača korištena je univarijantna analiza varijance, te Scheffeoov test. Usporedbom pojedinih tipova igrača u prosječno pretrčanim kilometrima tijekom jedne utakmice utvrđeno je da najviše pretrče defanzivni vezni igrači (10.50 km) i ofanzivni vezni igrači (10.39 km). Defanzivni vezni igrači (4.2 km) i napadači (4.0 km) imaju najviše prosječne vrijednosti pretrčane udaljenosti kad je ekipa u posjedu lopte, a defanzivni vezni igrači (4.45 km) kad ekipa nije u posjedu lopte. Za vrijeme kada je lopta izvan igre nema statistički značajne razlike u pretrčanoj udaljenosti između pojedinih tipova igrača. Usporedbom pojedinih tipova igrača s obzirom na intenzitet aktivnosti, moguće je uočiti da napadači najviše vremena provode u aktivnostima niskog intenziteta (54.01 min), defanzivni vezni igrači u aktivnostima srednjeg intenziteta (6.20 min), dok u aktivnostima visokog intenziteta najviše vremena provode ofanzivni vezni igrači (6.51 min).

Ključne riječi: **nogomet, kretanje, tipovi igrača**

Introduction

Football game is characterized by a multitude of tasks the players perform during a match, which is manifested through a large amount of different types of movements (walking, running, sprinting, jumping, sliding, duel, etc.). It has been, for example, established that elite football players cover over 10.5 km per match (Rampinini et al., 2007; Dellal et al., 2010), 30% of which consists of high-intensity movements (Rampinini et al., 2007; Bradley et al., 2009 and 2010). The players that are engaged more in the phase of attack create more opportunities to receive the ball and make a meaningful pass to a teammate. In the phase of defense, a greater amount of movement allows the players to create high pressure primarily on the player in possession of the ball, but on the other players as well, which prevents the opposing team from organizing their play in the phase of attack.

As a result of specific demands formed by the large dimensions of the pitch, through the development of the football game, a need for specialization of players for certain positions in the team has appeared. In previous researches, differences in the amount of movement between players that play on different positions have

been established (Di Salvo et al., 2007 and 2009; Bradley et al., 2009 and 2010; Bangsbo et al. 1991; Reinzi et al. 2000; Dellal et al., 2010). Di Salvo and associates (2009) have, for example, established that in English Premier League the type of players which cover the most distance in high intensity are side backs (on average 10.96 ± 1.06 km/match), while the least distance covered in high-intensity was covered by central defenders (on average 0.68 ± 0.13 km/match). Aside from this, it has been established that the amount of movement differs between players that belong to different football traditions. For example, players in English Premier League cover on average 10.1 ± 0.7 km/match which is significantly more than the elite South American players who cover on average 8.64 ± 1.16 km/match (Reinzi et al., 2000).

Total amount of movement, or distance covered, is usually divided into activities of low, medium and high intensity (Rampinini et al., 2007; Bradley et al., 2010). In regard to movement with high intensity, we can again find differences between particular types of players. According to the research done by Bradely et al. (2009) side midfielders spend the most time engaged in high-intensity activities (on average 3.14 ± 0.57 km/match), and central defenders spend the least (on average 1.83 ± 0.26 km/match).

Running at maximum speed (sprinting) occurs on average every 90 seconds of the match (Reilly and Thomas, 1976) and doesn't last more than 2 to 4 seconds (Reilly and Thomas, 1976; Bangsbo, 1991). Latest research shows that 96% of sprints are shorter than 30 meters, and 49% is shorter than 10 meters (Valquer et al., 1998). Sprinting represents just 1-11% of total covered distance during a match, which is 0.5-3% of total duration of the match (Bangsbo, 1991.; Reilly and Thomas, 1976).

Despite a sizable number of previous researches that have dealt with this issue, it is noticeable that they were conducted on national leagues (England, Spain, France, the Netherlands), Champions League and UEFA Cup, and that there are certain inconsistencies in defining the particular types of players, as well as in defining the areas of intensity of activities. Therefore the real goal of this research is to establish the differences between the 5 basic types of elite players (central defenders, side backs, defensive midfielders, offensive midfielders and forwards) with variables that describe the amount, intensity, and speed of movement of the players when in possession of the ball, when not in possession of the ball and then when the ball is out of play, on a representative sample of players that have competed at World Cup 2010 in South Africa, which wasn't the case in previous researches.

Methods

Population and entities sample (players)

The population of entity consists of players (approx. 600) from the 32 national teams which have participated at the World Cup 2010 finals in South Africa Republic. To keep the estimate of variables reliable only the players that have played at least 250 minutes in 3 matches (226) were taken into consideration. From this pool a sample of 150 players was randomly selected (30 for each type of player: central defender, side back, defensive midfielder, offensive midfielder and forward).

Movement variables

For every match, 7 basic and 1 derived indicator of movement were registered for each player, as well as the number of minutes and matches played. Based on this information, a matrix has been formed in which the data for each player was determined as sum results in all the matches divided with the total number of minutes played and then multiplied by 90 (the official time of a football match) - "maximum running speed" is an exception for the variable, as it has been calculated as the average value of maximal running speed in all the matches played. The basic variables which describe the movement of the players are:

- **Distance covered – team in possession of the ball** - represents the distance covered by the player while his team is in possession of the ball.
- **Distance covered – team is not in possession of the ball** – represents the distance covered by the player while his team is not in possession of the ball.
- **Distance covered – ball out of play** – represents the distance covered by the player when the ball is not longer in active play (delays, set pieces, throw-ins).
- **Maximum running speed** – represents the maximum running speed measured during the match.

- **Low intensity activity** – represents the time the player has spent in activity in which the speed of movement is less than 10km/h.
- **Medium intensity activity** - represents the time the player has spent in activity in which the speed of movement is equal to or greater than 10km/h, and less than 15 km/h.
- **High intensity activity** - represents the time which the player has spent in activity in which the speed of movement is equal to or greater than 15km/h. and a derived variable:
- **Distance covered** – represents the total distance covered. It is calculated as a simple sum of variables: distance covered when team is in possession, when team is not in possession, and when the ball is out of play.

Statistical analyses

For all variables descriptive indicators were calculated: arithmetic mean, minimum and maximum result, standard deviation, skewness and kurtosis. Normality of the distributions of all variables was tested by the Kolmogorov-Smirnov test (K-S test). In determining the differences between particular types of players we used the univariate analysis of variance and Scheffes's test in the scope of Post-hoc technique, which is used to reduce the probability of error of type α which occurs due to a high number of comparisons.

Results and discussion

Table 1 shows that a player on average covers 9.96 km in a match, 3.85 km (39%) of which is when his team is in possession of the ball, 3.97 km (40%) while his team is not in the possession of the ball and 2.1 km (21%) when the ball is out of play. The average value of maximum running speed is 26.25 km/h, and it has ranged from the minimum of 20.96 km/h, to the maximum of 31.5 km/h. The values of kilometers covered on average are somewhat lower from the values Di Salvo and assoc. (2007 and 2009) have come up with in their research conducted on matches of Spanish La Liga, UEFA Champions League and UEFA Cup. It is possible to assume that the reasons the players on those matches scored a higher average on kilometers covered is due to the higher concentration of quality, the fact that the teams in observed matches were of similar strengths and finally that the World Cup 2010 finals were held in South Africa Republic where the climate conditions were not as favorable. Aside from that, through additional observation of Table 1, we can note that the players on average spend only 5.7 minutes (6%) engaged in high intensity activities (speed of movement \geq 15km/h), 5.31 minutes (6%) in medium intensity activities (10 \leq speed of movement < 15 km/h) and 52.29 minutes (58%) in low intensity activities (speed of movement < 10 km/h). In other activities, such as walking or standing, players spend on average 26.7 minutes (30%). It is also noticeable that all the variables of players' movement do not deviate in a statistically significant way from normal distribution ($\max D > 0.11$), which justifies the use of univariate analysis of variance to check the set hypothesis.

Table 2 shows the results of the univariate analysis of variance and Scheffes's post-hoc test of differences between players who play primarily on the positions of offensive midfielders, central defenders, side backs and forwards in the distance covered variable.

Based on the results we can conclude there are statistically significant differences between the analyzed types of players in this variable – between the offensive and defensive midfielders

Table 1: Descriptive statistical parameters: arithmetic mean (M), minimum value (Min), maximum value (Max), standard deviation (SD) skewness (a3) and kurtosis (a4) of basic and derived variables, and KS test of normality of distribution of variables.

	M	Min	Max	SD	a3	a4	maxD
Distance covered (km)	9.96	7.80	11.93	0.81	0.06	-0.31	0.05
Distance covered with the ball (km)	3.85	2.47	5.46	0.56	0.05	-0.12	0.05
Distance covered without the ball (km)	3.97	2.66	5.46	0.56	0.10	-0.16	0.05
Distance covered with ball out of play (km)	2.14	1.53	2.91	0.26	0.18	0.01	0.04
Maximum running speed (km/h)	26.25	20.96	31.50	2.29	-0.04	-0.78	0.09
Low intensity activity (min)	52.29	44.29	60.50	3.19	-0.02	-0.48	0.05
Medium intensity activity (min)	5.31	3.20	8.33	1.08	0.61	0.05	0.08
High intensity activity (min)	5.70	3.20	8.80	1.26	0.26	-0.50	0.05

K-S-test_{0.05} = 0.11

Table 2: Results of the univariate analysis of variance and Scheffe's post-hoc test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable distance covered

Distance covered (km)	F= 16.29; p=0.00				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	10.39				
Defensive midfielder	10.50	1.00			
Central defender	9.29	0.00	0.00		
Side back	9.93	0.05	0.03	0.01	
Forward	9.68	0.00	0.00	0.29	0.75

(between which a statistically significant difference has not been established) compared to the other types of players, and between the side backs and central defenders. The results show that the midfielders cover the most distance in a match (defensive midfielders 10.50 km and offensive midfielders 10.39 km) because they cover the largest area of the pitch and because they are a link between the defensive and offensive part of the team. In the phase of attack, the main role of defensive midfielders is to position themselves diagonally behind offensive midfielders (primarily the one who is in the possession of the ball) so they can open up the option of passing backwards as a tactical device of delaying the attack, and putting themselves in a position that allows quick transformation to defense in the event that possession is lost. In the phase of defense, defensive midfielders position themselves on an imaginary line that connects the ball and the middle of the goal if the opposing team's offense is their own half or around the centre of the pitch. If the opposition's offensive line is closer to the goal they cover a part of the pitch in a zonal defense or mark a certain player individually. The amount of distance covered is also dependant of whether the team plays with one or two defensive midfielders.

Offensive midfielders differentiate from the defensive midfielders mostly in movement when the team is in possession of the ball because they have to search for the area to receive the ball, and then use the ball efficiently. The slightly shorter distance they cover can also be explained by the cooperation of the offensive midfielders with forwards in the phase of attack on an area approximately the same as the one that is covered by the two defensive midfielders.

Additionally, a statistically significant difference between the central defenders and side backs has been established. Central defenders (9.29 km) and forwards (9.68 km) have, on average,

covered less kilometers than the other types of players because they are primarily focused on playing in one phase of the game (central defenders in defense, and forwards in attack), while the side backs have a greater number of kilometers covered (9.93 km) than both the central defenders and the forwards because apart from the greater participation in the phase of defense they are also a significant presence in the phase of attack. Similar results were obtained by Di Salvo et al. (2007; 2009), with a notation that the average values of kilometers covered were slightly higher in their research.

Side backs move statistically significant more than the central defenders, and more - but not statistically significant more - than the forwards. The current trend in development of the modern football game is partially based on the side backs that cover the whole length of the field next to the throw-in line. As they are players of the last line their primary tasks are defensive in nature (they attack players from the lateral area of the pitch in a zonal defense, and participate in all the defensive actions as first or last players). They have to transform quickly from the phase of defense into an offensive player by taking their position next to the throw-in line or by running quickly into the empty space in order to open up space for another midfielder, which is not possible unless the side backs participate in the offense because that space then has to be covered by the offensive midfielder. The reason they cover less distance than the midfielders even though they are covering the entire length of the pitch is that they rarely move into the width.

Forwards, on the other hand, move over the entire width of the pitch, but not over the full length (usually just to the half of the pitch). The role of the forward is primarily based on the phase of attack so their total distance covered is lesser compared to the other players. The same goes for the central defenders, the differ-

ence being that their performance is mostly based on the phase of defense where they are positioned in a zone between the side backs, so their space for movement is greatly reduced. In the phase of attack they participate at the beginning of a continuous attack or in the transition in a combined attack. In both cases their role ends when they pass the ball to the closest midfielder and by positioning themselves at the prearranged distance from their own goal (generally not beyond the centre of the pitch). They rarely find themselves involved in the finishing stages of an attack, unless there are set-pieces which create a possibility for them to come forward and be dangerous in aerial duels.

By comparing the observed types of players in kilometers covered when their team is in the possession of the ball (Table 3), we can notice that offensive and defensive midfielders, side backs and forwards cover a statistically significant amount of kilometers than central defenders. These results are expected because the first mentioned types of players are significantly more involved in organizing the phase of attack. Apart from this, another statistically significant difference has been observed, the one between offensive midfielders (who, on average, cover the most kilometers when their team is in possession: 4.2 km) and side backs (3.77 km) while no statistically significant difference has been established between other types of players. Offensive midfielders cover the most distance when moving with the ball, which is to be expected as their role in the team is defined by moving with the ball and passing it to their teammates. Offensive midfielders are the link between the defense and attack, and their role is to take the ball from the defensive midfielders or the players in the last line of defense and transfer it to the finishing phase of an attack.

Forwards and defensive midfielders have similar results which they have achieved by different means - the forwards must react quickly and efficiently due to a constant pressure from the players in defense - the results have been drawn through a large number of contacts with the ball, while defensive midfielders have less contact with the ball, but those contacts occur in the area around the centre of the pitch where the pressure from the opposing

teams is significantly less, therefore, they can hold the ball in possession and cover a certain distance with it.

Central defenders have covered statistically significant less distance than any other type of player with the ball because they can not expose themselves to the risk of holding the ball for too long or covering a great distance with it as there are no players between them and their goal should they lose the ball. If we compare the players by the number of kilometers covered when their team is not in the possession of the ball (Table 4), it is evident that the defensive midfielders have the greatest number of kilometers covered (4.45 km). In addition, the statistically significant difference compared to all the other types of players. On the other hand, the forwards have the smallest number of kilometers covered (3.54 km) which makes them statistically significant from almost all the other types of players (statistically significant difference with the error of less than 0.05 has not been identified only between them and the central defenders, as the error in this case was less than 0.16). These results show that in the phase of defense the midfielders have the most defensive tasks because they have to close down the middle area of the pitch (the biggest part of the pitch), while the forwards participate the least in defensive duties. This variable reveals the differences in the results between two types of midfielders. The greatest distance covered while the opposing team is in possession of the ball is achieved by the defensive midfielders (4.45 km).

This happens because of the specific way their movement changes in regard to how far the ball is from the goal (they position themselves on an imaginary line that links the ball and the middle of the goal, while the opposing team's attack is in the defensive half or around the centre, and if the opposition's attack is in the attacking half they cover a part of the pitch in a zone or they mark a certain player individually). The forwards have, on average, scored the smallest values in distance covered when moving without the ball. That is because the role of a striker in the phase of defense is to find a position to optimize his movement when his team regains possession of the ball.

Table 3: Results of the univariate analysis of variance and Scheffe's post-hoc test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable distance covered with the ball.

Distance covered with the ball (km)	F= 12.21; p=0.00				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	4.20				
Defensive midfielder	3.90	0.20			
Central defender	3.37	0.00	0.00		
Side back	3.77	0.02	0.91	0.04	
Forward	4.00	0.57	0.96	0.00	0.54

Table 4: Results of the univariate analysis of variance and Scheffe's post-hoc test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable distance covered without the ball.

Distance covered without the ball (km)	F= 14.22; p=0.00				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	4.10				
Defensive midfielder	4.45	0.02			
Central defender	3.86	0.78	0.00		
Side back	4.00	1.00	0.01	0.87	
Forward	3.54	0.01	0.00	0.16	0.01

In distance covered when the ball is out of play no statistically significant difference between certain types of players has been found, which is in agreement with their average values that range from 2.06 km for central defenders and up to 2.18 km for offensive midfielders (Table 5). This can be explained by the fact that every player is trying to maintain optimal positioning to one another so they have to cover approximately the same distance in order to take their position in the pre-arranged formation, which is their only task in a situation when the ball is out of play.

Through observation of the variable maximum running speed (Table 6) results, we can conclude that every type of player has to have a high level of sprinting capabilities. Forwards achieve statistically significant greater speed than the defensive midfielders. Between the other types of players no statistically significant difference was established. Despite that, we can observe that offensive midfielders with 27.09 km/h and forwards with 27.37 km/h are very similar in their sprinting capabilities and are the fastest players in the team. On the other hand, the other three types of players have similar average values for maximum running speed (25.35-25.74 km/h) and they differ significantly from offensive midfielders and forwards.

Therefore it is possible to conclude that the players on these positions (offensive midfielders and forwards) have to escape the opposing team's defense with quick reactions or go around the

opponents in order to create an advantage in space and numbers. Furthermore, these types of players find it easier to achieve greater speed because they find themselves more often in a chance to operate in larger spaces. The defensive players are in general, somewhat slower due to the duels and aerial challenges they have higher body mass and height than the offensive players (Bangsbo, 2003).

The forwards achieve the fastest speed of movement because they have to react in small space with the opposing team's defense players. Speed is the crucial factor which enables them to win space for an efficient attacking action and considering they often receive the ball with their backs to the goal. Defensive midfielders have no need for quick reactions because they operate in the part of the pitch where crucial things don't take place, so the players don't have the need to move quickly. The result which shows that offensive midfielders are the second fastest type of players is very interesting. Such information points to the current trend of development of the football game where quick transition through the middle is becoming more and more important, which is the role the offensive midfielders perform.

Low intensity activity (Table 7) is characteristic for forwards and central defenders, because these two types of players have the least contact with the ball and the areas of the pitch they cover is where the game is played the least, so low intensity running is

Table 5: Results of the univariate analysis of variance and Scheffe's post-hoc test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable distance covered when the ball is out of play.

Distance covered when the ball is out of play (km)	F= 0.95; p=0.44				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	2.18				
Defensive midfielder	2.15	0.99			
Central defender	2.06	0.53	0.79		
Side back	2.16	1.00	1.00	0.69	
Forward	2.15	0.99	1.00	0.77	1.00

Table 6: Results of the univariate analysis of variance and Scheffe's post-hoc test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable maximum running speed.

Maximum running speed (km/h)	F= 5.12; p=0.00				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	27.09				
Defensive midfielder	25.35	0.07			
Central defender	25.69	0.24	0.98		
Side back	25.74	0.27	0.98	1.00	
Forward	27.37	0.98	0.01	0.07	0.08

Table 7: Results of the univariate analysis of variance and Scheffe's post-hoc test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable low intensity activity.

Low intensity activity (min)	F= 7.82; p=0.00				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	51.44				
Defensive midfielder	50.51	0.79			
Central defender	53.71	0.09	0.00		
Side back	51.79	1.00	0.58	0.18	
Forward	54.01	0.03	0.00	1.00	0.08

sufficient for them to reach the desired position. Defensive midfielders must spend a greater amount of time in high intensity activities because that enables them to position themselves better for the actions that take place in their area of operation – and as the game is played in their area for the greater part of the match they spend less time engaged in low intensity activities.

In contrast to the low intensity activities, defensive (6.20 min) and offensive midfielders (5.75 min), because of the specialty of their position and their activity in a large area of the pitch, spend the most time in medium intensity activities. That is why in this variable a statistically significant difference has been established between the offensive midfielders compared to the central defenders and forwards, and defensive midfielders compared to all the other types of players, except the offensive midfielders (table 8). Medium intensity activities are the most prominent characteristic of midfielders because only with such activities can they fulfill all the tasks in the large area of the pitch they cover, and at the same time divide their energy rationally for the entire duration of the match.

In the high intensity activity variable (Table 9), statistically significant differences were noted between the central defenders compared to all other types of players, and between forwards compared to all midfielders who, because of the specialty of their position and their role in the game (creating the finishing stages of an attack), spend the most time engaged in high intensity activities (offensive midfielders with 6.51 min, and defensive midfielders with 6.27 min). Unlike them, the central defenders, on average, spend the least amount of time engaged in high intensity activities (4.51 min). High intensity activities occur with every direct confrontation with the opponent when fighting for the ball. As the midfielders have the most of such activities, both in defense and in attack, their score being the highest in this variable was to be expected. Central defenders have the most duels that are short lived, until the ball is cleared or the game is stopped - and this only in the phase of defense, which reflects in them spending significantly less time engaged in high intensity activities.

Table 8: Results of the Kruskal-Wallisov's test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable medium intensity activity.

Medium intensity activity (min)	F= 16.19; p=0.00				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	5.75				
Defensive midfielder	6.20	0.54			
Central defender	4.65	0.00	0.00		
Side back	5.22	0.24	0.00	0.22	
Forward	4.73	0.00	0.00	1.00	0.35

Table 9: Results of the Kruskal-Wallisov's test of differences between players who primarily play the positions of: offensive midfielder, defensive midfielder, central defender, side back and forward in the variable high intensity activity.

High intensity activity (min)	F= 16.86; p=0.00				
	Arithmetic mean	Offensive midfielder	Defensive midfielder	Central defender	Side back
Offensive midfielder	6.51				
Defensive midfielder	6.27	0.90			
Central defender	4.51	0.00	0.00		
Side back	5.77	0.09	0.50	0.00	
Forward	5.45	0.00	0.05	0.02	0.84

Conclusion

By comparing the particular types of players in average distance covered during a match, we can conclude that defensive midfielders (10.50 km) and offensive midfielders (10.39 km) cover the most distance, which is expected as they are covering the largest area of the pitch, and as they are the link between the defensive and attacking part of the team so they have tasks in both defensive phase and attacking phase of the game. If we observe the average distance covered when their team is in the possession of the ball (phase of attack), it is visible that the offensive midfielders (4.2 km) and forwards (4.0 km) have the highest average values, because once the possession of the ball is obtained the focus is to move the game towards the opponent's goal, during which the biggest role falls to the offensive midfielders and the forwards. While in the phase of defense (when their team is not in possession of the ball), on average most distance is covered by the defensive midfielders (4.45 km). During the time the ball is out of play there is no statistically significant difference in distance covered between the particular types of players. Therefore it is possible to conclude that the midfielders cover the most distance (defensive and offensive midfielders), while the central defenders and forwards on average cover a little less distance. However, the results also point to the fact that all types of players in elite football must have very high running capabilities because their average values move in the range of only 0.82 km (from 9.68 to 10.5, with average value of 9.96 km). By comparing the types of players based on the intensity of the activities during the time spent in active play, it is noticeable that the forwards spend the highest amount of time in low intensity activities (54.01 min), defensive midfielders in the medium intensity activities (6.20), while offensive midfielders spend the most time engaged in high intensity activities (6.51 min). Due to their position and their role in the system, the forwards participate less in the phase of defense than the other types of players, so the time they spend engaged in low intensity activities was to be expected. On the other hand the offensive midfielders' primary task is to create good opportunities in the final stages of an attack, which results in the highest average values in high intensity activities, while the defensive midfielders, due to the specialty of their position and a large area of the pitch they are active in, spend the most time in the medium intensity activities (6.20 min).

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Submitted: November 23, 2011.

Accepted: December 09, 2011.

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Notational analysis of the State championship of Bosnia and Herzegovina and Balkans championship in judo for male competitors

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Original scientific paper

Abstract

Main goal of this research is used notational analysis to define differences of the indicators of the situation efficiency among senior male from participants of the State championship of Bosnia and Herzegovina and Balkan's Judo Championships. Analysis has been done based on video scripts of 109 fights for BIH senior's male and video scripts of 79 fights for Balkan senior's male in all seven categories. Matches have been monitored with 18 variables of situation's efficiency in Judo. For defining differences of indicators of situation's efficiency it has been used χ^2 (Chi Square) test. The results of the χ^2 tests implicate to the statistically important differences among seniors - male in analyzed indicators of the situation's efficiency. Both groups of the examined were more efficient with throwing techniques comparing to the floor techniques. Bosnian seniors male used more hand throwing techniques while male Balkan championship dominated with leg throwing techniques and grappling techniques. The most efficient techniques that seniors - male used from BH State competitors are: Ippon Seoi Nage, Tani Otoshi, Harai Goshi, etc, while male competitors from Balkans championship used: Uchi Mata, Sukui Nage, Ippon Seoi Nage, etc.

Key words: judo, notational analysis, male competitors

Introduction

Nowadays judo is very dynamic and demanding martial art where the fight is developing into two main areas: standing combat and floor combat. First: both areas of fight request different approaches in the process of training fighters for the championships; and second: necessity for the analysis of the situation's efficiency monitoring in judo can give quality information about acting manner of the fighters and their efficiency during the matches. Notational Analysis is an objective way of recording performance so that key elements of that performance can be quantified in a valid and consistent manner (ISPAS, 2011). Researches of the capabilities, distinctions and knowledge of fighters that are directed into notational analysis of the indicators of the situation's efficiency, which competitors realize during the competitions (Milanović, 1999; Milanović, 2009) represent good base for the applying researching results of situation's efficiency in judo.

The manner of leading the fight in judo requests from fighters extraordinary application of technical elements of judo into the right and left side at standing position and floor; same as possibility of combining of those techniques. Valuing importance of technical parameters of situation's efficiency is that they are collected in the conditions of real fights of two fighters in the most important competitions. Looking from the different aspects of preparatory time for the competition, situation's efficiency of some technical elements of judo is important. Same importance have proper

choice of application of the techniques in the competition and optimal approach to the application of those techniques through exercises in the situation's conditions of judo fight and through proper technology of training. In that context it is important to distinguish some researches that treat aspects of situation's efficiency. Weers (1996) confirmed that top-level judo fighters have capabilities to apply six throwing techniques in the standing position and two grappling techniques on the floor. There is huge number of the techniques in judo 99 (Kajmović et al., 2010) – throwing techniques, grappling techniques – but number of the techniques that won the competitions is little. For that reason situation's efficiency of the techniques is not same. Research of the Sterkowicz & Kasek (1983) appointed to that fact. Those researches confirmed that efficiency of the holding techniques Osae Komi Waza by senior female is higher comparing with male, but they are less efficient with hand throwing techniques; and both groups of examined have same typical efficiency of throwing Seoi Nage technique. Main goal of this research notational analysis as confirmation of indicator's differences of situation's efficiency for senior male from Bosnia and Herzegovina and male competitors from Balkan's championships in judo. It serves also for defining those factors that mostly contribute to the success of the results, on this two level of competitions for these two groups of examined.

Methods

Sample of the examined

Specimen of the examined is defined as a total of fights ($n = 109$) State championship of Bosnia and Herzegovina held in Kiseljak 2011 years (B&H) and total of fights ($n = 79$) from Balkan's Judo Championship, held in Trebinje (B&H) 2010 years for the male seniors competitors for all seven categories (60, 66, 73, 81, 90, -100 and +100). At the Balkan's Championships further national judo teams participated: Bosnia and Herzegovina, Serbia, Bulgaria, Rumania, FRY Macedonia, Albania, Greece, Turkey and Montenegro.

Sample of variables

Analysis of the parameters of situation's efficiency is based on official classification of judo techniques by 18 indicators of situation's efficiency (IJF – Waza list, 2010) as it follows.

- Groups of judo techniques: 1) Nage-Waza (Throwing techniques), 2) Katame-Waza (grappling techniques);
- Subgroups of judo techniques: 3) Te-Waza (Hand throwing techniques), 4) Koshi-Waza (Side throwing techniques), 5) Ashi-Waza (Leg throwing techniques), 6) Sutemi-Waza (Sacrificing throwing techniques), 7) Osa-Komi-Waza (Holding techniques), 8) Shime-Waza (Struggling techniques), 9) Kansetsu-Waza (Lever techniques);
- Quantitative indicators of judo fights: Technical points - 10) Ippon (10pts), 11) Waza -ari (7pts), 12) Yuko (5pts), 13) Koka (3 pts) - Penalties - 14) Shido 1 (-3pts), 15) Shido 2 (-5pts), 16) Shido 3 (-7pts), 17) Hansokumake/Shido 4 (-10pts).
- 18) Situation's efficiency of the separate throwing judo techniques and floor techniques.

Data processing methods

The frequencies and percentage values were counted for all the observing variables. For the confirmation of the differences between the frequencies it was used χ^2 test (Chi Square test) at the level of statistical importance 5% ($p < 0,05$) assisting with contingent tables (Petz, 1997). Testing importance of the correlation among monitored variables it was used coefficient of the contingency (C). For the measuring of the situation's efficiency of every particular judo techniques it was used formula (Sterkowicz, 1999):

$I_{\text{eff}} = \text{Number of the official scores} / \text{Total number of the attacks} \times 100.$

Results and Discussion

Based on the analysis of video scripts of 109 fights from State championship of Bosnia and Herzegovina and 79 video scripts of Balkan's championship held Bosnia and Herzegovina, it was presented 330 technical actions among which both groups presented 87,9% from the group Nage Waza, while a small number of the technical actions were presented from the group Katame Waza 12,1% (Table 1). Male seniors from Balkan's dominates with throwing techniques 91,7%, comparing to the male seniors from BiH 83,3%, that have more efficiency in floor techniques 16,7%, comparing to the male seniors 8,3%. The results of the χ^2 tests appoint to the existence of the statistics differences among monitored frequency of the throwing techniques, comparing to the grappling techniques ($p < ,0021$) with coefficient of the contingency ($C = ,13$).

Table 1. Notational analysis of the groups of the judo techniques

	Nage-Waza	Katame-Waza	TOTAL
BIH	125 (83,3%)	25 (16,7%)	150 (45,5%)
BALKAN	165 (91,7%)	15 (8,3%)	180 (54,5%)
TOTAL	290 (87,9%)	40 (12,1%)	330 (100 %)

$$\chi^2 = 5,33; df = 1; p < ,0021; C = ,13$$

Comparing the situation's efficiency of the applied judo subgroups techniques among male from State championship of Bosnia and Herzegovina and seniors from Balkan's championship (Table 2) from 330 presented techniques, to the group of Te Waza (hands) belongs 32,7% and Ashi Waza (legs) 30,0%. Osae Komi Waza (holdings) is presented by 8,2%, Sutemi Waza (sacrificing) is presented by 13,9%, while Koshi Waza (side) was presented by 11,2%, Kansetsu (lever) by 2,7% and Shime (struggling) by 1,3% of the applying efficiency in combats. Monitoring the structure of the situation's efficiency male seniors from State championship of Bosnia and Herzegovina showed that they dominates with hand techniques by 38,0%, comparing to the Balkan's male seniors by 28,3%, side by 10,7% comparing to the Balkan's male seniors by 11,7%. Male seniors from Balkan's championship had higher frequency of the leg throwing techniques of 37,8% comparing to the B&H males of 20,7%, in holding techniques they had 12,0% comparing to the males that had efficiency of 5,0%. B&H senior also had higher efficiency in applying lever by 3,3% comparing to the Balkan's senior by 2,2%, while struggling techniques are almost equally used 1,3% and 1,1%.

Results of χ^2 tests ($\chi^2 = 15,7$) appointed to the existence of the differences ($p < ,015$) in the frequency of the situation's efficiency for the applied subgroups of judo techniques between B&H male and Balkan's male competitors. Coefficient of contingency ($C = ,21$) doesn't show big differences among monitored variables. Comparing those indicators with indicators (Sterkowicz, 1998) of the Olympic games in Atlanta, they appointed that competitors dominate in throwing techniques (Te Waza), holding techniques (Osae Komi Waza), side throwing techniques (Koshi Waza) and leg throwing techniques (Ashi Waza); while they use struggle throwing techniques (Sutemi Waza) very little.

Table 2. Notational analysis of the subgroups judo techniques

	BIH	BALKAN	TOTAL
Te-Waza	57 (38,0%)	51 (28,3%)	108 (32,7%)
Koshi-Waza	16 (10,7%)	21 (11,7%)	37 (11,2%)
Ashi-Waza	31 (20,7%)	68 (37,8%)	99 (30,0%)
Sutemi-Waza	21 (14,0%)	25 (13,9%)	46 (13,9%)
Osae-Komi-Waza	18 (12,0%)	9 (5,0%)	27 (8,2%)
Kansetsu-Waza	5 (3,3%)	4 (2,2%)	9 (2,7%)
Shime-Waza	2 (1,3%)	2 (1,1%)	4 (1,3%)
TOTAL	150 (45,2%)	180 (54,5%)	330 (100 %)

$$\chi^2 = 15,7; df = 6; p < ,015; C = 0,21;$$

Analyzing 430 realized quantity parameters of Judo points and penalties (Table 3), 27,9% was realized by Ippon, 12,6 by Waza-ari, 23,3% by Yuko, 18,4% with penalty Shido 1 and 2,5% with Hansokumake. B&H male showed better efficiency with 28,5 Ippons comparing to the Balkan male with 27,4% Ippons, while male presented 20,8% and male 25,7% of Yuko. During the fights B&H senior received less Shido penalties 17,4% then Balkan's competitors 19,3%, so as with strongest Hansokumake (disqualification) 3,9%, while Balkan male had 1,3%.

Results of χ^2 tests show that there are statistically important differences ($p < ,05$) in frequency of the realized quantity parameters between B&H senior and Balkan's judo seniors, and coefficient of the contingency ($C = ,17$) appoints that correlation among monitored variables exists. Comparing these facts with research of quantity parameters (Sterkowicz, 1998) from the Olympic games in Atlanta, the most of actions were awarded with point Koka for both examined groups, while the most frequent penalty was Shido.

Table 3. Notational analysis of quantitative parameters

	BIH	BALKAN	TOTAL
Ippon	59 (28,5 %)	61 (27,4%)	120 (27,9%)
Waza – ari	23 (11,1%)	31 (13,9%)	54 (12,6%)
Yuko	43 (20,8 %)	57 (25,7%)	100 (23,3%)
Shido 1	36 (17,4%)	43 (19,3%)	79 (18,4%)
Shido 2	21 (10,1%)	23 (10,3%)	44 (10,2%)
Shido 3	17 (8,2%)	5 (2,1%)	22 (5,1%)
Hansokumake/S4	8 (3,9%)	3 (1,3%)	11 (2,5%)
TOTAL	207 (48,1%)	223 (51,9%)	430 (100%)

$$\chi^2 = 12,1 \quad df = 6 \quad p < ,05 \quad C = ,17$$

Analyzing first ten the most efficient separate judo techniques (Table 4), which BIH seniors presented are: Ippon Seoi Nage, Sukui Nage, Seoi Nage, Tai Otoshi which represent hand (Te) techniques; Uchi Mata, De Ashi Barai and O Uchi Gari as techniques from leg (Ashi) throwing group; Harai Goshi as side (Koshi) throwing techniques; Tani Otoshi as sacrificing (Sutemi) techniques; Kesa Gatame as holdings (Osae). Male seniors from Balkan's championship, the most efficiently applied techniques is Uchi Mata, O Uchi Gari, O Soto Gari as most effective represents of leg (Ashi) throwing techniques; Sukui Nage, Ippon Seoi Nage, Seoi Nage and Sode Tsurikomi Goshi as hand (Te) throwing techniques; Kesa Gatame as holding techniques (Osae); Tani Otoshi as sacrificing (Sutemi) throwing techniques.

Comparing these facts with researches of the most efficient techniques from the Olympic games in Atlanta (Sterkowicz, 1998), male competitors dominates with hand techniques of Seoi Nage, Kata Guruma, Sukui Nage, Kuchiki Taoshi, Tai Otoshi, etc. Uchi Mata, O Uchi Gari, Ko Uchi Gari, O Soto Gari, Ko Soto Gake of leg throwings; Tomoe Nage and Tani Otoshi from sacrificing throwings; from lever techniques Ude Hishigi Juji Gatame and holdings Yoko Shiho Gatame, emphasize to the different application of the judo techniques at the various levels of the competition.

Conclusion

Obtained results could contribute to the better understanding of the monitoring and analyzing of parameters of situation's efficiency in judo for seniors in all level of competition. Notational analysis as way of monitoring and controlling of the efficiency of the relevant technical-tactical parameters in judo that are expressed by seniors could be directly applied into coaches education and training process so that optimal choice of content and load for training could be assured. On that way it could be also compared with higher demanding levels of competitions, all in terms of achieving better quality of judo, as a martial art.

Table 4. The most efficient judo techniques used by male seniors at the B&H and Balkan's championships

MALE B&H		RANK	MALE BALKAN	
%	Judo Techniques		Judo Techniques	%
10,3	Ippon Seoi Nage	1	Uchi Mata	13,7
9,1	Tani Otoshi	2	Sukui Nage	9,3
6,9	Harai Goshi	3	Ippon Seoi Nage	8,8
6,0	De Ashi Barai	4	O Soto Gari	8,2
6,0	Kesa Gatame	5	Sode Curi Komi Goshi	6,6
5,2	Uchi Mata	6	Tani Otoshi	6,0
5,2	O Uchi Gari	7	Harai Hoshi	4,9
5,2	Sukui Nage	8	O Uchi Gari	3,8
4,3	Tai Otoshi	9	Kesa Gatame	3,8
4,3	Morote Seoi Nage	10	Seoi Nage	3,8

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Acknowledgments

This research is part of Project „Notational Analysis in Function of Educating Coaches of the Judo Federation of Bosnia and Herzegovina“ of International Coaching Enrichment Certificate Program (ICECP).

Submitted: November 27, 2011.

Accepted: December 15, 2011.

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Active commuting to and from elementary school children 9 years old in Tuzla Canton

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Original scientific paper

Abstract

The aim of this study was to determine how children in Tuzla Canton travel to school and from school to home, what do children think about how much walking to school and from school to home is good for them. The sample consisted of randomly selected of children N=169 (school girls 90 girls and 79 boys) from elementary school in Tuzla canton, chronological age (9.7 years \pm 1.1 yr). All Pupils had to answer on 32 closed questions, two of them were open. According to the results we can conclude: children in Tuzla canton are active commuters to/from school 71.6-80.5%. All children have the desire to spend more time with their parents on their way to/from school. On questions which would make walking to and from school are better in the highest percentage pleaded nothing, I feel fine about walking to school 49.1%. The results suggest that walking school have many social benefits and children in Tuzla Canton are active commuters to/from school.

Key words: Physical activity, walking, children, reasons, benefits

Sažetak

Cilj ovog rada bio je da se ustanovi kako djeca u Tuzlanskom kantonu putuju od kuće do škole i od škole do kuće, šta djeca misle o tome koliko je pješaćenje dobro za njih. Uzorak ispitanika sastojao se od slučajnog izabranih N=169 (90 djevojčica i 79 dječaka) iz osnovnih škola u Tuzlanskom kantonu, kronološke dobi (9.7 \pm 1.1 godina). Učenici su odgovorili na 32 pitanja zatvorenog tipa, a dva pitanja su bila otvorenog tipa. Prema dobivenim rezultatima možemo zaključiti: djeca u Tuzlanskom kantonu su aktivni putnici u/iz škole 84.6-85.2% i obično putuju sa prijateljima u/iz škole 71.6-80.5%. Sva djeca imaju želju da više vremena provode sa roditeljima na putu u/iz škole. Na pitanja šta bi moglo učiniti bolje pješaćenje u/iz škole djeca su se u najvećem procentu izjasnili da ništa, ne osjećaju na putu u/iz škole 49.1%. Rezultati pokazuju da pješaćenje do škole ima mnogo socijalnih dobiti i djeca u Tuzlanskom kantonu su aktivni putnici u/iz škole.

Ključne riječi: tjelesne aktivnosti, pješaćenje, djeca, razlozi, dobiti

Introduction

Children are designed to be active. Physically active children are healthier, happier and more socially connected than children who have more sedentary lifestyles (US Department of Health and Human Services, 2008). Children and young people who are physically active are more likely to be active adults, resulting in health benefits across the life course (Troost, Owen, Bauman, Sallis & Brown, 2002; Kjonniksen, Torsheim & Wold, 2008). Children who actively commute to school have higher levels of physical activity and improved cardiovascular fitness compared with children who do not walk or cycle to school (Davison, Werder & Lawson, 2008).

In recent decades, substantial changes in our lifestyles, urban environments and transportation systems have led to changed physical activity patterns among children. Active transport, in particular, has declined dramatically in countries such as the EU, USA, UK and Australia, where car travel has become the predominant form of personal mobility (Salmon, Timperio, Cleland & Venn, 2005; Ploeg, Merom, Corpuz & Bauman, 2008).

A growing number of industrialised countries such as Germany, Denmark, the Netherlands and Japan have successfully reversed unsustainable and unhealthy increases in rates of driving children to school and other local destinations. Some cities and municipalities in the UK, USA, EU and Canada have also achieved relatively high rates of active travel (Pucher, Dill & Handy, 2010).

Similar changes and benefits can be achieved in Australia. Data from the Australian Children's Nutrition and Physical Activity Survey indicate that, in contrast to sport and play, active travel tends to increase with age, and has similar participation rates for girls and boys at most age levels. Similar findings have been reported internationally. In a large UK study, year 10 females were 6.5 times more likely to meet recommended levels of physical activity if they actively commute to school (Smith, 2008).

Recent reviews have reported that lower household income and parental education levels are generally associated with higher rates of active travel among children (Sirard & Slater, 2008; Pont, Ziviani, Wadley, Bennett & Abbott, 2009). Spallek, Turner, Spinks, Bain & McClure (2006) reported similar relationships for walking to school among 871 Brisbane families with children aged 4-12 years (yr).

A Melbourne study, however, reported variable relationships between socioeconomic position and active travel according to age, gender and data collection period (2001 and 2004) (Ball, Cleland, Timperio, Salmon & Crawford, 2009). Variable findings in the Melbourne study, few of which were statistically significant, may be due to small study numbers (542 children) and relatively low levels of active travel to school. Australian children's rates of walking and cycling for transport are low in comparison to many other developed countries, and have declined substantially in recent decades. In Melbourne in 1970, 55.3% of young people walked to school or higher education, falling to 22.2% in 1994.

In the same time period, cycling to education declined from 7.5% to 3.9% and car travel increased from 14.3% to 55.3%. In the rest of Victoria over this time period, walking to education fell from 35.4% to 15.9%, cycling from 20.3% to 7.9%, and car travel increased from 16.5% to 43.9% (Australian Bureau of Statistics 1975; Australian Bureau of Statistics 1995).

Household travel surveys conducted in the Sydney metropolitan area show similar trends. The proportion of children aged 5-9 years who walked to school on the day of the survey more than halved between 1971 (57.7%) and 1999-2003 (25.5%). For children aged 10-14 yr, walking to school dropped from 44% to 21.1%. Cycling data were not included in the analysis, but were reported to be low (1-2%) (Ploeg et al., 2008).

Many different reasons are thought to account for low levels of walking to school. Parental safety concerns such as travel distance, traffic, and crime have been associated with inactive commuting Black, Collins & Snell, 2001; Tudor-Locke, Ainsworth, Adair & Popkin, 2003.

The aim of this study was to determine how children in Tuzla Canton travel to school and from school to home, what do children think about it if you walk to school and from school to home why it's good for them.

Methods

The sample consisted of randomly selected of children 169 (school girls 90 girls and 79 boys) from elementary school in Tuzla canton, chronological age 9.7 yr (\pm 1.1 yr). All parents wrote written permission to allow children to fulfill questionnaire. Questionnaires were answered in September and October 2010. Pupils had to answer on 32 questions, two of them were open. Closed questions were either just to cross the correct answer (e.g. Which class do you attend?), either on Likard scale from 1-2 and 1-5. For each question/variable frequencies/percent were calculated with SPSS 17.0 (*Statistical package for the social sciences*). Evenson, Neelon, Ball, Vaughn & Ward (2008) found questionnaire completed by school-age children to assess travel to and from school, including mode, travel companion, and destination after school, was reliably collected and indicated validity for most items when compared with parental reports.

Results and Discussion

With our investigation we wanted to find the proportion of pupils who are practicing active commuting to school, and the reasons why some children are not active and how they felt about active commuting.

Table 1. How you usually travel to / from school (N=169)

	To	From
	Percent %	Percent %
Valid on foot	85.2	84.6
by school bus	6.5	6.5
by car (given a lift)	1.8	2.4
bicycle	2.4	2.4
a mixture of on foot and by car	4.1	4.1
Total	100.0	100.0

Table 2. Who you usually travel with to / from school (N=169)

	To	From
	Percent %	Percent %
Valid an adult	1.2	2.4
an adult and other children	7.7	5.9
on my own	14.2	7.7
friends	71.6	80.5
brother/sister	5.3	3.6
Total	100.0	100.0

Actually the results for children in Tuzla canton are quite good as more than 85.2% of them is already walking at least all part of the way to school (Table 1). Other percentage is by school bus 6.5%, a mixture of on foot and by car 4.1%, bicycle 2.4 and by car 1.8-2.4%. Comparing to New Zealand children (aged 5-10 years) where slightly more than 42% of them are walking to school (Hinckson, Garrett & Duncan 2011). Most of the children in Tuzla canton traveling to school (Table 2) with friends 71.6-80.5%, on my own 7.7-14.2%, an adult and other children 5.9-7.7%, brother/sister 3.6-5.3% and adult 1.2-2.4%. Most countries with high rates of active travel to school have higher rates of cycling than walking to school which is similar results like Tuzla canton. In many cases, children in countries with high rates of active travel to school also travel further to school than Australian children (van Dyck, Cardon, Deforche & Bourdeaudhuij, 2009). Children in Tuzla canton showed good results.

Table 3. If you walked part or all of the way to school on most days, what benefits would there be ? (N=169)

Claims	Yes	No
Questions	Precent %	Precent %
My heart and lungs would be healthier	72.2	27.8
I would be alert and awake for school	96.4	3.6
I would be able to talk to my friends	81.1	18.9
My body would become healthier	74.0	26.0
It would be fun	90.5	9.5
I would be helping the environment	98.2	1.8
I would hear and see things that I wouldn't usually	98.2	1.8
I would save money on fares	98.2	1.8
I would get lots of fresh air	89.3	10.7
I would be able to talk to my parents on the way	100	0.0
I would be able to talk to my brothers/sisters on the way	98.8	1.2

Six main reasons in (Table 3) why children walked part or all of the way to school on most days, what benefits would there be: I would be able to talk to my parents on the way 100.0%, I would be able to talk to my brothers/sisters on the way 98.8%, I would be helping the environment 98.2%, I would hear and see things that I wouldn't usually 98.2%, I would save money on fares 98.2%, I would be alert and awake for school 96.4%.

Other studies Kerr, Rosenberg, Sallis, Saelens, Rank & Conway (2006); Cole, Leslie, Donald, Cerin & Owen (2007) report that children participating in a walking to school particularly like to spend more time with parents. Parents, on the other hand, appreciate having more time to kids to talk, have fun, save gas required to drive to and from school, have concerns addressed which may have kept them from allowing their children to walk to school (such as traffic, personal safety or distance), socialize with other families, reduce traffic congestion around schools, participate in physical activity as part of their day, etc.

Table 4. Which of the following would make walking to and from school better? (N=169)

Claims	Yes	No
Questions	Precent %	Precent %
Better weather	11.8	88.2
If my friends walked	22.5	77.5
If I was less frightened of meeting strangers	1.8	98.2
If I was less frightened of being bullied	0.6	99.4
More safer places to cross	5.3	94.7
More school lollipop people	3.0	97.0
Less/slower traffic	4.1	95.9
Cars kept away from the school entrance	1.2	98.8
If my parents walked with me	0.6	99.4
If my older brothers or sisters walked with me	3.6	96.4
Nothing, I feel fine about walking to school	49.1	50.9

Children nothing, feel fine about walking to and from school better 49.1%, if my friends walked 22.5%, and better weather 11.8%. This reason is far the strongest and again can't be changed by children and it is objective. Then there is a group of reasons which can be defined as objective obstacles from traffic.

Children's freedom to explore their communities is greatly limited when walking is not safe or enjoyable. Today, only 13% of all trips to school are made by walking and bicycling. Of school trips one mile or less, a low 31% are made by walking; within two miles of school, 2% are made by bicycling. Sadly, this deprives our neighborhoods of the activity and laughter of children walking and bicycling to and from school together (U.S. Centers for Disease Control and Prevention, 2006).

Today, fewer children are walking and bicycling to school, and more children are at risk of becoming overweight and obese than children 30 years ago (Koplan, Liverman & Kraak, 2004) Encouraging a healthy lifestyle requires creative solutions that are safe and fun. Implementing a walking school bus can be both. For many parents, safety concerns are one of the primary reasons they are reluctant to allow their children to walk to school (Martin & Carlson, 2005).

The experience of several affluent European and Asian countries demonstrates that active travel choices can be easy choices, including within urban environments similar to the low population density suburbs and surrounding cities. With the right conditions, policies, education and encouragement, more children would undoubtedly travel to school by foot (up to about 1km) or by bicycle (up to about 5km). These distances place active travel within the

reach of the approximately 80% of Bosnians families who live within 1-5 km of school (Ministry of Transport and Communications BiH, 1999).

Conclusions

According to the results we can conclude. Children in Tuzla canton are active commuters to/from school and usually travel with friends to/from school. Children who walked part or all of the way to school on most days, would be able to talk to parents on the way to/from school, would be able to talk to my brothers/sisters on the way, would be helping the environment, would hear and see things that I wouldn't usually and would save money on fares. Children nothing, feel fine about walking to and from school better. The results suggest that walking school have many social benefits.

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- Submitted: November 18, 2011.
Accepted: November 30, 2011.

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Analysis of quantitative changes in explosive strength under the influence of elementary water games

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Original scientific paper

Abstract

The goal of this research is to determine are any positive quantitative changes in the structure and the manifestation of explosive strength caused by the application of elementary school of swimming containing elementary water, applied on primary school students (control and experimental group). Sample variables used for the assessment of explosive strength contained five variables/tests (throwing medicine from lying on back – MESBML, long jump from place – MESSD, Running from a high start 20M – MBR20M, High jump from place – MESVM, High jump – MESVZ). For the development or advancement of expressing explosive strength, elementary swimming school was used in duration of ten days with a frequency of two school lessons per day. Overall research lasted for two week (ten working days). The final quantitative change in the structure and manifestation of explosive strength was determined by applying discriminative analysis. The obtained results show the following: after the final measurement, an expected higher positive change in expressing and manifesting explosive strength in the experimental group, in relation to the final group.

Key words: **Explosive strength, water games, quantitative changes**

Introduction

Nowadays, in all spheres of human lives, most tend to a faster and bigger change/transformation – high efficiency. Stated transfiguration can positively be defined as transformational process, in which an object or subject is exposed from the so-called entrance and exit. In such setting relationship and this particular case, the class of sports and physical education was observed a system in which a student enters with appropriate skills and thanks to whose influence, the stated positive change in students should be achieved (or at least, it should be like that, because of inadequate working conditions, substandard plans or working programs, not enough classes of physical activity, etc. we can get a suspended stagnation or even a decrease in student's skills) – Torlaković (2009). Moreover, an analysis was done on how much additional activity for students can cause quantitative changes in a particular segment of motor skills, specifically, explosive strength. The students of the experimental group were, in addition to their regular class of physical and medical education, subjected to additional activity (elementary swimming school containing elementary water games) in duration of two weeks, which is ten working days, with frequency of two classes per day. Apart from learning activities, extracurricular activities are known as other forms of work in school – Findak (2001), and if the stated additional activity in elementary school (swimming) shows any effect, "other forms of work" could be a way to increase organized/planned effect on students' motor skills. In order to prove that extracurricular activities are significant as an operator or something that should be done – make a change, in this research elementary school of

Sažetak

Cilj ovog istraživanja je da se kod učenika u osnovnoj školi (kontrolna i eksperimentalna grupa) utvrdi da li efekti primjene elementarne škole plivanja sa sadržajem elementarnih igara u vodi uzrokuju pozitivne kvantitativne promjene u strukturi i mogućnosti ispoljavanja eksplozivne snage. Uzorak varijabli za procjenu eksplozivne snage sastojao se od pet varijabli/testa (Bacanje medicine iz ležanja na leđima - MESBML, Skok u dalj iz mjesta - MESSD, Trčanje iz visokog starta 20M - MBR20M, Skok u vis iz mjesta - MESVM, Skok u vis iz zaleta - MESVZ). Za razvoj ili unaprijeđenje ispoljavanja eksplozivne snage, korištena je elementarna škola plivanja u trajanju deset dana sa po dva školska časa dnevno. Cjelokupno provođenje istraživanja trajalo je dvije nedelje (deset radnih dana). Konačna kvantitativna razlika u strukturi i manifestaciji eksplozivne snage utvrđena je primjenom diskriminativne analize. Dobijeni rezultati pokazuju slijedeće: nakon finalnog mjerenja, kod eksperimentalne grupe, u odnosu na kontrolnu grupu pojavila se očekivana veća pozitivna promjena u ispoljavanju i manifestaciji eksplozivne snage.

Ključne riječi: **Eksplozivna snaga, igre u vodi, kvantitativne promjene**

swimming with elementary water games was applied, in consistent with the allegations, and the organization and differentiation of starters, according to Grcić – Zubčević and Martinović method (2008). In this context, a working goal was set, that is, "to determine if the effect of applying elementary school of swimming containing elementary water games can cause positive quantitative changes in the structure and possibility of manifesting explosive strength in primary grade students" - Brackenridge, Fasting, Kirby, Leahu (2008).

Methods

Sample of the examinees

The examinee sample is defined as a population of male students, attending primary school in Sarajevo, aged 11 and 12 years. Research included students which were healthy during the process of testing and measuring. The overall number of the control group examinees was 20, and of the experimental group 22. All examinees had appropriate conditions for regular class of physical and medical education, but in addition to this class, the experimental group was allowed to a two-week long (10 working days) permission to use the pool, once a day, in duration of two class hours. None of the students, belonging to either group, was not involved in any physical activities of any sports club, which represented one of the basic conditions for enforcing research. The sample cannot be seen as selected by any criterion for entering primary school

Sample of variables

The selection of variables which would be used to define quantitative changes and manifestations of explosive strength in this research was done by the following:

1. Throwing medicine from lying on back (MESBML),
2. Long jump from place (MESSD),
3. Running from a high start 20M (MBR20M),
4. High jump from place (MESVM),
5. High jump (MESVZ).

Training Program

Elementary school of swimming training program lasted for 10 days, with a frequency of two school lessons daily (20 lessons in total). The program was performed in the Vogošća pool, on working days, in the afternoon (Table 1.). The program was conducted by educated swimming instructors, professors of sports and physical education, of which all had the University of Sports and Physical Education completed, and conducted similar programs in the past (education of non-swimmers) – Grcić-Zupčević (1996). All starter examinees of the elementary school of swimming were non-swimmers, therefore, the beginning of research did not require the statement of the initial state of examinees. The initial state was not done for one more reason – the goal of research is the estimation of swimming starters' development and manifestation of explosive strength, not the improvement in swimming techniques. Nevertheless, variable and final testing were done during research among examinees in a way of checking the improvement in gaining swimming skills in order to secure another positive effect, that is improve swimming knowledge – Vojinović, Babaik, Strajnić, Kalentić (2011). After variable testing, homogenous groups of 5 to 7 students were formed, and during research, new groups were continually formed depending on stu-

dents' improvement – Zenić (2010). For evaluating elementary swimming in the variable and final state, the following was used: Dive to a depth, diving out objects from the water, Jump on feet in shallow water, Jump on feet in deep water, chest floating (floating on the chest), and back floating (floating on back)

Data processing methods

Processing of data obtained was performed by a programming package, SPSS 12.0 for Windows. For determining the quantitative changes, Discriminative analysis was used – which represents a very suitable mathematical and statistical procedure in cases when it is necessary to distinguish the differences formed between initial and final measurement of the tested population.

Results

Control group: I and II measurement – difference noticed after the final measurement

After the application of discriminative analysis for experimental group's results, (the matrix previously stated that the initial state of the experimental group would be treated as one group, and the final state of the sample as another (second) group), by using Boks' test (Table 7.), it was proven that the difference between covariance matrix was statistically significant (.000), which met the requirements needed to continue the procedure. In table 8., a single isolated discriminated function can be observed, which significantly differs the initial and final state (coefficient of canonical correlation is ,779). A distinctive root for the discriminative function is also high (1,742), as is the level of coverage of the variance included in this discriminative function (100%). The significance of isolated functions is determined with Wilkson's lambda test (Table 9.), whose stated value is of high medium

Table 1. Training program

Content of days	1 th	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th
Initial measurement of motor skills	*									
Games and exercises for adapting on water	*	*								
Games and exercises for adapting on water	*	*	*	*	*	*	*	*	*	
Games and exercises for breathing while moving		*	*							
Floating			*	*						
Slip into the water after pushing				*	*	*	*	*	*	
Elements of hops (the head - on your feet)		*	*		*	*				
Crawl technique – arms, legs, coordination			*	*	*	*	*	*	*	
Back technique – legs, arms, coordination			*	*	*	*	*	*	*	*
Checkup of initial state		*	*	*	*	*	*	*	*	
Final measurement of motor skills										*

significance (.455), which indicated on a conclusion that there is an existant difference between the initial and final state, that is, that the „groups” have a significantly different arithmetic environment. The overall claim is positively surrounded by a significance level of significant (,000). The groups' centroids defined in table 10. determine a group's sign, resulting in a negative coefficient predetermined for the initial and positive for the final state. Structural coefficients of discriminative functions, shown in table 11., are a more reliable indicator of relative power of discriminative variables, explaining the reason why they were used for the analysis and explanation of discriminative function. The structure of coefficients' relations itself indicate that a bigger positive difference is present in the final measurement of the experimental group, in regard to the control group, specifically in variables of: throwing medicine from lying on back (MESBML ,601), long jump from place (MESSD ,578), high jump from place (MESVM ,478), high jump (MESVZ ,579) – Rađo (1997). The variable running from a high start 20M (MBR20M -,379), reacted the as in the previous case and has a negative sign, and the justification for this indication can be found in the analysis of interpretations of numerical indicators regarding speed characteristics.

Control group I and II measurements - the difference determined after the final measurement

Table 2. Box's Test

Box's M		297,333
F	Approx.	2,355
	Df 1	103
	Df 2	112432,8767
	Sig.	,00

Table 3. Significance of isolated functions

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1,830	100,0	100,0	,763

Table 4. Wilks' Lambda

Test of Function	Wilks' Lambda	Chi - square	df	sig
1	,377	193,189	13	,000

Table 5. Centroids

GROUP	Function
1	-1,235
2	1,235

Table 6. The structure of discriminative function

Function	
MESBML	,177
MESSD	,165
MBRVS20M	-,197
MESVM	,178
MESVZ	,279

Experimental group: I and II measurement – difference established after the final measurement

Based on the structure of the discriminative functions, it can be concluded that the control group's isolated coefficients are of low value, which indicate on the fact that there are smaller quantitative differences present between the initial and final measurement. In conclusion, the sports class however had a positive impact on the parameters which follow the development and expression of explosive strength. In the experimental group, based on the numeric values of coefficients present in the structure of discriminative function, we conclude that a more significant positive difference is present at the final measurement in regard to the initial, which shows that the program of elementary swimming school with the application of elementary water games within the training process, significantly positively affected the parameters which follow the development and expression of explosive strength (Božanić, Benić, and Mumanović, 2011).

In the final comment, the differences between the development of the control group and the development of the experimental group, we concluded that there are significant differences in research structure of the experimental group in regard to the control group. The obtained results proven the research goal – to concluded that the students which were a part of the elementary swimming school containing elementary games, had a positive quantitative change in the structure and possibilities in expressing explosive strength – Jurak, Kovač, and Strel (2007), which suggests the introduction of the previously mentioned activities to regular education process, in order to cause a more significant and effective change in students' motor skills, which are an equivalent to research population.

Eksperimental group: I i II measurements - the difference determined after the final measurement

Tabela 7. Box's Test

Box's M		766,031
F	Approx.	5,114
	Df 1	128
	Df 2	130576,664
	Sig.	,000

Tabela 8. The significance of isolated functions

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1,742	100,0	100,0	,779

Tabela 9. Wilks' Lambda

Test of Function	Wilks' Lambda	Chi - square	df	sig
1	,455	141,166	13	,000

Tabela 10. Centroids

GROUP	Function
1	-1,307
2	1,307

Tabela 11. The structure of discriminative function

Function	
	1
MESBML	,601
MESSD	,578
MBRVS20M	-,379
MESVM	,478
MESVZ	,579

Discussion

After the fact that the initial state of control group would be treated as one, and the final state as another group was indicated, by using Boksov's test (Table 2.), a testing of the identity matrix was performed, which showed that the difference between covariance matrix was statistically significant (.000), which made it able to acquire the requirements for performing the further procedure of discriminative analysis. In table 3., an isolated discriminated functional group can be observed, that is a discriminational function which significantly differentiates initial and final state, which shows the coefficient of canonical correlation (.763). A distinctive root for discriminative function is also high (1,830) as is the level of coverage of the variance included in this discriminative function (100%). The significance of isolated functions is determined with Wilks' lambda test (Table 4.), which is commonly used in discriminative analysis as F test's multilinear equivalent. Stated value is of low medium significance (.377), which indicated on a conclusion that there is an existent difference between the initial and final state, that is, that „groups“ have significantly different arithmetic environment. The overall claim is positively surrounded by a significance level of significance (.000). The groups' centroids defined in table 5. determine a group's sign, resulting in a negative coefficient predetermined for the initial and positive for the final state. Structural coefficients shown in table 6., are a more reliable indicator of relative power of discriminative variables, explaining the reason why they were used for the analysis and creation of discriminative function. The structure of coefficients' relations itself indicate that a smaller positive difference is present in the final measurement, specifically in variables of: throwing medicine from lying on back (MESBML, .177), long jump from place (MESSD, .165), high jump from place (MESVM, .178), high jump (MESVZ, .279). There is a specific reaction of the variable running from a high start 20M (MBR20M, -.197), that has a negative sign, which leads to a thought that the expression

of speed characteristics was higher at the initial measurement. The justification for this indication can be found in the analysis of interpretations of numerical indicators regarding speed characteristics which decreases when there is an increase in expression quality (inversely proportional).

Conclusion

The effect elementary swimming school, as an extracurricular activity, with the application of elementary water games has on the development and manifestation of explosive strength, in the conducted research, was checked by using discriminative analysis. The control group sample was represented by 20 primary school students, and the experimental group by 22. The experimental group was, in addition to their regular class of sports and physical education, subjected to swimming lesson, in duration of ten work days, two lessons daily. The goal of this research was formulated in a manner that it was necessary to conclude are there any effects present on the students of primary school which were subjected to elementary swimming school containing elementary water games (extracurricular activities), and if this program cause positive quantitative changes in the structure and possibility of expressing explosive strength. The goal of this research was not directed to prove the effect swimming school had on improving swimming skills. By applying discriminative analysis, there was a statistically concluded difference between the development and expression of explosive strength at the beginning and the end of the program, that is, between the initial and final measurement, in favor of the final measurement in both groups (control and experimental). The structure of change of the control group's discriminative function was significantly lower in regard to the experimental group, for which we can conclude to have bigger quantitative positive changes present in the final measurement in relation to the initial measurement. Therefore, the program of elementary swimming school which included elementary water games in the overall process, had a positive effect on parameters which are used to follow the development and expression of explosive strength – Horvatin-Fučkar, Hečimović, and Rađenović (2011). This statement suggest the introduction of previously mentioned activities in the education proves in order to cause more significant and effective changes in students' motor skills, who are an equivalent to research group.

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Submitted: November 21, 2011.

Accepted: December 09, 2011.

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Trends in the importance of applying hypothetical personality dimensions during top level heavyweight K-1 fights

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Original scientific paper

Abstract

Therefore, the quality of an athlete's performance is determined by the weakest link in his preparation chain. Since the psychological process indicators and psychological state manifestations among top level K-1 fighters are heavily influenced by personality traits and characteristics manifested in those fighters' activities and formed under the influence of different factors during their year-long engagement in K-1, this research is important in terms of both theory and practice. This research has been carried out on a sample of 96 top level super heavyweight (over 91 kg) male fighters participating in final K-1 tournaments in Japan from 1993 to 2004 (in 84 matches and 205 rounds). The age of the examinees varied from 21 to 39 years. The research aimed at analysing the indicators of assessment of hypothetical personality dimensions with K-1 fighters during their fights at the final K-1 tournaments from 1993 to 2004. This paper was based on the explorative approach to K-1 phenomena in a situational condition. This resulted in a thorough sectional view of the most successful fighters, helping to determine an absolute criterion for defining what a quality fighter is, as the final tournament gathers only the 8 best fighters. It follows therefore that the examinees in this paper were the most able K-1 fighters in the world. The abovementioned fighters have been, after a detailed, studious and meticulous review of the recordings, described by a group of hypothetical personality dimension variables. The gathered data on hypothetical personality dimensions have been processed with the descriptive statistic method and presented according to the total frequency of their application. By means of trend analysis we examined the development trends in the significance of hypothetical personality dimension variables in the sense of their increase and decrease in the period of 12 years, as to obtain data on hypothetical personality dimensions state of a K-1 fighter. Through the analysis of the fights at the final K-1 tournaments (GP Tokyo Dome) we identified the hypothetical personality dimensions which had been manifested during the fights. These clearly indicate that a fighter needs to possess certain character traits if he wishes to achieve his maximum in K-1. These characteristics are not merely "advisable" but almost an obligatory component of a group of characteristics including stability, discipline, perseverance, motivation, an ethical quality, absence of uncontrolled aggressiveness and anxiety etc. committee.

Key words: K-1, top level fighters, super heavyweight, frequency, trend

Introduction

Orandum est ut sit mens sana in corpore sano / We should pray (to the gods) to have a sound spirit in the sound body. This Latin quotation reflects the belief that was and still is dominant in some areas of the society, when it comes to psychological aspects of engagement in sport. Namely, the importance of psychological factors in sport performance, recreation, and other segments in the lives of athletes, artists and other people has been ignored considerably. The erroneous dogma that identifies physical preparedness, stamina, and performance as the basic and dominant links that inhibit most of the „negative“ mental influences has lost its credibility and gave way to recent scientific information on tremendous influence of mental factors on all aspects of life. The psychologists analysed a personality from several different points of view. We should point out a situational approach which indicates that the behaviour is largely conditioned by the situations or environment and an interaction approach where the situation and personality traits are taken into account as behavioural co-determinants, as variables that jointly determine behaviour. In other words, our knowledge of both, meaning the traits and situations, may help us understand better the behaviour of K-1 fighters during the fights. In view of this, psychological features constitute predisposition for a particular behaviour of a person,

but it does not imply that such a behaviour will be manifested with certainty in all situations. Regardless of how much a fighter is physically capable and talented; these two characteristics can be irrelevant in sport unless that person is adequately mentally prepared. Lack of appropriate preparation, anxiety over the performance, absence of self-confidence, can all have fatal consequences for a successful sport performance. The world of sport is full of individuals who have never achieved the kind of success inherent in their talent. Therefore, when we speak of K-1 sport we must keep in mind its complexity and incessant direction towards securing strong cohesive factors that would incorporate the requirements of various aspects and approaches to contact sport in general, merged in K-1. Naturally, this has already been far beyond practice in narrower terms, for integration of knowledge from various fields is simply inevitable. The personality traits and characteristics heavily influence the psychological processes and psychological state manifestations of top level K-1 fighters. The personality traits are manifested in the fighters' activities and formed under the influence of different factors during their year-long engagement in K-1. Various observations and analyses of fights (both live and on video recordings) by experts of different profiles (coaches, analysts, researchers, methodologists and other sport experts) have resulted in broadening and strengthen-

ing knowledge of different possibilities for applying and making the components of K-1 sport important for achieving success more concrete (Valera 1973, Kapo 2004, 2006, 2007, 2008, 2011, Bajraktarević 2004). Other combat sports have also conducted studies. That is why this research consisted of collecting information based on a set of hypothetical personality dimension variables in order to assess the significance of certain parameters during the fights of top level K-1 fighters at the final K-1 tournaments in the Tokyo Dome, Japan from 1993 to 2004. In view of all the above, the research objective was to analyse the assessment of hypothetical personality dimension application by K-1 fighters during their fights at the final K-1 tournaments from 1993 to 2004.

Methods

The situational aspect has been provided through video recordings of all fights held in the last 12 years (1993-2004) at the final Grand-prix tournament in Japan. This resulted in a thorough sectional view of the most successful fighters, helping to determine an absolute criterion for defining what a quality fighter is, as the final tournament gathers only the 8 best fighters. It follows therefore that the examinees in this paper were the most able K-1 fighters in the world. This research has been carried out on a sample of 96 top level super heavyweight (over 91 kg) male fighters participating in final K-1 tournaments in Japan from 1993 to 2004 (in 84 matches and 205 rounds). The age of the examinees varied from 21 to 39 years. Each of the 96 fighters that had managed to qualify for the final tournament was described with 13 variables used for the assessment of hypothetical personality dimensions, in order to evaluate, as detailed as possible, the importance of certain parameters during the fights of top level K-1 fighters.

The collected data on hypothetical personality dimensions were processed by descriptive statistics and presented in total frequencies. By means of trend analysis we examined the development trends in the significance of hypothetical personality dimension variables in the sense of their increase and decrease through the period of 12 years, as to obtain the data on the hypothetical personality dimension states of a K-1 fighter.

These data have been processed by a special algorithm (Bonacin 2006) which includes rescaling the initial data to a universal range from 1 to 5. This results in the unification of all entities in all variables, thus allowing them to be compared and processed even at the level of manifested variables. Based on the estimate of top K-1 fighters' fights (DVD and VHS recordings were used) made by competent professionals, different aspects of K-1 tactics necessary for attaining top results in K-1 have been classified.

Variables for assessing hypothetical dimensions of personality of K-1 fighters during the fights

1. HPDKONC - concentration
2. HPDSAMK - self-control
3. HPDANKS - anxiety
4. HPDAGRS - aggressiveness
5. HPDMOTI - motivation
6. HPDUPOR - persistence
7. HPDHLAD - coldness
8. HPDDISC - discipline
9. HPDMORA - moral
10. HPPOPSB - possesses positive relation towards the weaker opponent

11. HPPOPBB - possesses positive relation towards the stronger opponent
12. HDLPNO - behaviour after the knockout
13. HDTAKLU - tactfully cunning

Results and Discussion

The indicators of psychical process and manifestation of psychical conditions of K-1 fighter are heavily influenced by the traits and features of K-1 fighter's personality, displayed in the activities, and formed in the course of long-term K-1 training, which includes the influence of various factors. This research analyses the set of variables in hypothetical dimensions of personality to perform the assessment of significant parameters in the course of the activities in K-1 competitions. Chart and Graph 1 present the values that K-1 fighters realised in the contests. The highest value is indicated by the variable that relates to positive attitude towards a strong fighter (HPPOPJB) (4.3) which implies a considerable respect among the fighters who most probably had no negative attitude towards their own personality, and where the fighters attempted to identify the weaknesses in the opponent's personality in order to achieve their own success.

The concentration variable (HPDKONC) (4.1), indicates that K-1 fighters were focused on their tasks and forms of attention scope, which are essential for achieving success in K-1 sport. The self-control variable (HPDSAMK) (4.1), indicates that K-1 fighters, in the course of a match as well as during the K-1 tournament, held their potentials within expected limits, without displaying huge oscillations and emotive fluctuations. The motivation variable (HPDMOTI) (4.1), indicates that K-1 fighters demonstrated a desire to win, i.e. they directed their behaviour towards a set objective, expressing their comprehension that the victory can be achieved step by step and their readiness to stick to that to the end.

The moral conduct variable (HPDMORA) (4.1), indicates that K-1 fighter were behaving in accordance to K-1 rules and actual social norms that implied adherence to particular rules and customs during the tournaments. The variable of positive attitude toward inferior fighter (HPPOPSB) (4.1) indicates that the fighters did not demonstrate underestimation, but respect towards the opponent's person and weaknesses, without insulting one's person. The persistence variable (HPDUPOR) (4) also displays high readings, because persistence in K-1 sport is very important. A fighter has to demonstrate endurance, patience, not giving up the set objectives, and one should not feel that the fight is a challenge because one must win three successive fights in one evening, which is not possible without having this hypothetical dimension of personality. The other variables display lesser values, but play an important role. These variables are: coolness (HPDHLAD) (3.9), which indicates that K-1 fighters expressed enviable presence of mind in decision making and control over one's emotions; discipline (HPDDISC) (3.9) that indicates that K-1 fighters executed given tasks in the course of a match; shrewdness in tactics (HDTAKLU) (3.8), which indicates that K-1 fighters 'saw well through' their opponents, and made a wise analysis of the situation and person they were fighting against, and choose the most effective strategy, respecting the established moral norms and accepted code of conduct. It is obvious that the logic of reversed metric orientation is valid for some variables in this hypothetical aspect, as it was the case of fight simulation (training) process in tactical education. Therefore, it would be justified to wonder if an average value of these variables indicates exactly reversed position in direction that is evaluated by these values. If we accept this supposition,

and seems that we have to, concerning that we are talking about K-1 fighters, than the low average will seem entirely as expected.

The anxiety variable (HPDANKS) (1.7), indicates that prior to match and in the course of it K-1 fighters expressed no psychical tension, anxiety, fear and insecurity that would affect the success in fight. The uncontrolled aggressiveness variable (HPDAGRS) (1.4) indicates that K-1 fighters did not express anger, rage, and they did not seek for the reasons to launch direct or indirect attack. They also did not express intolerance, quarrelsomeness etc. in the course of final K-1 tournaments. The variable of behaviour upon the knockout (HDLPPNO) (1) indicates that although the subjects of research were top-level K-1 fighters, they were not capable to re-enter the fight after they made errors and received blows during the fight, and this is confirmed by the smallest assessment of all hypothetical parameters monitored in this research. The obtained statistical indicators suggest that, from the point of view of psychology, K-1 fighters certainly represent selected fighters who possess highly determined psychological abilities¹ that affect the success in K-1 sport.

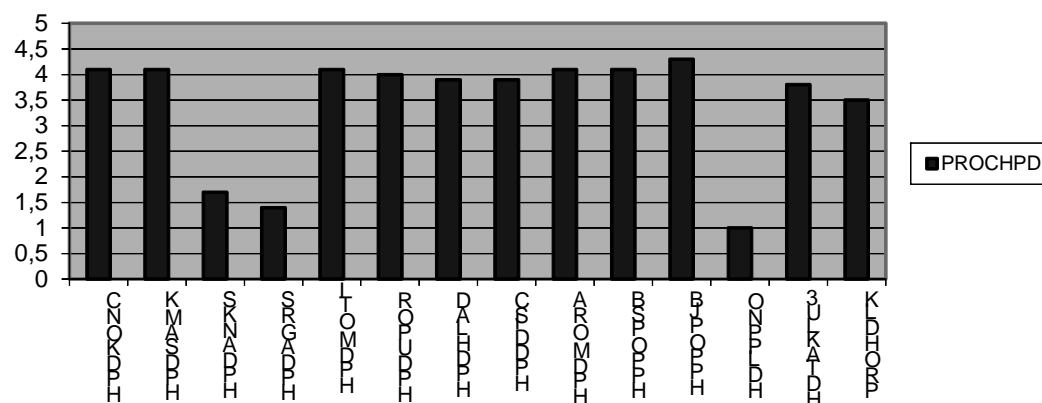
Total average of three reversely orientated, abstracted variables (HPDANKS, HPDAGRS, HDLPPNO) was (1.37), which indicates that negative aspects of personality exerted a very low level of influence on fight outcome, or the fact that they placed in final tournament. The average value of the other ten variables was (3.99), most certainly a high value, which again suggests that positive aspects of personality exerted strong influence on the fight outcome, i.e. participation in final K-1 GP tournament in Japan.

Table 1 Assessment of hypothetical personality dimensions of participants at the final K-1 tournaments (1993-2004)

VARIABLES	UKZB3PR	PROCHPD
HPDKONC	2061	4,1
HPDSAMK	2085	4,1
HPDANKS	861	1,7
HPDAGRS	729	1,4
HPDMOTI	2051	4,1
HPDUPOR	2031	4
HPDHLAD	1979	3,9
HPDDISC	1963	3,9
HPDMORA	2044	4,1
HPPOPSB	2069	4,1
HPPOPJB	2157	4,3
HDLPPNO	337	1
HDTAKLU	1944	3,8

Graph 1

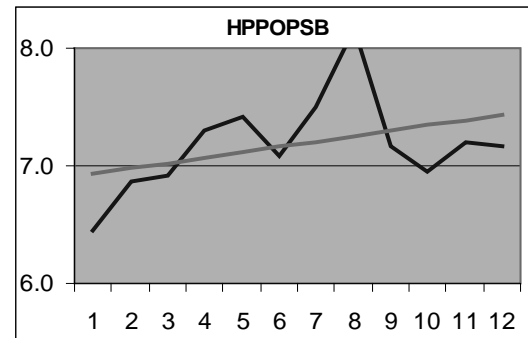
Assessment of hypothetical personality dimensions of participants at the final K-1 tournaments (1993-2004)



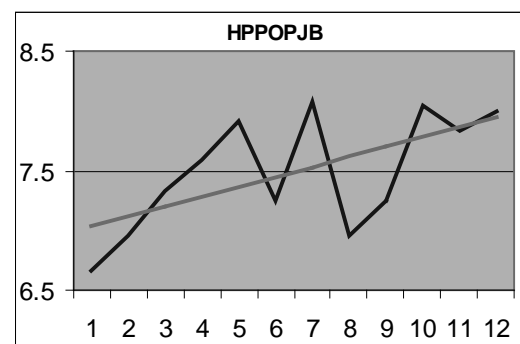
¹ High psychological stability of K-1 fighters in this research is most probably the result of long-term, strenuous trainings and vast experience that the K-1 fighters acquired during fights.

The trend increase in the assessment of hypothetical personality dimensions state in the period between 1993 and 2004 clearly indicates an increase of the **HPPOPJB variable (positive attitude towards a strong fighter)** which implies a considerable respect among the fighters. They most probably did not have a negative attitude towards their own personality and attempted to identify the weaknesses of the opponent in order to achieve success (Graph 2). **The variable of positive attitude toward an inferior fighter (HPPOPSB)** also has an increasing trend, most likely because the fighters did not demonstrate underestimation but respect towards their opponent and his weaknesses. (Graph 3).

Graph 2.

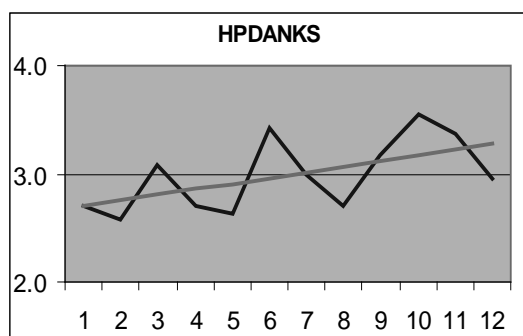


Graph 3.

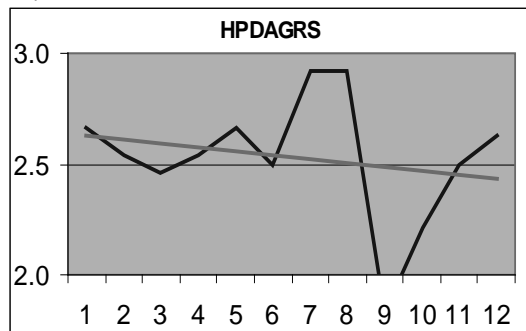


The trend increase in the assessment of hypothetical personality dimensions state in the period between 1993 and 2004 clearly indicates an augmentation in the assessment of anxiety (HPDANKS), most likely due to an increased psychological tension or an insecurity prior to but also during the fight. The fighters were anxious about the opponents they had already fought against during the tournament which added to their anxiety and, consequently, influenced their performance during the fight. K-1 fighters expressed the highest level of anxiety during the 1998 and 2002 tournaments (Graph 4). The HPDAGRS hypothetical personality dimension variable (uncontrolled aggressiveness) showed a decrease probably because these were experienced, top level fighters who did not express anger, rage, did not seek for reasons to launch direct or indirect attack nor expressed intolerance, quarrelsomeness in the course of final K-1 tournaments.

Graph 4.

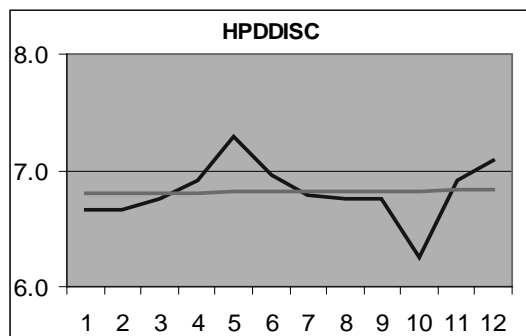


Graph 5.



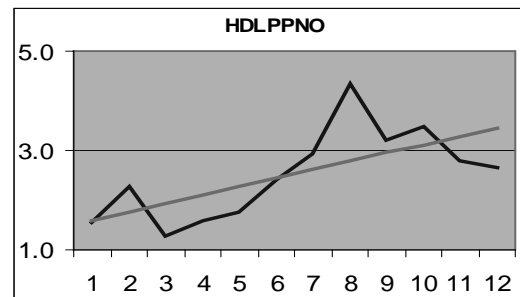
The trend in the assessment of **HPDDISC hypothetical personality dimension variable (discipline)** indicates an equal application throughout the analysed tournaments, suggesting that K-1 fighters had in the course of the match succeeded in fulfilling the tasks they were given before the fight (Graph 6). The moral conduct variable (HPDMORA), indicating that K-1 fighters were behaving in accordance to K-1 rules and actual social norms that implied adherence to particular rules and customs during the tournaments (Graph 7).

Graph 6.



The trend in the assessment of **HDLPPNO hypothetical personality dimension variable** (behaviour after the knock out) shows an increase. That suggests that all the fighters had probably come to these tournaments well prepared and thus able to recover after a knockout during the match more quickly and efficiently. (Graph 8).

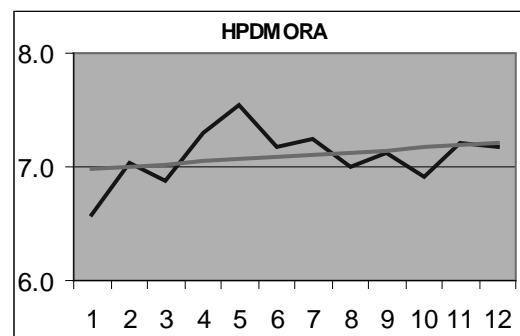
Graph 8.



Conclusions

These data should help shorten the time period needed to create a top quality K-1 fighter. As we all know, in all martial arts and, consequently, K-1 a fighter is at his best usually around the time when his age is already becoming a problem, forcing him to stop fighting. For this reason, it is essential to identify the most important techniques and principles in this sport and thus shorten the period needed for creating a top level K-1 fighter. This would, of course, also help prolonging a fighter's career in sport. Through the analysis of the fights at the final K-1 tournaments (GP Tokyo Dome) we identified the hypothetical personality dimension states which had been manifested during the fights. These clearly indicate that a fighter needs to possess certain character traits if he wishes to achieve his maximum in K-1. These characteristics are not merely "advisable" but almost an obligatory component of a group of characteristics including stability, discipline, perseverance, motivation, ethical quality, absence of uncontrolled aggressiveness and anxiety etc. The above mentioned characteristics are already known to have an enormous positive influence on the person of an athlete in general. The only difference is that this positive influence has been proved by this research. That comes to no surprise as it is very difficult to imagine a K-1 tournament winner who is unmotivated, undisciplined, superficial, unethical, anxious, uncontrolled, etc. This sporting activity as such does not allow athletes to have these characteristics, because such fighters will be eliminated in the simplest possible way: they will be defeated in the preliminary rounds! The trend analysis shows that the application of following variables increased: HPPOPJB, HPPOPSB, HPDANKS, HDLPPNO, HPDMORA, whereas the HPDDISC variable has an almost identical level throughout all these tournaments.

Graph 7.



The HPDAGRS variable was decreasing probably because these were experienced, top level fighters who did not express anger, rage, did not seek for reasons to launch direct or indirect attack nor expressed intolerance, quarrelsomeness in the course of final K-1 tournaments.

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Submitted: November 15, 2011.

Accepted: December 11, 2011.

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Differences between winning and losing teams from World water polo championship for women

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Original scientific paper

Abstract

The aim of this study is to determine the difference between winning and lost in the water polo team for the women from the World Water Polo Championships in Shanghai, China the 2011th year. Sample of respondents represents the analysis of winning and losing team of 45 matches of the World Water Polo Championships for women. The sample of variables is based on certain segments of the water polo game for women in stages of attack and defense, and those are: GS - goals scored, AAG - Attempt to achieve goals; A - Action shot; C - Centre shot; X - Extra player shot, 5 m - Penalty, 5 m1-Penalty Attempt, TF - Turnover foul and SP - Sprint. The results of Chi square test show a statistically significant difference $p = .000$ in the analyzed segments of Waterpolo matches. The biggest differences between winning and losing teams is sprint - counter with the achievement of a goal which says that the winning team had a good defense tactics and rapid swimmers which are able to achieve goals. A lost teams were making a great offense causing penalties where it was more successful winning team and the game was based on the midfielder.

Generally one can come to the conclusion that the winning teams based there tactics on counter strike because they had a better swimmers and by better swimming therefore defensive team made offenses causing the penalty where the winning team had a better success and the game was based on the center because the center is organizer of the game

Key words: **Water polo, Women, Winners, Lost**

Sažetak

Cilj ovog rada jeste utvrđivanje razlika između pobjedničkih i izgubljenih ekipa u vaterpolu za žene sa Svjetskog prvenstva u vaterpolu Šangaj, Kina 2011. godine. Uzorak ispitanika predstavlja analiza pobjedničkih i izgubljenih ekipa od 45 utakmica Svjetskog prvenstva u vaterpolu za žene. Uzorak varijabli je baziran na određenim segmentima vaterpolo igre za žene u fazama napada i odbrane i onu su: GS - postignuti golovi; AAG - pokušaj da se da go; A – gol iz akcije; C – centar dao gol; X – sidraš dao gol; 5 m – penal; 5 m1- pokušaj iz penala koji je golman odbranio ili igrač fulio; TF – faul u kontranapadu SP – sprint – kontra sa postignutim golom. Rezultati Hi kvadrat testa pokazuju sa postoje statistički značajne razlike $p = .000$ u analiziranim segmentima vaterpolo utakmice. Najviše razlika između pobjedničke i izgubljene ekipe je sprint – kontra sa postignutim golom što govori da je pobjednička ekipa imala dobru taktiku odbrane i brze plivačice koji su uspjeli da postignu golove. Izgubljene ekipe su pravile veliki prekršaja što je prouzrokovalo penale gdje je bila uspješnija pobjednička ekipa i igra se zasnivala na igračima centra. Generalno može se doći do zaključka da su pobjedničke ekipe zasnivala taktiku na kontranapadu jer su imali bolje plivačice samim boljim plivanjem odbrambena ekipa je pravila prekršaje što je prouzrokovalo penale gdje je pobjednička ekipa imala bolji uspjeh i igra se zasnivala na centrima jer je centar i organizator igre.

Ključne riječi: **Vaterpolo, žene, pobjednice, izgubljeni**

Introduction

Water polo as a sport for women has a long historical development, however in 1979 the International Swimming Federation, for the first time organize the World Cup for Women, 1985. year and since 1985 year to there were organized the European Championship which gives additional impulse in developing water polo sport for women. On the proposal of FINE, which supported the international Olympic committee for women's water polo becomes a promotional sport for the Olympic Games in Atlanta in 1996, and for the Olympic Games in Sydney 2000 year of women's water polo becomes officially included in Olympics. Also, the World Water Polo Championships for women are held every two years, on which are also happening constant transformation of rules of the game which points to the need for analysis of water polo match in which it comes to winning, losing and unsolved matches Escalante et al., (2011) point to changes in the rules during the period 2005 to 2009 in which FINA introduced new rules aimed at improving the water polo game for the women the most significant changes is to increase the time interval from seven to eight minutes duration of the quarter, the intervals between periods, Minimum distance a penalty shoot is 5 feet and length of and reasons for exclusion player made a foul. Because

of all the above there is a need for feedback information from the contests that will cvantificate technical and tactical indicators (Lozovina, Pavicic & Lozovina, 2004; Platanou, 2004).. Feedback from the competition can be used in the positive transformation of performance athlete in order to achieve the effective results of on competitions that information be collected in an objective, valid and consistent manner and based on analysis and evaluation of key elements of the coach and the player opens up new possibilities to improve water polo game. Studies that determined the requirements for women's water polo the game (Polglaze et al., 2008) indicate a highly intensive repeating activity of players because of the specificity of these activities in the water and the opposing player. Lupo et al., (2010) analyzed water polo matches between the Euro League and Italian League and Italian Series A1 Series B during the competition season 2005 / 6 for the men in the technical and tactical indicators, the results of the analysis of multivariate variance indicate significant results between the duration of the counter-attack on the number of players who are directly involved in the action and the types of shots on goal. The results indicate that the level of competition has revelation impact on the above segments of water polo games. Lupo et al., (2011) analyze the technical and tactical walks of 12 matches for women's water polo National Athletic Collegiate Associatin (NCAA)

in the three segments of the counter attack on the strength of the game and the outcome of the result of the match on the lost teams and the winning teams. The results between winning team and lost were establish between duration of action, the number of players, girdles, exclusion and penalty shots and shots from outside the area 5 meters. Winning teams have shown a better ability to perform the action with a more rapid action with effective girdles ie, passing and shooting towards the goal. Enomoto et al., (2001) analyze the matches from the World Championship for Women 2001. The following segments of water polo game: attack, shots, the results of shooting, foul, mistakes with the ball, the error without the ball and attack. The results showed that highly ranked teams in the attack have a frequent shots with only minor errors in relation to the lower ranked teams in the attack, highly ranked teams had more individual fouls and goalkeepers had more ineffective defense, but lower ranked teams.

The aim of this study is to determine differences between winning and lost in the water polo team for the women from the World Water Polo Championships in Šangaj, China the 2011th year.

Methods

Sample of the examines

Sample of subjects analysis is winning the lost teams of 45 matches from the official website of the World Water Polo Championships for women held in Shanghai, China the 2011th year 18-30 July.

Sample of variables

The sample of variables is based on certain segments of the of water polo game for women in stages of attack and defense, and those are: GS - goals scored, AAG - Attempt to achieve goals; A - Action shot; C - Centre shot; X - Extra player shot, 5 m - Penalty, 5 m1- Penalty Attempt, TF - Turnover foul and SP - Sprint.

Data processing methods

For all the analyzed variables for women of water polo game will calculate the frequency and percentage values, and to determine the frequency differences between winning and the lost teams will use a Chi-Square test on statistical significance level of 5%

Results and Discussion

Table 1 and Figure 1 shows the results of the differences between frequency of winning and the teams who lost in a water polo match at the world championship in Tokyo in 2011. The results H square test (Chi-square = 227) clearly shows a statistically significant difference $p .000$ in the analyzed segments of the water polo match. Analyzing the individual variables it can be seen the total achieved 907 (14.6%) of the goals that 603 (17.8%) winners and 304 (10.7%) lost teams. A lost teams tried to reach the goal in 1130 (39.4%), and the winning teams tried in 1339 (39.5%) attempts, a total of 2469 (39.6%) attempts to score. The winning player scored a goal out of action 208 (6.1%) attempts, a player lost 104 (3.7%) attempts, the total 312 (5.0%). Central player of lost team scored 29 goals (1.0%), and the winning 100 (2.9%), the total 129 (2.1%). Anchors and the winning

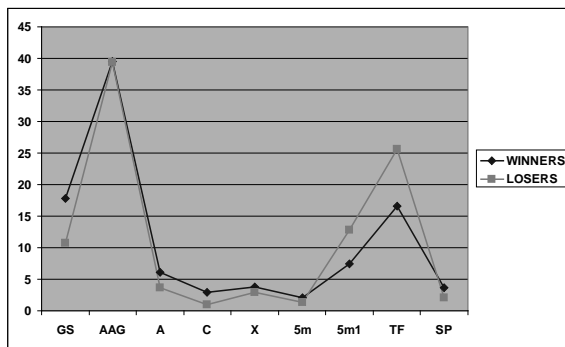
teams achieved 128 (3.8%) goals, lost Team Scores 83 (2.9%) the total 211 (3.4%) goals. Total penalty achieved, 112 (1.8%) of which achieved by the winning player 71 (2.1%), and the loss given 41 (1.4%) goals from penalties. Attempt at scoring from penalty which goalkeeper defended or missed Total 617 (9.9%), defense or failure of the player that lost did not achieve the goal 365 (12.8%), and the winning player 252 (7.4%). Foul in the counter attack has made the winning player 562 (16.6%) and lost 728 (25.6%) Total 1290 (20.7%). Sprint with counter attack and achieved goal were a total of 182 (2.9%) of which the winning player had 123 (3.6%), and the player lost 59 (2.1%).

The biggest differences between winning and lost teams is sprint - counter with the achievement of a goal which says that the winning team had a good defense there tactics and rapid swimmers which are able to achieve goals (Hayley and Associates 2010). in the research results indicate that swimming with the ball reduces the speed of swimming in the women's water polo, but the accuracy remains unchanged. A lost teams have played so-called rougher tougher defense and rules offenses, where the awarding penalties and the winning team was on target with a penalty shoot-which is probably a lot of influence on the game. During the game and setting up more tactics being played on the central players so that the center of winning teams had been more successful in the scoring of the lost teams. It must be said that the goalie winning player was more successful in defense of what can be concluded from defended penalty (Francisco and Associates, 2009). The study the analysis found that there are significant statistical differences in the thirty-six parameters values that are attacking and defending in the female category and forty-six men between winning teams and lost. If the results of this study compare with those of studies in Argudo (2000), Argudo & Lloret (1998a, b) and Argudo and Lloret (1999), which is the subject of the analysis focused on the tactical assessment of the European water polo championship in 1997, it is clear that between winner and lost, in the women's water polo, are on the level of statistical significance, 05 in favor of the winning team.

Table 1. The results the winning and losing team in water polo for women.

VAR. Engleski	WINNING	LOST	TOTAL
GS goals scored	603 17,8%	304 10,7%	907 14,6%
AAG - Attempt to achieve goals	1339 39,5%	1130 39,4%	2469 39,6%
A – Action shot	208 6,1%	104 3,7%	312 5,0%
C – Centre shot	100 2,9%	29 1%	129 2,1%
X – Extra player shot	128 3,8%	83 2,9%	211 3,4%
5 m - Penalty	71 2,1%	41 1,4%	112 1,8%
5 m1- Penalty Attempt	252 7,4%	365 12,8%	617 9,9%
TF – Turnover foul	562 16,6%	728 25,6%	1290 20,7%
SP - Sprint	123 3,6%	59 2,1%	182 2,9%
TOTAL	3386 55,5%	2843 44,5%	6229 100%
Chi-square = 227; Degrees of freedom = 8; Probability = 0.000			

Figure 1. The results the winning and losing team in water polo for women.



Conclusion

The results of this study indicate that the winning teams had the highest mobile tactic of the defense player from the lost and that the winning team had the better goalies when it comes to the women's water polo championship. Water polo players attacks were based on a central player, as well as shots on goal proving goals scored by the center. You can reach the conclusion that the winning teams motor function was better prepared and faster swimmers because he was given plenty of goals from counter attacks and lost teams have made several breaches in the counter attack which was a larger number of penalties and better success winning team in the penalty shoot-out. As it was expected, the pace of the game was on the winning team as well as improved tendering on the ground as shown from results. Unfortunately, in Bosnia and Herzegovina there is no women's water polo, it is true some have tried, but had no succeed. This is one of the first attempts to get to certain indicators and presenting in Bosnia the Herzegovina. The results can be used in Water polo clubs, to Faculty of Sport and Physical Education and the similar institutions that deal with this issue. Research results can be a good basis for further research projects aimed at improving women's water polo and men's water polo.

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Submitted: November 11, 2011.

Accepted: December 13, 20101.

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The impact of sports manager 'sport science education' to business and sporting success of football

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Original scientific paper

Abstract

The purpose of this paper is viewed through the analysis of the impact of sports manager 'sports science education', as well as sports manager with education outside of sports science, to football organizations in Sarajevo Canton as it pertains to business and sporting success for the season 2003/2004. Research has been conducted on a stratified sample of 27 football clubs of Sarajevo Canton, the number of respondents (N = 405) with a total of 81 variable. Scale estimates of samples were created based on the Likert model, Terstons and Bogardus scales with higher numbers of stages 1-10, 1-100, which gave a stronger discriminative force to the instrument.

Data were analyzed with SPSS 12.0 statistical package for Windows, using the regression analysis. Based on the results obtained, it is found that business success in football is directly affected by 'sports science education' of sports managers, specifically those with a minor in coaching and training school. The sporting success, as it turns out, is also directly affected by 'sports science education' of sports managers, specifically with a coaching and training minor or a sport science and physical education degree. Interestingly, statistically significant correlation was found attributing to the impact of managers whose education is outside the sports orientation to both business and sporting success, which can be interpreted as a consequence of engaging licensed managers in football clubs. Research results could be used for identifying current market mechanisms with respect to the institutions that educate sports managers, innovating existing curricula and significantly linking education with practice. Moreover, research results indicate the need for creation of a new managerial philosophy in football organizations that are to be based on continuous organizational learning and education.

Key words: **sports education, business and sporting success and impact**

Introduction

It was confirmed that the sports organizations development, economic and social, was determined by the level of education and innovation skills of managers in the sport on the basis of research results in the area of Canton Sarajevo (Mašala 2008). However, the lack of serious discussion about the impact of education in sports, seeks above all, a deeper consideration of the accepted perspective of sports professionals and professionals and the impact of rapid changes in today's environment. (Smith, Hans, 2009). Because of that, this study is based on this assumption that the *business and sporting success* in football is determined by a number of managers with targeted education relating to sports affiliations. The aim of this study is related to determining the impact of sports programs for managers on one, as well as determining the impact of education managers whose education is beyond the sporting orientation on the other side, in relation to *business and sporting success* in football. With the conducted statistical analysis procedures, obtained data was used in detection of the impact of managers educated with sports

Sažetak

Cilj ovog rada je analiza utjecaja obrazovanja menadžera sportskog usmjerenja, kao i obrazovanja menadžera izvan sportskog usmjerenja nogometnih klubova Kantona Sarajevo u odnosu na ostvareni poslovni i sportski uspjeh za takmičarsku sezonu 2003/04.

Istraživanje je provedeno na stratificiranom uzorku 27 nogometnih klubova Kantona Sarajevo, broja ispitanika (N=405) sa ukupno 81 varijablom. Skala procjene uzoraka kreirana je na osnovu modela Likertove, Terstonske i Bogardusove skale sa većim brojem stupnjeva 1-10; 1-100 što je dalo jaču diskriminativnu snagu instrumentu.

Podaci su analizirani na osnovu statističkog paketa SPSS 12.0 for Windows i u tu svrhu je korišten postupak Regresione analize. Na osnovu dobivenih rezultata, uočava se da na poslovni uspjeh u nogometu utiču obrazovanja menadžera na nivou završene više trenerske škole. Uticaj na sportski uspjeh u fudbalu, prisutan je kod obrazovanja menadžera na nivou završene Više trenerske škole i završenog Fakulteta sporta i tjelesnog odgoja. U slučaju poslovnog kao i u slučaju sportskog uspjeha, obrazovanje izvan sportskog usmjerenja ima svoj statistički utjecaj, što se može tumačiti posljedicom angažmana licenciranog menadžerskog kadra u nogometnim klubovima.

Rezultati istraživanja mogu poslužiti u svrhu prepoznavanja aktuelnih tržišnih mehanizama sa aspekta potreba institucija koje obrazuju menadžere sporta, te značajnijeg povezivanja obrazovanja sa praksom. Osim toga rezultatima istraživanja se ukazuju na potrebu kreiranja nove menadžerske filozofije u fudbalskim organizacijama zasnovane na kontinuiranom organizacijskom učenju i obrazovanju.

Ključne riječi: **sportsko obrazovanje, poslovni i sportski uspjeh i uticaj**

orientation in relation to the *business and sporting success* in football. This effect is explained by the consequence of engaging licensed managers in football clubs who do not have to have formal sports education/degree. By definition, the professional status of managers in the UK is a relatively new phenomenon, which marked the creation of FIFA's "Pro license" in 1997 and the first graduates emerged after 1998. year (Crust, Lawrence, 2006). Furthermore, the research illuminates a need for engaging managers targeting specific sports not only in football, but also in other sports organizations. This highlights the dependence of mandatory organizational learning and education (Šunje, 2002).

Method

A stratified sample was applied for this study. The sample includes a set of 27 football clubs and 405 managers/participants of the Sarajevo Canton in a competition season 2003/2004. As a basis for drawing the sample, we used the monograph "Strategy of development of the Sarajevo Canton by 2015" (Canton Sara-

jevo, 1999). This pattern seemed appropriate because it ensured the representation of managers with the lowest and highest organizational responsibilities (elementary, middle and top level). Scale sample estimates were created based on the Likert model, Terstons and Bogardus scales with larger number of stages 1-10, 1-100 with higher numbers of stages 1-10, 1-100, with a stronger discriminative force to the instrument (Bala, 2007; Jurišić, 2005; Fajgelj, 2004; Supek, 1981 and later). The questionnaire was approved by the Ministry of Culture and Sport of Canton Sarajevo in 2003 for the purpose of scientific research. To construct the questionnaire, following instruments were used as a template: Collection of existing urban cantonal and municipal regulations in the field of sport (Vujmilović, Rašidagić, Zubović, Masala, 2004)., Economics and Management in Sports (Bartoluci 1999)., Sport Governance in the Global Community, Morgantown: Fitness Information Technology (Thoma, JE, Chalip, L. 1996) In the procedure of conducting the survey, the participants/managers are asked to answer what type of educational background they had, namely: a) sports education with a degree in sport science and physical education, b) sports education with a minor degree in sports coaching and training, c) sports education with a degree in high school of sports (i.e. high school equivalent of associate degree in sports), d) education outside of sports orientation. The remaining questions were related to sports club reports pertaining to: e) the total level of revenue achieved financially, f) the best sport result achieved in the domestic competition, and g) the best sport results achieved at the international level in football for season 2003/2004.

Variable sample included a total number of 81 variables. A set of 75 variables related to attitudes of the total number of surveyed managers (presidents, directors, consultants, general officers, sports directors, directors of marketing and PR team managers - A scout, heads of professional staffs, coaches A, Coaches B, coaches C, team leaders of youth facilities, school sports leaders, heads of departments and heads of the monitoring of maintenance

facilities) depending on which types of sports education they had. In addition to the views expressed on the type of education, the set of variables included in the results also reported the amount of clubs' earned income, the best sport results achieved in the domestic international competition in football for season 2003/2004. In the final process of defining the sample, based on the vault analysis, six collective variables were isolated that determine the educational profiles of the total analyzed managerial personnel, namely: education manager with a degree in high school of sports (MGTSPG), education manager with a minor degree in sports coaching and training (MGTVSS), education managers with a degree in sport science and physical education (MGTSPO), education manager with a degree outside the sporting orientation (MGTDISM), then a variable of *business success* (POUSP) and a variable of *sporting success* (SPUSP) in the competitive football season 2003/2004.

The method of data processing was based on the statistical regression analysis procedure and the computational outcome of SPSS - statistical analysis software program. In the completion of the statistical procedures, presented were the values of correlation coefficients in the regression model predictions, then their values displayed with significance levels of F-ratio in the variance analysis and significance tests of model predictions based on the predictor variables and display parameters of regression analysis.

Results and Discussion

THE IMPACT OF SPORTS MANAGER ŽSPORT SCIENCE EDUCATION' TO BUSINESS SUCCESS OF FOOTBALL

Tables: 1.a., 1.b. and 1.c.: The parameter display regression analysis of variable of education managers with a minor degree in sports coaching and training (MGTVSS) in relation to variable success in football (POUSP) for the 2003-2004 seasons.

Table:1.a. Correlation and determination coefficient

Model	R	R ²	Adjusted R ²	Std. Error R ²
1	0.504	0.254	0.224	473837.1217

Table: 1.b. Omnibus test for testing the significance of the model predictions

Model	Variable choice	Sum of squares	df	Mean square	F	Signf.
1	Regression	1910741297585.989	1	1910741297585.989	8.510	0.007 **
	Residual	5613040446949.160	25	224521617877.967		
	Total	7523781744535.150	26			

** F-ratio is statistically significant at less than 1%

Table: 1.c. Value and significance level of standardized and unstandardized regression coefficients

Model		Unstandardized coefficients		Standardized coefficients		t-test	Signf.
		B	Std. Error	Beta			
1	(Constant)	50020.348	103523.052			0.483	0.633
	MGTVSS	175446.949	60141.459	0.504		2.917	0.007 **

** B-coefficient is statistically significant at less than 1%

Based on the results presented in the table 1.a., one can see that the coefficient of determination R^2 has a value of 0.224. Practically, this means that managers with a minor degree in sports coaching and training (MGTVSS) can be attributed to 22.4% variability of *business success* (POUSP) of football clubs. In this case, the adjusted coefficient of determination is taken as a better measure assessment of the shared variability between the predictor and criterion. The results of this analysis indicate that the profile of education managers with a minor degree in sports coaching and training significantly affects the *business success* of football clubs in Canton Sarajevo, and with this in mind, one can consider their involvement within analyzed clubs is not at all random.

F-ratio, table: 1.b., which is referring to significance model prediction testing, is statistically significant at levels far less than 1%. This means that the whole model achieves significantly better and more successful prediction of football club *business success* (POUSP) in relation to the base-line prediction. Therefore, this model is possible and applicable in practice. Thus, this provides additional information to the general observation and recognition of the importance of this type of education managers and their overall share of the labor market.

Based on the results presented in the table: 1.c., one can see that the regression coefficient is statistically significant at a level less than 1%. So, after the base-line prediction and the constant value, the input for predictor manager with a minor degree in sports coaching and training (MGTVSS) variable significantly improves prediction power of models that has been singled out. The regression coefficient is a positive sign, which means that if a football organization hires more managers with a minor degree in sports coaching and training, the greater the chance of higher *business success* measured in earnings.

Tables: 2.a., 2.b. and 2.c: The parameter display regression analysis of a variable outside of sports training orientations (MGTDORM) in relation to *business success* in football (more successful) for the 2003/2004 season.

From the table: 2.a, one can see that the value of the coefficient of determination adjusted R^2 is 0.190, which indicates that the predictor variable that refers to the number of analyzed frames with education beyond sport orientation (MGTDORS) explains 19% of variability of *business success* (POSUP) in football. Such a statistical significance of education of managers outside the sporting orientation can be interpreted through the publicity and the attractiveness of the football market and the marketing and entrepreneurial potential of football in Sarajevo Canton (Mašala, 2003; Mašala, 2008; Mašala, Šunje, Rado, Čičić 2008).

Table: 2.b., presented an analysis of the model prediction, which makes a constant value of *business success* (POSUP) and predictor variables of education managers outside the sporting orientation (MGTDORM). F-ratio is statistically significant at less than 5%, and it can be concluded that the model is fully applicable and statistically significant. Based on the analysis results it is possible to bring a very similar conclusion as in the previous case, the impact of education managers outside the sports orientation in relation to *business success* in football clubs conditioned competitiveness and attractiveness of the football market in Canton Sarajevo.

Based on the results table 2.c., the regression coefficient is statistically significant at less than 5%. This means that the variable education of managers outside the sporting orientation (MGTDORM) significantly contributes to predictability of power models. Since the coefficient is negative, it can be concluded that the greater involvement of managers outside the sporting orientation to football clubs reduces *business success* and vice versa.

Table: 2.a. The correlation coefficients and determination

Model	R	R^2	Adjusted R^2	St. Error R^2
1	0.470	0.221	0.190	484199.4414

Table: 2.b. Omnibus test for testing the significance of the model predictions

Model	Variable source	Sum of Squares	df	Mean Square	F	Signif.
1	Regression	1662554269194.786	1	1662554269194.786	7.091	0.013 *
	Residual	5861227475340.370	25	234449099013.615		
	Total	7523781744535.150	26			

* F-ratio is statistically significant at less than 5%

Table: 2.c. Value and signif. level of standardized and unstandardized regression coefficients

Model		Unstandardized coefficients		Standardized coefficients	t-test	Signif.
		B	Std. error	Beta		
1	(Constant)	2159187.512	744213.852		2.901	0.008 **
	MGTDORM	-142326.221	53446.748	-0.470	-2.663	0.013 *

* B-coefficient is statistically significant at less than 5%

** B-coefficient is statistically significant at less than 1%

THE IMPACT OF SPORTS MANAGER 'SPORT SCIENCE EDUCATION' TO **SPORTING SUCCESS** OF FOOTBALL

Tables: 1.d., 1.e. and 1.f. The parameter display regression analysis of variable education managers with a degree in sport science and physical education (MGTSPO), in relation to *sporting success* (SPUSP) in football for the 2003-2004 seasons.

Table: 1.d. Correlation coefficients and determination

Model	R	R ²	Adjusted R ²	St. Error R ²
1	0.409	0.168	0.134	15.2925

Table: 1.e. Omnibus test for testing the significance of the model predictions

Model	Variable source	Sum of Squares	df	Mean Square	F	Signif.
1	Regression	1176.700	1	1176.700	5.032	0.034 *
	Residual	5846.543	25	233.862		
	Total	7023.243	26			

* F-ratio is statistically significant at less than 5%

Table: 1.f. Value and significance level of standardized and unstandardized regression coefficients

Model		Unstandardized coefficient		Standardized Coefficient	t-test	Signif.
		B	Std. Error	Beta		
1	(Constant)	9.614	3.139		3.063	0.005 **
	MGTSPO	9.447	4.211	0.409	2.243	0.034 *

* B-coefficient is statistically significant at less than 5%

** B-coefficient is statistically significant at less than 1%

Based on the results presented in the table 1.d., we notice a significant correlation between *sporting success* (SPUSP) predictor variable of education managers with a degree in sport science and physical education (MGTSPO). According to the adjusted value of coefficient of determination R² equal to 0.134, it can be concluded that the predictor variable of education managers with a degree in sport science and physical education (MGTSPO) and criterion variable *sporting success* (SPUSP) in football share 13.4% of common variability. These results indicate that the profile of education managers with a degree in sport science and physical education statistically affects *sporting success*, but at the same time the *sporting success* is conditioned by the commitment of managers.

F-ratio, Table: 1.e., shows statistical significance at less than 5%, which means that the model predictions made by the constant value of *sporting success* (SPUSP) and predictor variables education managers with a degree in sport science and physical education (MGTSPO) is significant in its entirety. In this regard, the results indicate the applicability of this model into practice through its share in achieving *sporting success*, which is considered to be fully expected. In this way, the connection between quality education and good sporting practice is almost entirely confirmed.

Regression coefficient table: 1f, which refers to the predictor variable of education managers with a degree in sport science and physical education (MGTSPO) is statistically significant at less than 5%. This means that this variable significantly contributes to the model predictions for *sporting success* (SPUSP) in football. The regression coefficient, given the positive sign, indicates a positive correlation between the profile of education and *sporting success*. On average, the more managerial staff with a degree in sport science and physical education in football clubs, the more *sporting success*, i.e. the sporting clubs/organizations will have a higher value.

Tables: 2.d., 2.e. and 2.f. : The parameter display regression analysis of variable of education managers with a minor degree in sports coaching and training (MGTVSS) in relation to *sporting success* (SPUSP) in football for the 2003-2004 season.

Table: 2.d. Correlation coefficients and determination

Model	R	R ²	Adjusted R ²	St. Error R ²
1	0.386	0.149	0.115	15.4593

Table: 2.e. Omnibus test for testing the significance of the model predictions

Model	Variable source	Sum of Squares	df	Mean Square	F	Signif.
1	Regression	1048.482	1	1048.482	4.387	0.047 *
	Residual	5974.761	25	238.990		
	Total	7023.243	26			

* F-ratio is statistically significant at less than 5%

Table: 2.f. Value and significance level of standardized and unstandardized regression coefficients

Model		Unstandardized coefficients		Standardized coefficients	t-test	Signif.
		B	Std. Error	Beta		
1	(Contant)	8.714	3.378		2.580	0.016 *
	MGTVSS	4.110	1.962	0.386	2.095	0.047 *

* B-coefficient is statistically significant at less than 5%

** B-coefficient is statistically significant at less than 1%

Based on the results in the table 2.d., it can be noted that the adjusted coefficient of determination R² is 0.115, which indicates that the predictor variable education managers with a minor degree in sports coaching and training (MGTVSS) shared 11.5% variability with *sporting success* criterion variable (SPUSP). In this connection, it is possible to conclude that the profile of an education manager with a minor degree in sports coaching and training has a statistical impact on the *sporting success* of football clubs, but at the same time, the *sporting success* is conditioned by the commitment of managers. In this case, this type of managerial staff may be considered as a selective choice of football clubs.

F-ratio, table 2.e., shows statistical significance at less than 5%. This means that the model predictions for *sporting success* (SPUSP) based on constant values and the predictor variables of education managers with a minor degree in sports coaching

and training (MGTVSS) is statistically significant and applicable in practice. As the underlying essence is to look at *sporting success*, the connection of the manager with this type of education to *sporting success* is entirely natural and expected.

The regression coefficients table: 2.f., pertaining to predictor variable of education managers with a minor degree in sports coaching and training (MGTVSS) and *sporting success* in football are statistically significant at less than 5%. The regression coefficient is a positive sign, so in this case it is recommended that the football organizations engage more managers with targeted education of minor degree in sports coaching and training.

Tables: 3.d., 3.e., and 3f. The parameter display regression analysis of variable of education managers with a degree outside the sporting orientation (MGTDORM) in relation to athletic success (SPUSP) in football for the 2003/2004 season.

Table: 3.d. Correlation coefficients and determination

Model	R	R ²	Adjusted R ²	St. Error R ²
1	0.488	0.239	0.208	14.6262

Table: 3.e. Omnibus test for testing the significance of the model predictions

Model	Variable Source	Sum of Squares	df	Mean Square	F	Signif.
1	Regression	1675.092	1	1675.092	7.830	0.010 **
	Residual	5348.151	25	213.926		
	Total	7023.243	26			

** F-ratio is statistically significant at less than 5%

Table: 3.f. Value and significance level of standardized and unstandardized regression coefficients

Model		Unstandardized coefficients		Standardized coefficients	t-test	Signif.
		B	Std. Error	Beta		
1	(Constant)	74.474	22.480		3.313	0.003 **
	MGTDRSM	-4.518	1.614	-0.488	-2.798	0.010 **

* B-coefficient is statistically significant at less than 5%

** B-coefficient is statistically significant at less than 1%

From the table: 3.d., it is noted that the value of the coefficient of determination R^2 adjusted amounts 0.208, meaning that the predictor variable of education manager with a degree outside the sporting orientation (MGTDORM) explains 20.8% of variability *sporting success* (SPUSP) in football. This high level of variability of predictor variables with *sporting success* in football is in this case justified because football clubs hire trained, licensed managers who are, as already determined in earlier research, associated with the business and *sporting success* in football (Mašala, 2008; Mašala, Šunje, Rađo, 2008).

Based on results from the table 3.e., the variance of regression is nearly eight times greater than the variance of the error, which makes the F-ratio statistically significant at 1%. This means that the model which includes a constant value of *sporting success* (SPUSP) predictor variable of education manager with a degree outside the sporting orientation (MGTDORM) is statistically significant and applicable in practice.

From the table: 3.f. one can see that both regression coefficients are statistically significant at the level of 1%. In this respect, we can say that the predictor variable of education manager with a degree outside the sporting orientation (MGTDORM) significantly contributes to predictive power of the model in predicting the value of *sporting success* (SPUSP) of football organizations. However, the sign of the coefficient is again negative, which means that the profile of education manager with a degree outside the sporting orientation and *sporting success* is at a negative correlation. This brings us to the conclusion that the more managerial staff with education outside of the sporting orientation in football clubs, the *sporting success* reaches low values and vice versa.

Discussion and Conclusion

SPORTS EDUCATION AND BUSINESS SUCCESS IN FOOTBALL

Analyzing corrected coefficient of determination R^2 results, F-ratios and regression coefficients results, education managers with a minor degree in sports coaching and training (MGTVSS) variable and *business success* (POUSP) variable, it is possible to conclude that:

- The educational profile of managers with a minor degree in sports coaching and training has a statistically significant impact on the *business success* of football clubs in Sarajevo Canton area, considered as expected.
- Furthermore, the assumed model, consisting of predictor variability of education managers with a minor degree in sports coaching and training and a constant value to *business success* in football, is found to be statistically significant as a whole and as such is fully applicable in practice.
- Positive values of the regression coefficient (the value without a negative sign) significantly improves the prediction power of the model and it suggests that if a football club hires more managers with a minor degree in sports coaching and training, it has a higher *business success* measured in earnings. This confirms the connection between sports education attained at the Department of Sport Science and Physical Education with a good sporting practice.

Analyzing corrected coefficient of determination R^2 results, F-ratios and regression coefficients results, education managers with a degree outside of the sporting orientation (MGTDORM) variable and *business success* (POUSP) variable, it is possible to conclude that:

- The educational profile that refers to the education of managers with a degree outside of the sporting orientation is statistically more significant on impact of *business success* in football. The presence of such an effects can be explained with significant marketing and entrepreneurial potential of football in Sarajevo Canton, which places this sport as one of the more attractive market segments engaging various educational profiles of managers (Mašala, 2008; Mašala, Šunje, Rađo, Čičić 2008, Mašala, Šunje, Rađo 2008)
- The assumed model, consisting of predictor variability of education managers with a degree outside of the sporting orientation and constant values of *business success*, is statistically significant and entirely possible in practice. However, by analyzing the values of the regression coefficient, we are observing that the predictor and criterion variables are negatively correlated. It directs us to believe that with the involvement of a larger number of managers in football clubs with education beyond the sporting orientation does not increase but reduces the chance of *business success*.

SPORTS EDUCATION AND SPORTING SUCCESS IN FOOTBALL

Analyzing corrected coefficient of determination R^2 results, F-ratios and regression coefficients results, education managers with a degree in sport science and physical education (MGTSPO) variable and *sporting success* (SPUSP) variable, it is possible to conclude that:

- Statistical significance of correlation, educational profile of managers with a degree in sport science and physical education variable and football *sporting success* variable is almost equal in this case, indicating that without a formal education in sports there is no *sporting success*, and vice versa.
- The predictor model, which is composed of a constant value of *sporting success* and a predictor variable for education managers with a degree in sport science and physical education (MGTSPO) is significant in its entirety and fully effective in practice. In this way, it is possible to confirm the connection between sports education attained at the Department of Sport Science and Physical Education with a good sporting practice.
- The values of the regression coefficients without the negative correlation, significantly improves the prediction power of the model and significantly affect the *sporting success* football clubs have in the Sarajevo Canton. In this case, the educational profile of managers in the surveyed clubs can be considered as obligatory selective choice. From the above, it is possible to infer that if a football organization hires more managers with a degree in sport science and physical education, they will achieve greater *sporting success*.
- Taking into account the results of further analysis, we notice that this profile of education is more connected with *sporting than with business success* in football, which provides additional information for further consideration of the importance of this type of education managers.

Analyzing corrected coefficient of determination R^2 results, F-ratios and regression coefficients results, education managers with a minor degree in sports coaching and training (MGTVSS) variable and *sporting success* (SPUSP) variable, it is possible to conclude that

- Statistical significance of correlation, educational profile of managers with a minor degree in sports coaching and training variable and football *sporting success* variable is almost

equal in this case, indicating that without a formal education in sports there is no *sporting success*, and vice versa.

- The predictor model, which is composed of a constant value of sports success and a predictor variable for education managers with a minor degree in sports coaching and training (MGTVSS) is significant in its entirety and fully effective in practice. In this way, it is possible to confirm the connection between sports education attained at the Department of Sport Science and Physical Education with a good sporting practice.
- The regression coefficient values, without the negative correlation, significantly improves the prediction power of the model and significantly influences *sporting success* in football, and as such, football clubs are encouraged to hire more managers with targeted education of this profile.

Analyzing corrected coefficient of determination R^2 results, F-ratios and regression coefficients results, education managers with a degree outside of the sporting orientation (MGTDRS) variable and *sporting success* (SPUSP) variable, it is possible to conclude that:

- The educational profile, which refers to the analysis of managers with education beyond the sports orientation, shows a high level of statistical significance in relation to *sporting success* in football, which is considered particularly interesting. The high level of statistical significance in the *sporting success* of football clubs is justified by the involvement of licensed personnel managers who do not have to have sports education, but do significantly affect the success of the football sports organizations (Mašala, 2008; Mašala, Šunje, Rađo 2008). Besides this, the high statistical significance could be attributed to high quality educational programs for licensing of coaches of different levels (A, B license, etc.) implemented under the auspices of UEFA Football Association of Bosnia and Herzegovina.
- The assumed model, consisting of predictor variability of education managers with a degree outside of the sporting orientation and constant values of *sporting success*, is statistically significant and entirely possible in practice.
- Looking at the values of the regression coefficient, it is observed that the predictors and criterion variable are in negative correlation. This suggests that, on average, the more staff with this type of education is present in football organization, *sporting success* attains lower values and vice versa.

With this research conducted, the hypothesis has been confirmed in its entirety, with additional information obtained regarding how football labor markets work. Also, the results indicate a relationship between *sporting* and *business success* on one hand and predictive variables of education managers in football clubs on the other, which is considered an essential potential of football organizations. The practical value of this work is reflected in the provision of new information for more efficient linking of sports education with practice. In addition, research findings have significant informative value not only for football clubs but also for their professional associations at national and international levels.

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- Submitted: November 15, 2011.
Accepted: December 10, 20101.

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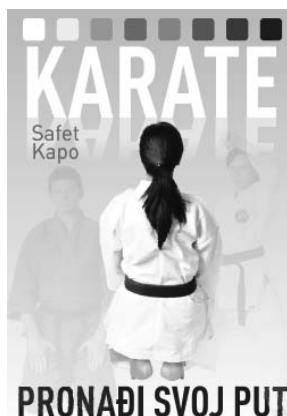
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Faris Rašidagić, Gordana Manić and Nedeljko Vidović

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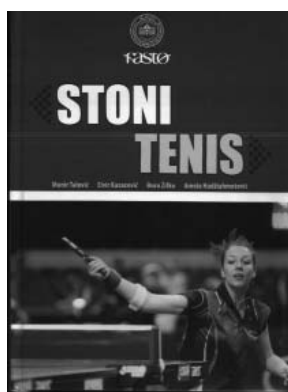
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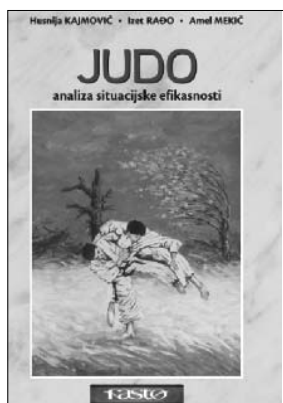
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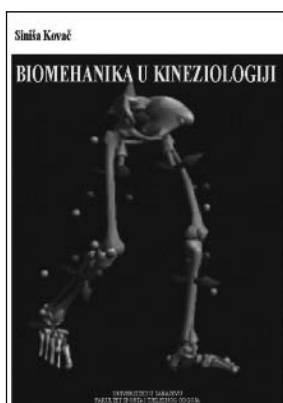
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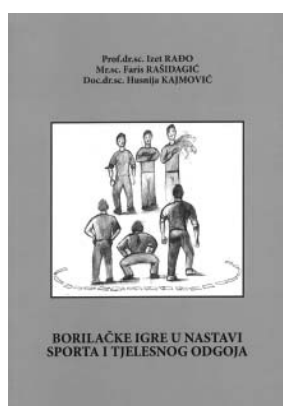
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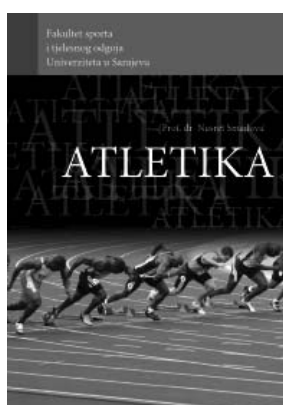
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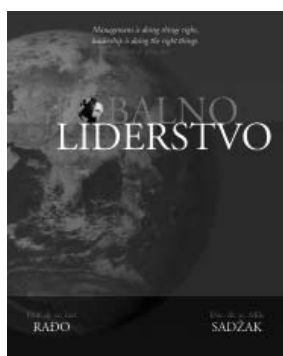
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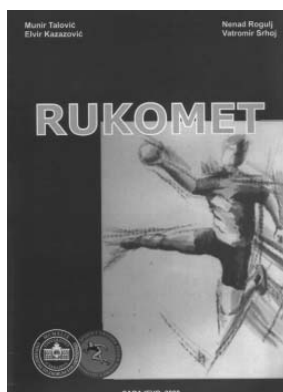
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