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ORIGINAL SCIENTIFIC PAPER

Analysis of Cadets' Endurance Development at Higher Military Educational Institutions during the Kettlebell Lifting Training

Kostiantyn Prontenko¹, Grygoriy Griban², Alla Aloshyna³, Ihor Bloshchynskyi⁴, Zhanneta Kozina⁵, Olexandr Bychuk⁶, Inesa Novitska⁷ and Mukola Korchagin⁸

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Abstract

The influence of the kettlebell lifting training on the level of endurance development and functional abilities of the cadets' cardiovascular system in the course of study is examined in the article. Cadets of the 1st–5th years of study (n=474) who were studying according to the current system of physical training (group A, n=416) and cadets who were attending a kettlebell lifting class (group B, n=58) took part in the research. The study of the level of endurance development was conducted during the following tests: 3 km race, 5 km accelerated march, and the obstacle course (400 m). The cardiovascular system functioning was examined concerning these indicators: heart rate, arterial blood pressure, Robinson's index, and heart rate recovery from a standard load. The improved indicators of the endurance and cardiovascular system of group B cadets have been reliably determined ($p < 0.05$ – 0.001) which proves the efficiency of the kettlebell lifting training concerning the future officers' formation of physical readiness for professional activity.

Key words: endurance, cardiovascular system, cadet, kettlebell lifting

Introduction

Combat experience has shown that the winner of the battle is not only the one who is armed better, but also the one who is effectively good at the weapons and techniques, who has more developed moral combat characteristics, endurance, commitment to success, physical abilities, resistance to emotional and mental loads (Finogenov, 2015; Habchuk, 2016; Rolyuk et al., 2016). Modern professional military (combat) activity is connected with many negative factors, worsening the physical condition, working capaci-

ty of military servicemen and combat capability of military units. That is why the significance of the physical training for the increase of combat capability of units and military servicemen's resistance to various negative factors of modern combat is increased (Kamaiev et al., 2018; Pichugin, Griban, & Romanchuk, 2011). The analysis of the results of the scientific researches which military servicemen of different military specialties were involved in, showed that the efficiency of their professional activity mostly depends on the development of such physical qualities as endurance and strength



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(Abdullah et al., 2016; Bolotin, Bakayev, & Vazhenin, 2016; Grankin & Kuznecova, 2017; Oderov et al., 2017). The high level of endurance development ensures the improvement of the functional abilities of the main life support systems, especially the cardiovascular system (Cobar & Madrigal, 2016; Gardasevic, Bjelica, & Corluka, 2018; Karim & Jabbar, 2018; Shephard & Astrand, 1992).

The analysis of the literature sources (Beauchamp & Pike, 2006; Manocchia, Spierer, Lufkin, Minichiello, & Castro, 2013; Oleshko, 2011; Vatel & Gray, 2005) shows that kettlebell lifting is one of the effective means of physical training which ensures strength and endurance development. The exercises with kettlebells promote effective development of physical and moral characteristics, volitional powers, functional abilities of the cardiovascular and respiratory systems and supporting-motor apparatus improvement (Ambrozy et al., 2017; Kruszewski et al., 2017; Maulit et al., 2017). Besides, simplicity of the exercises in kettlebell lifting, compactness of the equipment, possibility to carry out training alone and with a group at the gym, in the sports part of the military barrack and in the open air, low accident rate, the simplicity and economic efficiency of the materials supply (Griban, K. Prontenko, & V. Prontenko, 2014; Kuzmin, 2003; Prontenko et al., 2018) means that kettlebell lifting training of the cadets will ensure the working capacity increase in the process of studying and future professional military activity.

The aim of the article is to investigate the influence of the kettlebell lifting training on the level of endurance development and functional abilities of cadets' cardiovascular system in the course of their study.

Methods

The research was conducted with the cadets of 1st to 5th years of study ($n=474$) of S.P. Koroliov Zhytomyr Military Institute, who were engaged in the current system of physical training (group A, $n=416$), and also with the cadets who were attending the kettlebell lifting class during their study (group B, $n=58$).

The research of the level of development of cadets' endurance was carried out according to the following tests: 3 km race, 5 km accelerated march, overcoming of the obstacle course (400 m). The performance of the cardiovascular system was examined concerning these indicators: heart rate, arterial blood pressure, Robinson's index, and heart rate recovery from a standard load. The Robinson's index characterizes the performance of the cardiovascular system. The decrease of the indicator determines improvement in the system functioning. The Robinson's index in standard units was determined based on the product of heart rate and systolic blood pressure divided by 100. The research of the heart rate recovery was held after 20 squats in 30 seconds. The examination of the exercises was conducted by the instructors of Physical Education, Special Physical Training and Sport Department during the exams. The examination of the cardiovascular system functioning was carried out by the medical personnel of the institution. The significance of the difference in the results of the cadets was determined during the studying based on the Student's test and the dynamics of the results was investigated in both groups. The significance for all statistical tests was set at $p<0.05$. All statistical analyses were performed with the SPSS software,

version 21, adapted to medical and biological researches.

This study complies with the ethical standards of the Order of the Minister of Defense of Ukraine "on Approval of the Regulation on the Organization of Scientific and Technical Activity in the Armed Forces of Ukraine" No. 385 dated 27.07.2016.

The methods of the research: theoretical analysis and generalization of the scientific and methodological literature, pedagogic observation, biomedical methods, testing and methods of mathematical statistics.

Results

The analysis of the results in the 3 km race showed that the indicators of endurance development of the cadets from both groups do not differ significantly ($p>0.05$) during the 1st and 2nd years of study (Table 1). Starting from the 3rd year of study, the results of the 3 km race of the cadets who were engaged in kettlebell lifting started to be higher in comparison to the results of the cadets who were studying according to the current system of physical training at higher military educational institutions (HMEI) ($p<0.05-0.001$). Thus, the results of group B (11 min 46 sec) are 29.5 sec better than the results of group A (12 min 15 sec) in the 3rd year of study ($p<0.05$), the results of group B (11 min 31 sec) are 30.8 sec better than the results of group A (12 min 02 sec) in the 4th year of study ($p<0.05$), the difference in the results of group B (11 min 22 sec) and group A (11 min 58 sec) is 36.2 sec in the 5th year of study ($p<0.01$). The study of the results changes in the 3 km race of the cadets of every group determined that the changes are positive in both groups. However, the level of endurance development of the cadets of the 5th year of study is 1 min 11 sec better than the level of the cadets of the 1st year of study in group A ($p<0.001$) and the changes are more prominent in group B – the difference in the results of kettlebell lifters of the 5th and the 1st years of study is 1 min 53 sec ($p<0.001$). The level of endurance development of the cadets of both groups was rated as adequate in the 1st year of study, as good in group A in the 2nd, 3rd and 4th years of study and as excellent in the 5th year of study. The cadets' of group B level was rated as excellent in the 2nd – 5th years of study that means the positive influence of the kettlebell lifting training on the level of endurance development.

The analysis of the results in 5 km accelerated march proves the high level of endurance development of the cadets who were attending kettlebell lifting class. Thus, the results of the cadets of group B are 16.7 sec better than the results of the cadets of group A only in the 1st year of study ($p>0.05$) and the results of the kettlebell lifters are better than the results of the cadets who were studying according to the current system of physical training at HMEI in the other years of study ($p<0.001$) (Table 1).

The difference is 1 min 05 sec in the 2nd year of study, 1 min 11 sec – in the 3rd year of study, 1 min 12 sec – in the 4th year of study, 1 min 02 sec – in the 5th year of study. The changes in the results in 5 km accelerated march proves that the kettlebell lifting training ensures endurance development more effectively – the difference in the results of the cadets of the 5th (19 min 51 sec) and the 1st (22 min 58 sec) years of study is 3 min 07 sec in group B ($p<0.001$); the results of the cadets in the 5th year of study are 2 min 22 sec better than in the 1st year of study in group A ($p<0.001$).

Table 1. The Level and Dynamics of Endurance Development of the Cadets group A and the Cadets group B (n=474)

Years of study	Group A (n=416)		Group B (n=58)		Confidence intervals
	N	Mean±SD	N	Mean±SD	
3 km race, sec					
1	62	789.3±8.19	16	795.2±13.42	p>0.05
2	112	757.4±7.66	9	729.4±13.17	p>0.05
3	91	735.2±7.93	14	705.7±12.10	p<0.05
4	76	722.1±7.86	12	691.3±10.93	p<0.05
5	75	717.8±7.34	7	681.6±11.21	p<0.01
5 km accelerated march, sec					
1	62	1394.9±7.73	16	1378.2±14.07	p>0.05
2	112	1347.1±5.28	9	1282.3±13.84	p<0.001
3	91	1306.3±5.91	14	1234.9±12.95	p<0.001
4	76	1279.0±6.79	12	1207.2±13.15	p<0.001
5	75	1252.6±6.73	7	1190.8±13.62	p<0.001
Overcoming the obstacle course (400 m), sec					
1	62	143.1±1.69	16	146.0±1.82	p>0.05
2	112	137.8±1.27	9	137.4±2.73	p>0.05
3	91	132.2±1.34	14	129.2±2.08	p>0.05
4	76	126.9±1.30	12	122.8±2.65	p>0.05
5	75	123.3±1.52	7	118.2±2.21	p<0.05

Legend: N - number of subjects; Mean - arithmetical average; SD - standard deviation

According to the cadets' from group A 5 km accelerated march results, the level of endurance development is rated as adequate in the 1st year of study, good in the 2nd – 4th years of study, excellent in the 5th year of study. The results of the cadets from group B are rated as good only in the 1st year of study and excellent in the 2nd – 5th years of study.

The study of the results in overcoming the obstacle course proves that the indicators did not differ significantly in the 1st and 2nd years of study (p>0.05) (Table 1). The results of the kettlebell lifters of the 3rd and 4th years of study are 3 and 4.1 sec better respectively than the result of the group A cadets, but the significant difference has not been determined (p>0.05). The results of group B are 5.1 sec better than the re-

sults of group A in the 5th year of study (p<0.05). The changes in the results of the cadets of both groups are positive – the best results are determined in the 5th year of study: the result in group A is 2 min 03 sec which is 19.8 sec better than the results in the 1st year of study (2 min 23 sec) (p<0.001), the result in group B is 1 min 58 sec which is 27.8 sec better than the results in the 1st year of study (2 min 26 sec) (p<0.001). The comparison of the results in overcoming the obstacle course with normative requirements concerning the year of study proves that the results of the cadets in the last years of study are rated as good in group A and excellent in group B. It shows the positive influence of the kettlebell lifting training on the physical qualities of the cadets who are future officers.

Table 2. The Level and Dynamics of the Cardiovascular System Indicators of the Cadets group A and the Cadets group B (n=474)

Years of study	Group A (n=416)		Group B (n=58)		Confidence intervals
	N	Mean±SD	N	Mean±SD	
Heart beat at rest, bpm					
1	62	71.3±0.67	16	71.0±1.41	p>0.05
2	112	70.8±0.55	9	69.3±1.86	p>0.05
3	91	70.5±0.61	14	67.4±1.32	p<0.05
4	76	69.2±0.64	12	64.8±1.36	p<0.01
5	75	70.7±0.66	7	62.5±1.29	p<0.001
Systolic blood pressure, mmHg					
1	62	122.3±0.61	16	121.7±1.35	p>0.05
2	112	121.8±0.48	9	120.3±1.57	p>0.05
3	91	121.5±0.53	14	119.6±1.41	p>0.05
4	76	120.9±0.58	12	118.9±1.44	p>0.05
5	75	121.2±0.50	7	118.1±1.46	p<0.05
Diastolic blood pressure, mmHg					
1	62	72.5±0.58	16	72.0±0.84	p>0.05
2	112	72.1±0.40	9	70.9±0.87	p>0.05

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Years of study	Group A (n=416)		Group B (n=58)		Confidence intervals
	N	Mean±SD	N	Mean±SD	
Diastolic blood pressure, mmHg					
3	91	71.3±0.43	14	69.9±0.85	p>0.05
4	76	70.6±0.45	12	68.7±0.79	p<0.05
5	75	71.9±0.48	7	67.8±0.81	p<0.001
Robinson's index, s. u.					
1	62	87.19±0.81	16	86.41±1.82	p>0.05
2	112	86.23±0.65	9	83.36±2.38	p>0.05
3	91	85.65±0.69	14	80.61±1.94	p<0.05
4	76	83.66±0.73	12	77.04±2.51	p<0.05
5	75	85.69±0.79	7	73.81±2.67	p<0.001
Heart rate recovery after 20 squats in 30 seconds, sec					
1	62	132.1±2.58	16	134.6±4.45	p>0.05
2	112	125.6±1.96	9	117.5±4.37	p>0.05
3	91	121.3±2.05	14	103.8±3.12	p<0.001
4	76	118.5±2.27	12	95.2±3.28	p<0.001
5	75	116.9±2.45	7	88.1±3.21	p<0.001

Legend: N - number of subjects; Mean - arithmetical average; SD - standard deviation

The analysis of the heart rate of the cadets showed that the difference in the results of group A and group B is not discovered in the 1st and 2nd years of study ($p>0.05$). The significant difference in the results of the cadets is discovered in the last years of study: the indicators of the heart rate of the kettlebell lifters is 3.1 bpm better than the indicators of the cadets who were studying according to the current system of physical training in the 3rd year of study ($p<0.05$), 4.4 bpm – in the 4th year of study ($p<0.01$), 8.2 bpm in the 5th year of study ($p<0.001$) (Table 2). The study of the heart rate changes in every group during studying proves that the average indicators of the heart rate in both groups have the upward trend – the indicators of the cadets of the 5th year of study in both groups A and B are better than in the 1st year of study. However, the difference in the heart rate indicators of the cadets of the 5th and the 1st years of study is 0.6 bpm in group A ($p>0.05$) and 8.5 bpm in group B ($p<0.001$).

The examination of the blood pressure shows that the indicators of the systolic blood pressure are the same in both groups A and B in the 1st – 4th years of study ($p>0.05$). The difference is discovered in the 5th year of study – the indicators of the systolic blood pressure of the kettlebell lifters are 3.1 mmHg better than the indicators of the cadets studying according to the current system of physical training ($p<0.05$) (Table 2). The analysis of the diastolic blood pressure shows similar dynamics of the indicators: the indicators are the same in both groups A and B in the 1st – 3rd years of study ($p>0.05$) and the indicators of the cadets from group B are 1.9 and 4.1 mmHg better than the indicators of the cadets from group A in the 4th and 5th years of study respectively ($p<0.05$; $p<0.001$). The study of the blood pressure changes in every group during studying proves that the indicators of both systolic and diastolic blood pressure have the upward trend in both groups. However, in group A, the difference in the blood pressure indicators of the cadets of the 1st and the 5th years of study is 1.1 and 0.6 mmHg respectively and it is not authentic ($p>0.05$) and in group B, the difference is 3.6 mmHg in systolic blood pressure ($p>0.05$) and 4.2 mmHg in diastolic blood pressure

($p<0.01$).

The analysis of the Robinson's index showed that the difference in the indicators of group A and group B is not discovered in the 1st and 2nd years of study ($p>0.05$). The Robinson's index of the cadets who were attending kettlebell lifting class is discovered to be 5.04 s. u. better in the 3rd year of study ($p<0.05$), 6.62 s. u. in the 4th year of study ($p<0.05$), 11.88 s. u. in the 5th year of study ($p<0.001$) than the Robinson's index of the cadets who were studying according to the current system of physical training (Table 2), that proves the positive influence of the kettlebell lifting on the improvement of the functional abilities of the cadets' cardiovascular system. The study of the Robinson's index changes determined that the indicators improved till the 4th year of study ($p<0.01$), but worsened in group A in the 5th year of study. Moreover, the indicators of the Robinson's index of the cadets of the 5th year of study do not differ from the indicators of the cadets of the 1st year of study ($p>0.05$), the difference is 1.5 s. u. In group B, the upward trend is defined concerning the functional abilities of the cardiovascular system of the kettlebell lifters during the studying – the indicators of the 5th year of study are 12.6 s. u. better than the indicators of the 1st year of study ($p<0.001$).

The analysis of the heart rate recovery after 20 squats in 30 seconds showed that the indicators were the same in the 1st and 2nd years of study ($p>0.05$). The heart rate recovery of the kettlebell lifters is determined to be 17.5 sec better in the 3rd year of study ($p<0.001$), 23.3 sec better in the 4th year of study ($p<0.001$), 26.8 sec better in the 5th year of study ($p<0.001$) than the heart rate recovery of the cadets who were studying according to the current system of physical training (Table 2). The analysis of the indicators changes of the cardiovascular system functioning recovery showed that the heart rate recovery is improved in both groups. However, the difference in the indicators of the cadets of the 5th and the 1st years of study is 15.2 sec in group A and 46.5 sec in group B ($p<0.001$), that emphasizes the positive influence of the kettlebell lifting training on the cardiovascular system functioning improvement.

Discussion

The principle of kettlebell lifting is to lift weights as many times as possible in a definite period of time. Modern competitions in kettlebell lifting measure this period by 10 or 12 minutes (Beauchamp & Pike, 2006; Griban et al., 2014; Prontenko et al., 2017). In biathlon sportsmen do two exercises, each takes 10 minutes. According to the data of scientists (Kuzmin, 2003; Manocchia et al., 2013), who write about physiologic characteristics of kettlebell lifting in their works, during only one exercises in kettlebell lifting sportsmen lift more than 10 tons in 10 minutes. The authors equal the competitive work in kettlebell lifting to overcoming the distance of 10–15 km in speed skiing concerning the energy consumption (Tikhonov, Sukhovey, & Leonov, 2009). The scientists (Ambrozy et al., 2017; Grankin & Kuznecova, 2017; Kruszewski et al., 2017; Manocchia et al., 2013) mention that kettlebell lifting place high demands to the cardiorespiratory system of sportsmen and that the improvement of the results in kettlebell lifting correlates with the indicators of step-test, timed inspiratory capacity, 3 km race that proves high level of endurance development of the kettlebell lifters. The authors mention that systematic kettlebell lifting training makes the volume of cardiac muscle and blood vessels larger; changes blood composition (increase the quantity of erythrocytes and hemoglobin) (Oleshko, 2011; Tikhonov et al., 2009; Vatel & Gray, 2005).

From the physiological point of view, the endurance is the ability to perform work continually with definite intensity, the ability to deal with the exhaustion (Krivokapic, 2017; Wilmore & Costill, 2004). The endurance allows performing the work which involves many muscle groups and places high demands on the cardiovascular and respiratory systems continuously (Costa et al., 2016; Platonov, 2004). The examination of the influence of kettlebell lifting on the functional state of the cadets' organisms defined that the kettlebell lifting training ensures heart rate decrease, stabilization of the blood pressure at rest, accelerated recovery process. Besides, the results in 3 km race, 5 km accelerated march, overcoming the obstacle course by the cadets who were attending a kettlebell lifting class are defined to be better ($p < 0.05$ – 0.001) than the results of the cadets who were studying according to the current system of physical training. It proves the efficiency of the kettlebell lifting training during studying concerning the formation of physical readiness of the future officers for the professional activity.

The positive influence of the kettlebell lifting training on the level of endurance development and functional abilities of the cardiovascular system of the cadets have been determined. Thus, the results in 3 km race, 5 km accelerated march, overcoming the obstacle course, indicators of heart beat, Robinson's index and heart rate recovery of the cadets who were attending a kettlebell lifting class are better during the last years of study than those of the cadets who were studying according to the current system of physical training ($p < 0.05$ – 0.001). The high level of endurance development and functional abilities of the cardiovascular system of the cadets who were attending a kettlebell lifting class will ensure the improvement of their future performance of the professional activity.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Beliefs about the Influence on Attitudes of Turkish University Students toward Advertising through Sport

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Abstract

This research study had two main goals; the first was to compare consumers' attitudes towards advertising in general and attitudes towards advertising through sport, while the second was to verify the association of beliefs about and attitudes towards advertising through sport. The data was collected from 173 randomly selected students (male: 75; female: 98) who attended Middle East Technical University in Ankara. The questionnaire contained eight socio-demographic items and 39 items that were related to attitudes and beliefs about advertising through sport. A factor analysis was carried out to select the most influential item of each construct, and a Wilcoxon Signed Ranks Test was used to compare attitudes toward advertising in general and advertising through sport, while the Optimal Scaling Method was used to discover whether beliefs about the influence of consumer's attitudes toward advertising through sport that have been more positive than their attitudes toward advertising in general. This analysis confirmed that consumers' attitudes towards advertising through sport were significantly more positive than advertising in general, while some beliefs (social role and image, hedonism/pleasure and annoyance/irritation) significantly influenced Turkish consumers' attitudes towards advertising through sport.

Key words: sport, advertising, beliefs, attitudes, Turkey

Introduction

Based on extant literature, it is clear that it is not easy for advertising to thrive in heavily regulated industries such as finance, retail, education, pharmaceuticals etc. (Bjelica, Gardasevic, Vasiljevic & Popovic, 2016; Ling, Piew & Chai, 2010). From this reason, one of the crucial goals is to assess the determinants of consumers' attitudes towards advertising as this can help marketers to discover how various indicators affect consumers' preferences to achieve the goals of the enterprises concerned, such as promoting the enterprise and creating global brand awareness, as well as increasing the sales of certain products and services (Popovic, Jaksic, Matic, Bjelica & Maksimovic, 2015a). Therefore, it is beneficial to investigate its nature, mostly because advertising is an attractive promotional tool for marketers who can use it to strengthen commu-

nication with potential consumers who are persuaded to buy certain products or services. For this reason, the advertising has become one of the most important segments of contemporary life around the world (Ling et al., 2010); the first authors to research this area were Bauer and Greyser (1968) who quickly became aware of the fact that consumers' attitudes towards advertising reflect the behaviour of the target mass audience, which is associated with (un)favourable reactions regarding the content of the advertising messages. Lutz (1985) also concluded that the general attitudes towards advertising are a significant concept as it is one of the determinants of attitudes towards specific advertisements and it can influence the way consumers respond to any particular advertising (cited in Molnar, Lilic, Popovic, Akpinar & Jaksic, 2011). Consequently, it was evident that the consumers' attitudes towards ad-



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vertising are one of the significant factors that can strengthen its effectiveness, especially because consumers' cognitive abilities are contained in their feelings and thoughts (Mehta, 2000).

Analysing the relevant literature, it is clear that many articles on the topic of consumers' attitudes toward advertising exist; however, most of these studies dealt with the problem of general advertising (cited in Popovic et al., 2015a), which pointed to a negative trend in consumer attitudes during the 1960s and 1970s (Andrews, 1989; Muehling, 1987; Zanot, 1984). Nevertheless, some researchers received the opposite results, and they claimed that the trend was positive and criticized their colleagues who argued differently (Shavitt, Lowrey, & Haefner, 1998). They quickly concluded that both findings were correct and that the reason they received the opposite results lies in the fact that they used elements that differed considerably regarding consumers' attitudes towards advertising. Hence, some researchers believe that the elements of sport, such as athletes, teams, images of sporting events and sporting venues (Pyun, 2006) specifically affected consumers' attitudes and caused significant fluctuations in their attitudes in parallel to other elements, and they recognized sport as an independent advertising platform (Pyun, Kwon, Chon, & Wook, 2012). Accordingly, the authors believed that their companies could overcome the negative attitudes of consumers towards advertising through the use of sport motives, such as radio advertisements, television advertisements, online banners or magazine ads, largely because sport ensures a healthy image and a wide demographic profile from which any specific consumer segment could be targeted (Pitts, & Stotlar, 2007).

All data mentioned above raised the question of whether consumers' attitudes towards advertising through sport are more positive than their attitudes towards advertising through other mediums. Based on a theoretical framework created by Pyun and James (2011) and the fact that advertising through sport in Turkey is an unexplored area, this research study had two main goals: the first was to compare consumers' attitudes towards advertising in general and attitudes towards advertising through sport, because the authors have assumed that Turkish consumers have recognized sport to be an independent advertising platform; however, this had to be proven. Because the author believed that this hypothesis would be confirmed, the second goal was to verify the association among beliefs about and attitudes towards advertising through sport, as this issue has been totally neglected in Turkey; the author expected that enterprises would profit from the use of sport as an advertising medium and that the identification of specified beliefs influencing the positive attitudes would enhance advertising strategies.

Methods

The subjects that were asked to participate in the survey were

randomly selected students who attended Middle East Technical University in Ankara. Out of 174 questionnaires distributed, 173 usable questionnaires were returned (male: 75; female: 98) for a response rate of 99%, which represents an acceptable level.

The questionnaire was composed of three sections: 1) attitude toward advertising in general (three items) and attitude toward advertising through sport (three items), 2) belief factors about advertising through sport: product information (five items), social role/image (eight items), hedonic/pleasure (four items), annoyance/irritation (four items), good for the economy (four items), materialism (four items), and falsity/no sense (four items), and 3) and eight items capturing socio-demographic information. Therefore, the system of variables consists of 39 items, measured on a seven-point Likert scale anchored with 1 (strongly disagree) and 7 (strongly agree) as well as 1 (strongly dislike) and 7 (strongly like) regarding attitudes and beliefs about advertising through sport, and eight socio-demographic items that were modified from Pyun's (2006) original item to fit each relevant area. It is also necessary to highlight that all subjects were encouraged to interact with the interviewers and discuss each item if they felt they needed to. The subjects were informed that they are allowed to withdraw from participating in the survey at any time, and about the confidentiality of their responses. Because Middle East Technical University is a monolingual institution that requires a high level of English language proficiency, the author did not need to use the translation of original English versions of the scales, and the questionnaires were distributed in the English language.

The data were analysed using the Statistical Package for the Social Sciences (SPSS 20.0). The factor analysis was carried out to select the most influential item of each construct, while the Wilcoxon Signed Ranks Test was used to compare consumers' attitudes towards advertising through sport with their attitudes towards advertising in general. Then, the Optimal Scaling Method was used and Categorical Regression Analysis employed to reveal the relationships between beliefs about product information, social role and image, hedonism/pleasure, annoyance/irritation, good for the economy, materialism and falsity/no sense, as well as attitudes towards advertising through sport.

Results

This section reports the results of the statistical analyses that have been examined in this study. First of all, the results of the factor analysis are presented, followed by the results of the Wilcoxon Signed Ranks Test that was used because there were some statistically significant differences between the Gaussian curves and those of this study in the variables of two attitude constructs (Table 1). Finally, the results of the Optimal Scaling Method are reported.

Table 1. Kolmogorov-smirnov test among attitudes towards advertising through sport and advertising in general

	KS	p
Advertising through sport	.21	.00
Advertising in general	.17	.00

The factor analysis was used to take the best item of each construct. The data revealed in Table 2 reported the following beliefs about advertising through sport, such as product information (P3), social role and image (S2), hedonism/pleasure

(H3), annoyance/irritation (A2), good for the economy (G2), materialism (M1), falsity/no sense (F4), as well as attitude towards advertising through sport (AS2) and attitude towards advertising in general (AG2), to be the best item of each construct.

Table 2. The factor analysis among attitudes and beliefs about advertising through sport

Variable	#	Spearman's correlation matrix								Hotteling		
		1	2	3	4	5	6	7	8	H1	h ²	%
Product information	P1	1.00	.00	.00	.00	.00				.64	.42	57
	P2	.45	1.00	.00	.00	.00				.80	.64	
	P3	.49	.67	1.00	.00	.00				.87	.75	
	P4	.21	.34	.46	1.00	.00				.66	.43	
	P5	.34	.50	.58	.52	1.00				.79	.62	
Social role and image	S1	1.00	.00	.00	.00	.00	.00	.00	.00	.72	.52	57
	S2	.47	1.00	.00	.00	.00	.00	.00	.00	.80	.64	
	S3	.54	.50	1.00	.00	.00	.00	.00	.00	.73	.54	
	S4	.44	.64	.48	1.00	.00	.00	.00	.00	.78	.62	
	S5	.51	.52	.63	.51	1.00	.00	.00	.00	.77	.60	
	S6	.56	.49	.45	.52	.43	1.00	.00	.00	.72	.51	
	S7	.40	.60	.48	.56	.58	.41	1.00	.00	.76	.58	
	S8	.47	.56	.38	.55	.50	.49	.55	1.00	.75	.56	
Hedonism/pleasure	H1	1.00	.00	.00	.00					.71	.51	60
	H2	.48	1.00	.00	.00					.78	.61	
	H3	.43	.54	1.00	.00					.84	.71	
	H4	.36	.41	.61	1.00					.76	.58	
Annoyance/irritation	A1	1.00	.00	.00	.00					.74	.55	51
	A2	.46	1.00	.00	.00					.78	.61	
	A3	.34	.30	1.00	.00					.65	.42	
	A4	.27	.39	.26	1.00					.66	.43	
Good for the economy	G1	1.00	.00	.00	.03					.79	.63	55
	G2	.61	1.00	.00	.00					.88	.77	
	G3	.45	.60	1.00	.01					.80	.64	
	G4	-.17	-.23	-.20	1.00					-.41	.17	
Materialism	M1	1.00	.00	.00	.00					.77	.59	49
	M2	.39	1.00	.30	.00					.65	.42	
	M3	.30	.08	1.00	.00					.58	.34	
	M4	.39	.35	.34	1.00					.77	.59	
Falsity/no sense	F1	1.00	.17	.00	.00					.56	.31	53
	F2	.11	1.00	.00	.00					.65	.42	
	F3	.28	.38	1.00	.00					.81	.66	
	F4	.38	.42	.58	1.00					.85	.73	
Attitudes toward advertising in general	AG1	1.00	.00	.00						.88	.77	78
	AG2	.67	1.00	.00						.89	.79	
	AG3	.66	.69	1.00						.89	.78	
Attitudes toward advertising through sport	AS1	1.00	.00	.00						.88	.77	73
	AS2	.70	1.00	.00						.89	.79	
	AS3	.54	.56	1.00						.80	.65	

The Wilcoxon Signed Ranks Test was used to compare two attitude constructs, because the authors wanted to test the hypothesis of whether the Turkish university students showed significantly more positive attitudes toward advertising through sport than those toward advertising in general. The results of the descriptive statistics in Figure 1 revealed that the Turkish university students' overall attitudes towards advertising through sport (Mean=5.26±1.07)

were favourable, as well as their overall attitudes towards advertising in general (Mean=5.06±1.17).

However, the Wilcoxon Signed Ranks Test, which is also included in Figure 1, supported the author's hypothesis and revealed that the consumers' attitudes toward advertising through sport in Turkey are significantly more positive than advertising in general ($p < 0.01$).

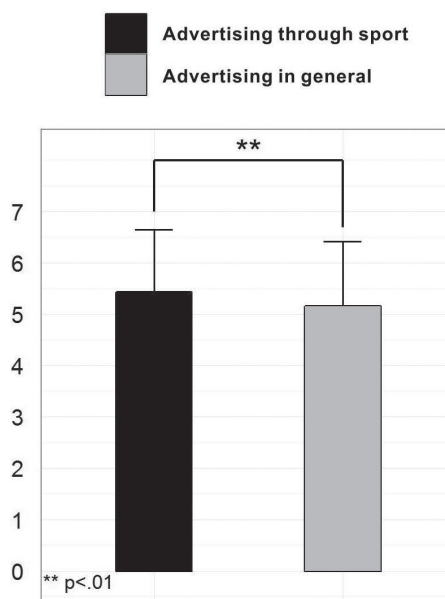


Figure 1. Wilcoxon signed ranks test among attitudes towards advertising through sport and advertising in general

Using an Optimal Scaling Method, the seven hypotheses were tested. The statistical analysis indicated in Table 3 that three of the maximum seven belief constructs (social role and image ($\beta=.09$), hedonism/pleasure ($\beta=.09$) and annoyance/irritation ($\beta=-.60$) significantly influenced attitudes towards

advertising through sport, while product information ($\beta=-.12$), good for the economy ($\beta=-.01$), materialism ($\beta=-.07$) and falsity/no sense ($\beta=-.24$) did not. The coefficient of determination ($R^2=.70$) indicated that 70% of the total variance of the attitude construct was explained by the seven belief constructs.

Table 3. Optimal scaling method among attitudes towards advertising through sport and beliefs about it

Variable	β	p
Product information	.12	.41
Social role and image	.09	.00
Hedonism/pleasure	.09	.00
Annoyance/irritation	-.60	.05
Good for the economy	.01	.72
Materialism	.07	.59
Falsity/no sense	-.24	.57
R		.83
P		.00
%		.70

Discussion

When discussing advertising through sport, it is very difficult to create frameworks that would be limited to a single research study, because there are a large number of research questions and factors that could have a significant impact on the conclusions that researchers make in this field, which is incorporated in every segment of contemporary life. For this reason, the author of this study clearly defined the research questions, in the most concrete sense, in order to be able to test his assumptions more successfully (i.e., to give more precise answers to the research questions). Thus, in this study, the author was initially researching whether there is a significant difference in the attitudes of consumers toward advertising through sport and advertising in general. Since the author was quite convinced that he would find differences in consumers' attitudes that are in favour of advertising through sport, he asked another research question. The author wanted to determine the relationship of a particular consumers' belief constructions, which are based on the theoretical framework of

Pyun and James (2011) and attitudes towards advertising through sport or to determine which beliefs might significantly influence the attitude of Turkish consumers towards advertising through sport.

In line with the previous paragraph, the author began with the assumption that consumers' attitudes towards advertising through sport are significantly more positive than their attitudes towards advertising in general, which was confirmed by empirical analysis; the findings of the Wilcoxon Signed Ranks Test have confirmed the assumption that consumers attitudes toward advertising through sport were statistically significantly more positive than attitudes toward advertising in general. As mentioned, the author was quite convinced that he would receive such results, which are in accordance with previous research carried out in other countries (Muratovic, Bjelica & Popovic, 2014; Mittal, 1994; Schlosser, Shavitt, & Kanfer, 1999; Popovic et al., 2015a; Pyun et al., 2012). However, this research question had to be verified, since the available literature also includes studies that had unexpected conclusions, that is,

results that were not consistent with the assumptions, which were based on many citations in the available literature (Popovic et al., 2015a). Therefore, in Turkey, the results obtained are congruent with the general idea that advertising through sport is a much more attractive promotional tool for acquiring potential consumers who should decide on a particular product or service and that in the best way it strengthens quality communication between business organizations and potential consumers (Popovic & Milasinovic, 2016).

Nevertheless, there are facts that are very noticeable in the work of various authors who deal with this issue: the examination of attitudes towards advertising in general, the existence of negative trends, and that potential consumers do not feel comfortable with traditional advertising messages (Andrews, 1989; Muehling, 1987; Zanot, 1984). However, regarding advertising in general in Turkey, it is interesting to point out that potential Turkish university students did not show negative attitudes; instead, it was positive, but not as much as it was positive towards advertising through sports, which was significantly more positive in the test sample. Therefore, various elements in the field of sport, such as athletes (Cristiano Ronaldo, Tiger Woods, Novak Djokovic, etc.) teams (Real Madrid, Bayern, Maccabi, Fenerbahçe, etc.), photos and videos from various sports events (FIFA World Cup, Olympic Games, Super Bowl, Wimbledon, Tour De France, etc.) and famous sports facilities (Beijing National Stadium, Allianz Arena, Kaohsiung National Stadium, etc.) have significantly affected the reduction of negative consumer reactions when they come into contact with traditional advertising messages, and it strengthened their attitudes towards advertising through sports. As such, the results of this research have a special value, especially because they will give specific guidelines to business entities regarding how to use elements of sports in their advertising campaigns, thus stimulating the development of their business ventures through sport as an independent platform for advertising their products or services. As has been unequivocally established from the above-mentioned (that the views of Turkish university students towards advertising through sport are significantly more positive than their attitudes towards advertising in general), this research continued with the testing of assumptions related to the second research question, i.e., the determination of the relationship between certain consumers' belief constructions, based on Pyun and James's (2011) theoretical framework, and attitudes towards advertising through sport. Attempts were made to identify specific beliefs about that have a significant impact on attitudes towards advertising through sport, mostly because their identification would lead to concrete knowledge that would enable business entities to prepare their advertising strategies in the best way, including reducing costs.

In the study itself, as has been mentioned several times, Pyun and James's (2011) theoretical framework was used, based on already constructed consumer beliefs that were reflected in product information, social roles and image, hedonism/pleasure, annoyance/irritation, good for the economy, materialism and falsity/no sense, as well as attitudes towards advertising through sport. However, this study is only a case study and might not represent a complete population, since the sample was compiled exclusively from university students who represent only one of the socio-demographic categories that should be explored. If the results obtained in this research are compared with the results obtained in Montenegro (Advertising through Sport=5.44±1.39; Advertising in General=5.26±1.51) and Ser-

bia (Advertising through Sport=5.39±1.84; Advertising in General=4.89±1.68), it is interesting to note that the results are almost in agreement when attitudes towards advertising through sport are concerned, that is, the most prominent attitudes of the Montenegrins, while they are less positive for the Serbians, while the Turks have the least positive attitudes (Muratovic et al., 2014; Popovic et al., 2015a) within this comparison.

In contrast, when attitudes toward advertising in general were in question, the situation is only slightly different. Although all three surveyed populations have positive attitudes toward advertising in general, Montenegrins are again distinctly positive, while this time Serbians showed less positive attitudes than the Turks. It is noteworthy that matching results can be found in research outside Europe, among university students in Singapore and the United States (Pyun & James, 2009, 2011; Pyun et al., 2012).

In contrast, when testing assumptions related to the relationship of intentionally constructed beliefs about and attitudes towards advertising through sport, it is interesting that the results are not approximately in agreement, as is the case with the first research question. This was also expected by the author of this research, and it is interesting that it was determined that beliefs about advertising through sport among Serbian consumers (Popovic et al., 2015a) can significantly influence attitudes towards advertising through sport in only one of the defined categories (Product Information) while in the case of Montenegrin consumers (Muratovic et al., 2014) is completely different: it was determined that most of the defined categories of beliefs about can significantly influence the consumers' attitude towards advertising through sport (product information, social role and image, hedonism/pleasure, annoyance/irritation, good for the economy and falsity/no sense); only the category defined as "materialism" was indicated as a significant factor that influences attitudes.

Outside of Europe, studies conducted in Singapore (Pyun et al., 2012) and the United States (Pyun, 2006) have found that beliefs about can significantly influence attitudes towards advertising through sport in two categories of beliefs (Product information and Hedonism/pleasure). Hence, the results of this research are not consistent with the results obtained in Serbia or in Montenegro, but three beliefs about advertising through sport (Social role and image, Hedonism/pleasure, Annoyance/irritation) have been identified, which can significantly influence consumers' attitude towards advertising through sport. Therefore, it is not difficult to conclude that it is necessary to define specific strategies in each of the countries, since the relation of beliefs about and attitudes towards advertising through sport varies from country to country, and the results from one country cannot be taken as guidelines for interventions in others. It is, therefore, necessary to initiate research in other countries, as an unequivocal need in business policy when advertising through sport.

When the differences in results reflecting the impact of beliefs about attitudes towards advertising through sport are concerned, several potential responses could resolve established variations among different countries. Primarily, we should start from the fact that sport can attract potential consumers based on their specific motives that are associated with the success of their favourite athletes, sports clubs, and national federations (Copeland, Frisby, & McCarville, 1996), and the motives that appear in such situations can be created through exciting experiences permeated by strong emotional feelings

associated (Micoogullari, 2017) with the success of their favourite individuals or teams. All the three mentioned European countries (Serbia, Montenegro, and Turkey) have had outstanding sport results in the past decade, both on the individual and the team levels, so it is very logical that the reason for very positive attitudes towards advertising through sport could lie in the fact that potential consumers are strongly identified with their sports heroes, and all advertising activities that involve any connection with them leads to a more positive attitude towards advertised products or services.

According to all of the above, this study represents an excellent basis for creating new advertising campaigns and strategies related to the acquisition of potential consumers in all spheres of modern industries in Turkey, as well as a cornerstone for further research in the field of advertising, and the relationship between beliefs about and attitudes towards advertising through sport. It is important to point out that marketers will make a profit for their companies if they decide that advertising campaigns should contain elements such as social roles and image, hedonism/pleasure and annoyance/irritation.

However, even though this research is an original contribution, reflected in the knowledge that the marketers will use, it still has significant limitations; first of all, the sample of respondents in this study reflects the views of university students in the area of central Turkey, and other socio-demographic categories should be included in further research. It would be advisable to carry out a national survey that would give clear results on the level of the whole country, as was the case in a study conducted by Popovic et al. (2015a) in Montenegro. Given the fact that significantly various results are obtained with Pyun and James's (2011) theoretical framework guidelines, it would be very meaningful to consider defining a new theoretical framework, or to include other beliefs about advertising through sport, such as informative, credibility, claim believability, drama, value corruption, aesthetics, entertainment, commercialism, and sex appeal in the existing theoretical framework (Ashill & Yavas, 2005; Barrio & Luque, 2003; D'Souza & Taghian, 2005; Korgaonkar, Silverblan, & O'Leary, 2001; Pyun et al., 2012; Tsang, Ho, & Liang, 2004; Wang, Sun, Lei, & Toncar, 2009; Wang, Zhang, Choi, & D'Eredita, 2002), since these authors proved to be potentially significant predictors in their studies. However, we should bear in mind that the current study explained 70% of the variance; only 30% of attitude construct is unexplained, which was not the case in the research in Montenegro ($r^2=48.7$), Serbia ($r^2=77$), Singapore ($r^2=43$) and the United States ($r^2=56.9$), where the coefficient of determination was considerably lower in Montenegro, and higher in Serbia. This fact indicates the necessity of creating separate theoretical frameworks for each nation, in order to obtain clearly defined beliefs constructs which would explain the higher percentage of the target variance. In addition, based on some previous research (Masanovic, 2018; Milosevic, Bjelica, & Masanovic, 2019; Popovic, Matic, Milasinovic, Jaksic, & Bjelica, 2015b), the author also suggests further researching attitudes toward advertising through sport within various socio-demographic categories, primarily because this might be the main reason for the national differences obtained.

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Conflict of Interest

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ORIGINAL SCIENTIFIC PAPER

Effect of Music with Brainwave Synchronizer on the Performance of Collegiate Throwing Athletes

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Abstract

Brainwave entrainment has been a method used as a therapy to reduce anxiety and heighten concentration, facilitating brain to enter a specific state. In sports, brainwave alignment is facilitated as athletes utilized music in their pre-competition routines. The aim of this study is to know if wave-synchronized music influence power performance of collegiate athletes by gathering six (N=6) college throwers, 3 males and 3 females in a quasi-experimental research. Participants ranged from shotput, discus and javelin events. With reversal method, throwing performance data were collected for 11 days, with treatment days using both high (T1, T2, T4) and low (T3) frequency waves after every 2 untreated observations. Results show that synchronizing alpha waves (12 Hz) to music listened by athletes during warm-up leads to significant increase in throwing distances of participants compared to the untreated trial performance. On the other hand, synchronizing theta waves (0.5-3 Hz) to music produced lower throwing distances significantly when compared to day-before and day-after observations. Throwing performance for the untreated observations also showed an increasing trend before the theta wave treatment day. However, no long-term effect of alpha waves was directly seen after the intervention as perceived in latter untreated observations. Further studies are needed to compare music with and without wave synchronizers or to compare the utilization of preferred music versus unfavored music during warm-up.

Key words: brainwave entrainment, throwing performance, arousal, alpha brainwave

Introduction

In competitions, the use of pre-match rituals is evident and believed to influence outcome of every individual athlete's performance. Aside from physical warm-up, athletes also listened to music of their choice as a pre-competition ritual. Athletes have previously reported to have done this on various events and help enforce a desirable performance. Not only used during warm-ups, athletes use the aid of music while in training sessions as well. This helped them in their motivation and emotions, leading to positive movement activation (Laukka & Quick, 2013). In some observations, this method has altered performers' character and personality in the playing field. With self-selected music, participants' self-esteem has seen to be affected, resulting to a positive and desirable per-

formance. This practice led to a character of greater risk taking among participants (Elvers & Steffens, 2017). While drive and character of athletes are affected, differences between sexes in terms of responses to synchronous music is still observed (Karrageorghis et al., 2010).

Between music and performance outcome, arousal and relaxation as a variable is being part of points for discussion. With the inverted U principle, function is only realized on high-difficulty tasks and found to differ from one gender to the other. One study found in arousal measures that women are more reactive from contributing conditions to arousal (Bargh & Cohen, 1978). Conversely for unfamiliar music being used, it is evident that both relaxing and arousing in nature decreased somatic anxiety, and only relaxing music decreased



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cognitive anxiety. As cognition responds to relaxing music, self-confidence increase was also observed (Kuan, Morris, Kueh, & Terry, 2018).

In the inverted U, the zone of optimal functioning (ZOF) is observed to be the most efficient variant of this hypothesis and found to be closely associated with the performance and outcome (Turner & Raglin, 1996). Achieving ZOF through music in sport often aims to improve athlete's well-being, the same way physical and psychological techniques influenced mood (Cobar, Borromeo, Agcaoili, & Rodil, 2017) and performance. In the study of Pelka et al. (2017), systematic breathing as intervention was also considered as a technique for relaxation, showing its interacting effects with running performance, specifically sprinting speed with better results than controlled groups.

Brainwave Entrainment and Arousal

Brainwave entrainment (BWE), being considered as a latent factor in music is known to reduce anxiety for both trait- and state-type significantly (Alipoor, Oraki, & Sabet, 2014). It was observed in a study that there was a heightened cognitive task performance specifically in learning time, complex navigational and decision-making abilities, when BWE is employed (Argento et al., 2017). For both, it possesses positive influence on the psycho-emotional make-up of an individual. Findings also suggested BWE as an effective therapeutic tool for people suffering from cognitive functioning deficits, pain, stress, headaches, PMS, and behavioral problems (Huang, 2008). However, this study by Huang (2008) suggested more trials for future researches and additional protocols with outcome.

As a significant mechanism in aiding athletes to reach a specific state, BWE become common in altering athletes' level of arousal and concentration. The interaction of arousal and stress response has been found to be favorable also for cardiovascular reactivity and higher self-confidence (Sammy et al., 2017). The effect of frequency of soundwave to concentration of athletes varies whether it is low or high for alpha or theta waves sensed by an athlete is seen to be connected with the level of relaxation and concentration state (Aris, Lias, & Taib, 2010). The functional system for excitatory and inhibitory processes was revealed through the inclusion of different frequency of waves in Hertz (Hz) and its association with arousal and wakefulness (Robinson, 2000). These were found in studies not only using sound but also light waves, and its association not only with alertness (Viola, James, Schlangen, & Dijk, 2008) but in effecting positive change in cognition (Cruceanu & Rotarescu, 2013). In one study, soundwaves at 2-8 Hz were used and found to affect participants' perceived sleep quality and after-sleep state positively when done in eight weeks (Abeln, Kleinert, Strüder, & Schneider, 2013). This specific function of wave frequency validated the effect of entrainment in individuals' behavior (Stinson & Arthur, 2013).

Soundwaves on Performance

The use of music as a motivational tool in exercise and sports performance has produced mixed findings. A study showed that the use of musical aid with no direct inclusion of soundwaves is found have better influence on cardiovascular exercise (K. Brooks & K. Brooks, 2010). It proved also that motivational music benefited athletes' performance in terms

of exhaustion time and in the use of oxygen. The prominence of beat and tempo, and how it manifests in movements showed more importance than music preference (Terry, Karageorghis, Saha, & D' Auria, 2012). Making rhythm-specific factors come in during warm-up found to significantly increase power output of well-trained athletes when motivational music was used, this is found in both peak and mean power with a Wingate test (Jarraya et al., 2012). For sports that focuses on fine motor skills like archery, performance improved by listening to relaxing music, and was associated with the greatest gain in performance with lowest physiological arousal (Kuan et al., 2018). These mixed findings reported included type of music, relaxing or arousing, and depending on the type of sport performance need to be aided, without noting special focus on soundwave synchronization.

Brainwave synchronization has been hypothesized in this study to be a factor in past studies' mixed findings. From physical performance, specific brain frequency has also been associated with open-ended creative problem performance (Li, Tseng, Tsai, Huang, & Lin, 2016). The dynamics between alpha and beta waves varied when open- or closed-ended creativity tasks are concerned. The specificity of wave synchronicity has produced specific and positive performance outcome, making practitioners use them with music resulting to better performance among non-elite practitioners (Simpson & Karageorghis, 2006). This idea made the application to be very specific to the nature of the sport. Specifically for field throwing events, athletes should be inclined to optimal arousal and concentration during competitions (Judge, Bell, Bellar, & Wanless, 2010), and appropriate entrainment aid should be taking in to consideration.

Mixed findings were noted with regards to investigating the direct effects of music in general to the actual sports performance among reasons are soundwaves in music being taken out of consideration. While the researchers recognize the benefit of pre-competition music exposure, they aim to know if soundwaves in music directly influence the performance of college throwers, utilizing alpha waves in particular. The investigation was delimited to the effect of soundwave frequency in music to throwing and did not scope effects brought by desirable nor undesirable type of music used before the throws. Findings derived from this study can support the supply for an alternative, psychological ergogenic aid for collegiate athletes.

Methods

Participants

The researchers accumulated six (N=6) college throwers, three (3) males and three (3) females with mean age (years) of 19.33, who are members of university competing team. Participants do not have hearing disorders.

Instrumentations

Throwing Implements - The researchers prepared materials for data collection such as javelin (M=800 g; W=600 g), shotput (M=7 kg; W=4 kg) and discus (M=2 kg; W=1 kg), with standards used in athletics tournaments, throwing events.

Stanley Measuring Tape (50 m) - Researchers used a tape as a tool to measure the throwing distances of participants (Figure 1). The instrument is made from a plastic material, ranging from 0 to 50 m.

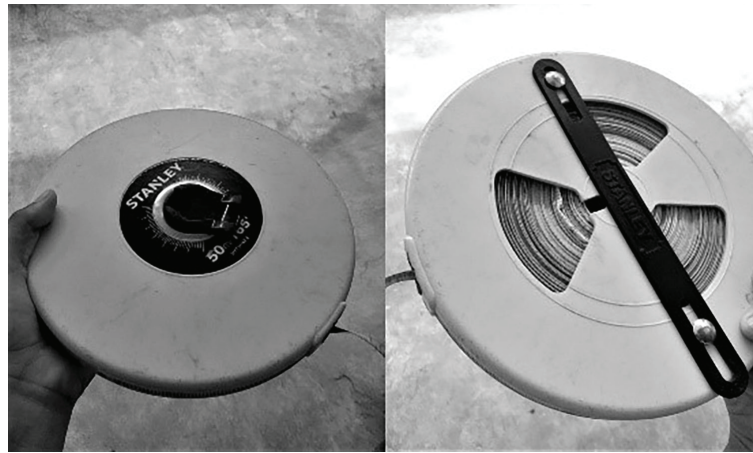


Figure 1. Distance Measuring Device

Wave-synchronized Music - The music used in the treatment sessions has standard of Alpha and Beta (12 Hz) brainwaves, and Theta (0.5-3 Hz) brainwaves downloaded on the web.

Omron® Body Fat Handheld Monitor (HBF-306) - The

handheld bioelectric impedance device (Figure 2) was used for demographic purposes. It was shown to be a tool in assessing body composition as validated and used in previous experimental studies (Moulton, 2013; Cobar & Madrigal, 2016).



Figure 2. Handheld Bioelectric Impedance Device

Study Procedures

Methodological Framework and Design - the proponents make use of a reversal method (Table 1), quasi-experimental design and collection of data was done for eleven days with

an observation-treatment cycle. Observations (O) serve as the untreated test while the Treatments (T) served as the post-test due to the inclusion of wave-synchronized music before their actual throws.

Table 1. Methodological Framework

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11
O1	O2	T1	O3	O4	T2	O5	O6	T3	O7	T4
		w/ Alpha Wave			w/ Alpha Wave			w/ Alpha Wave		w/ Alpha Wave

Pre-collection Routine - Participants were oriented about the nature, procedure and potential benefits of the study. They were informed that collection of the data will be done before training time to ensure that participants are not weary from training.

Collection of Data

Observation Sessions (O) - Collection were done every 3 in the afternoon under tropical climate. There were 10-minute warm-up before 10-minute dynamic stretching sessions. Per-

formance Trials were facilitated, with three trials of their best throwing event in between 5-minute rest intervals. Distance produced were recorded.

Treatment with Alpha Brainwave Synchronized (T1,2,4) - During treatment days, same procedure was done for all participants. There was a twenty-minute listening to music synchronized with a 12 Hz soundwave (Alipoor, Oraki & Sabet, 2014) concurrent to warming- up and stretching period. Implement used was based on the participant's best event, with 5-minute rest in between three trials. Distance produced were recorded.

Treatment with Theta Brainwave Synchronized (T3) - During treatment days, same procedure was done for all participants. There was a twenty-minute listening to music synchronized with a 0.5-3 Hz soundwave (Alipoor et al., 2014) concurrent to warming-up and stretching period. Implement used was based on the participant's best event, with 5-minute rest in between three trials. Distance produced were recorded.

This study was cleared and approved by the University Ethics Board of Polytechnic University of the Philippines, complied to the proper procedures set by the mentioned body. The researchers solicited consent from the participants and university officials before the implementation of the study to ensure full protection of all human subjects prior to the study. Each participant voluntarily provided written, informed consent before participating. Adequate level of confidentiality was en-

sured and any type of communication in relation to the research work were done with integrity. Consent was part of screening, eligibility and qualification for participation.

Statistical Treatment of Data

The researchers used Wilcoxon Signed-Rank Test in analyzing the treated data from the experiment. Bar graphs were also presented in comparing means.

Results

Participants of the study were subjected to anthropometric measurements before the implementation of treatments and performance trials. Data indicated, as shown in Table 2, that male throwers are relatively muscular dominant comparing low percent body fat in relation to BMI and weight.

Table 2. Demographic Profile of Participants

Variable	N	Males				Females			
		Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
Age	3	19.67	1.53	18	21	20	1.73	19	22
Weight	3	77	6.93	73	85	78.33	26.35	49	100
BMI	3	25.73	3.47	22.5	29.4	28.4	8.39	19.1	35.4
%BF	3	16	5.56	12.4	22.4	31	11.52	17.7	37.9

Females expectedly scored higher in fat measurements compared to male counterparts. However, mean percent body fat of 31% is seen to be beyond normal for shotput female athletes using the standards presented by Jeukendrup and Gleeson (2010) with 20-28% for females and 16-20% for shotput male athletes. This also showed that male participants are within the normal standard in terms of body fat composition.

Aside from the high body fat percentage, it is also observable that the female group varied in terms of weight, BMI and % BF compared to male participants, considering male groups'

heterogeneity composing of different type of events. Participants ranged from 18-22 yrs old.

Within the eleven-day investigation, a trend based on the mean performance was observed. Figure 3 shows the progression of performance with (T) and without (O) the inclusion of wave synchronizers. It shows consistent improvement in mean performance during three treatment days, specifically T1, T2 and T4, with 23.76 m, 24.25 m and 24.03 m respectively. Highest mean performance recorded were from T2, and O6 with 24.24 m.

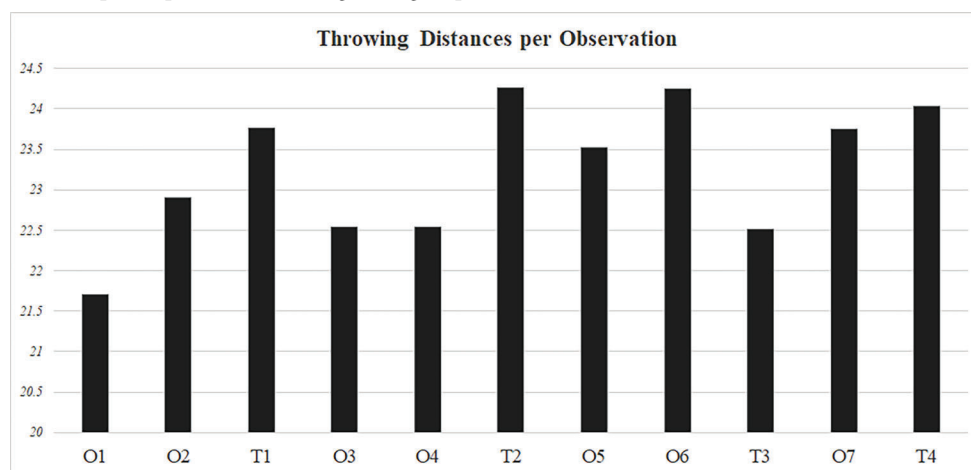


Figure 3. Mean Distance of Throws per Day of Observation Including Treatment Days

Mean throwing performance dropped when Theta Wave is introduced in the pre-trial routine during the third treatment day (T3) with 22.52 m, compared to 23.52 m and 24.24 m records of O5 and O6 respectively. Figure 3 shows that T3 scores were even lower than O2 with 22.90 m. Drop in mean performance did not manifest after a day without treatment (O7) yielding a mean of 23.76 m. It is observable also that mean performances of no-treatment days from O1 and O6 has an increasing trend.

Statistically comparing means of performance, Table 3 shows significant difference between the first alpha wave

treatment (T1) and O1, & O2. This significant change in performance was also observed in O3 when compared to the initial scores despite no alpha wave treatment. Observed significant change from O2 to T1 is consistent with the second alpha wave treatment (T2) when compared to O4. On the other hand, the visible drop from O6 to T3 is found to be statistically significant. T3 scores were also found significantly different when compared to scores acquired during O5. The rise in throwing distances with exclusion of theta waves at O7 is also significant.

Table 3. Comparing differences using Wilcoxon Signed-Rank Test (W)

	O ₂	T ₁	O ₃	O ₄	T ₂	O ₅	O ₆	T ₃	O ₇	T ₄
O ₁	- 13	- 15 *	- 15 *	-	-	-	-	-	-	-
O ₂	-	- 15 *	3	-	-	-	-	-	-	-
T ₁	-	-	15 *	-	-	-	-	-	-	-
O ₃	-	-	-	- 1	-	-	-	-	-	-
O ₄	-	-	-	-	- 15 *	- 15 *	- 15 *	TIE	15 *	15 *
T ₂	-	-	-	-	-	11	3	15 *	TIE	7
O ₅	-	-	-	-	-	-	5	15 *	- 7	- 11
O ₆	-	-	-	-	-	-	-	15*	9	3
T ₃	-	-	-	-	-	-	-	-	- 15 *	- 15 *
O ₇	-	-	-	-	-	-	-	-	-	TIE

Comparing untreated trials in between treatment days, no significant difference statistically observed between O1 & O2 and O5 & O6 particularly. During the two throwing days with the longest distances, no significant difference was found (between T2 and O6) despite one is treated and the other is not.

Discussion

Pre-competition music was seen to be exclusive as being a source of motivation (Laukka & Quick, 2013) and affecting self-esteem and behavior (Elvers & Steffens, 2017) for athletic performance. In this study, using music that is not self-selected and with the inclusion of soundwaves has presented links with throwing performance. Concurrent music and soundwave treatment with special attention to the latter as a variable infers music treatment for sports may be caused by several factors such as music preference, loudness, softness, aside from wave frequencies in it. Comparing with the study of Jarraya et al. (2012), increase in power output was observed only with the use of pre-competition music and no soundwave synchronization was specified, indicating that music alone can alter performance.

The contrast between alpha and theta waves in the study of Aris et al. (2010) was validated by the results of this study. The applicability of soundwaves in increasing physical performance is strong, particularly to those with power demands. Specifically in throwing, the needed optimal arousal (Judge et al., 2010) was linked to the concentration effects of alpha brainwaves. Entrainment through these soundwaves also explained the change in behavior (Stinson & Arthur, 2013) and performance of athletes.

The relaxation and arousal effect to performance of soundwaves is also in accordance to the nature of a sport as found in a previous study when using music (Kuan et al., 2018). Optimal arousal demands of throwing can only be supported by soundwaves that promote arousal. In contrast, synchronizing relaxation waves may affect power performance, lessening stimulation, as seen in the trials of this study.

While the effect of two different soundwaves is presented in this study, an increasing trend of performance is also observed for trials with and without alpha wave synchronization. The indication of adaptation during the experiment was detected as part of the nature of a reversal design. Despite no alpha wave treatment, O6 scores were closely comparable to T4 scores. The possibility of soundwave lasting influence to performance is also noticed in the result.

After the 11-day investigation, synchronization of alpha wave in pre-performance music significantly increased throwing distances of male and female college athletes compared to the

non-treatment counterparts. In contrast to this, significant drop in throwing distances were seen when theta wave was used during the warm-up (T4). While concurrent music and soundwave can be used to enhance performance, the researchers recommend that further studies be done comparing music with and without wave synchronizers, and focus on other variables within music used as well, such as preference, type of music, loudness, etc.

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Conflict of Interest

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ORIGINAL SCIENTIFIC PAPER

Experience Related Impacts on Jump Performance of Elite and Collegiate Basketball Players; Investigation on Force-Time Curvature Variables

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Abstract

Force-Time (F-T) curve variables of the vertical jump are known as contributing factors in jumping height. Experience-related differences might also have impacts on kinetic and kinematic outputs of athletes' jump. The aim of this study was to investigate the correlation between F-T curve variables with jump height (JH) and observe the differences between elite and collegiate basketball players. With institutional ethics approval, 12 elites (24.3 ± 5.9 years, 195.4 ± 23.1 cm, 89.1 ± 15.2 kg, 13.6 ± 2.3 years' experience) and 12 collegiate (21.6 ± 2.5 years, 183.2 ± 6.1 cm, 75.3 ± 9.5 kg, 9.1 ± 1.8 years' experience) male basketball players participated in this study. Correlation between F-T variables -included time, force, velocity, power and modified reactive strength (MRSI) - in the eccentric and concentric phases and JH was studied. Outcomes portrayed that concentric Relative Peak Force ($r=0.71$), Relative Peak Power ($r=0.83$), Peak Velocity ($r=0.99$) and MRSI ($r=0.71$) in elite players, and concentric Relative Peak Force ($r=0.79$), Average Power ($r=0.65$), Relative Peak Power ($r=0.81$), Peak Velocity ($r=0.98$) and MRSI ($r=0.83$) in collegiate players were significantly correlated with JH. Absolute and relative measures of power and force are shown to have a vital role in jump performance of basketball players. MRSI, which is defined as an explosiveness measurement in athletes, could be accounted as of jump performance criteria. Focusing on selected factors described above in training programs could enhance athlete jump performance, particularly in basketball society.

Key words: countermovement jump, F-T curve, power, modified reactive strength index

Introduction

Lower limb muscle strength and power are of crucial criterion for achieving a prosperous performance among athletes (Canavan & Vescovi, 2004; Markovic, 2007). Vertical jumps are the most commonly used tests for examination of lower limbs' strength and power (Jidovtseff, Quievre, Nigel, & Cronin, 2014; Laffaye, Wagner, & Tomblason, 2014). Previous studies focused on athletes' vertical jump performance, particularly obtained jump height (JH) (Jidovtseff et al., 2014; Laffaye et al., 2014; Sarvestan, Cheraghi, Sebyani, Shirzad, & Svoboda, 2018; Smith, Roberts, & Watson, 1992). Furthermore, vertical jumps are also employed to assess and evaluate the explosive

strength and power of the lower extremity in order to forecast and monitor the motor performance of athletes in several sports such as soccer, handball, volleyball, basketball, and sprinting (Carlock et al., 2004; Jiménez-Reyes & González-Badillo, 2011). Former studies are mostly assessed lower extremity power by performing a countermovement jump (CMJ) (Kollias, Hatzitaki, Papaikakou, & Giatsis, 2001; Laffaye et al., 2014; Sarvestan et al., 2018; Slinde, Suber, Suber, Edwén, & Svantesson, 2008). The CMJ is a type of vertical jump that is considered as the most useful test to assess neuromuscular coordination of athletes (Claudino et al., 2017) as well as neuromuscular and biomechanical features related to lower



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extremity dynamics (Claudino et al., 2017; Kollias et al., 2001). Vertical jump tests are generally used for various aims such as assessing the force and power of elite athletes who regularly participate in competitions (Cormie, McGuigan, & Newton, 2010). CMJ was also utilized in order to assess the effect of fatigue on performance (McGinnis et al., 2016).

CMJ includes rapid eccentric, and subsequently, concentric activity of muscle that is termed as stretch-shortening cycle (SSC). The SSC nature is known as rapid concentric contraction after quick eccentric contraction that increases stored energy and muscle activity (Cormie, McBride, & McCaulley, 2009; Cormie et al., 2010). Pre-activation, activating muscle structures prior to implementation, rate of change of muscle length compared with rate of change in the tendon, and role of stretching reflexes are the other effective aspects in SSC. Lower extremity power during the concentric phase is of factors that positively affect SSC, and in turn increase the jump height by increasing the center of mass vertical velocity. Sufficient time for producing and transferring force to the skeletal system is an extremely effective mechanism in SSC. The eccentric phase of SSC provides agonist muscles with sufficient time to generate significant force, and also provides sufficient time to the structures to reach significant stiffness (Jiménez-Reyes & González-Badillo, 2011). Previous studies indicated that athletes exhibit better performance in CMJ compared with that in squat jump (SJ) (Bobbert, Gerritsen, Litjens, & Van Soest, 1996; Bosco, Viitasalo, Komi, & Luhtanen, 1982; Cormie et al., 2010; Laffaye et al., 2014; Sheppard, McGuigan, & Newton, 2008), which could be due to SSC nature and especially because of the eccentric phase effect that exists in CMJ. Predominantly, studies on CMJ are generally focused on the concentric phase and there is a paucity of studies on the eccentric phase.

It has been pointed out that CMJ Force-Time (F-T) curvature variables, such as time, force and derived components could reveal an in-depth information on athletes' jump performance (Laffaye et al., 2014). Training level and neuromuscular adaptation, additionally, are brought up as effective parameters on F-T curve shape (Cormie, McBride, & McCaulley, 2008). Given the nature of SSC, cooperation of elastic contractile elements in particular, it has been speculated that biomechanical variables portray vital information on jump performance. Power and force measures, in addition to velocity, are of mechanical parameters surveyed in former investigations (Cormie et al., 2008; Jidovtseff et al., 2014; Laffaye et al., 2014; Sarvestan et al., 2018).

Scientific literature indicated that achieving relative peak power affects ultimate height during CMJ in both volleyball and basketball (Markovic, 2007; Riggs & Sheppard, 2009). It has, also, mentioned that relative peak power and average power are

significantly correlated with ultimate height in CMJ performance (Riggs & Sheppard, 2009). Relative power measure, which is normalized with body weight, is suggested that individual relative power significantly impacts performance in order to reach the ultimate possible jump height. However, other force-time (F-T) curve variables derived from CMJ, such as peak power (PP), peak velocity (PV), relative force (RF), average force (AF), and peak force (PF) were indicated as effective variables in concentric and eccentric phases of CMJ by several studies (Cormie et al., 2009; Cormie et al., 2010; Laffaye et al., 2014; Riggs & Sheppard, 2009; Sarvestan et al., 2018). However, number of studies that consider the experience-related differences in vertical jump performances among elite and sub-elite players, particularly in basketball players, are scarce. A description of these differences would aid coaches and fitness practitioners in planning optimal exercise program for athletes. To this end, and based on background covered above, the main objective of the present study involves assessing differences in F-T curve variables describing CMJ jump performance between elite and collegiate basketball players and assessing the relationship between F-T curve variables and height of CMJ.

Methods

Participants

Twenty-four elite ($n=12$, 24.3 ± 5.9 years, 195.4 ± 23.1 cm, 89.1 ± 15.2 kg, 13.6 ± 2.3 years' experience) and collegiate ($n=12$, 21.6 ± 2.5 years, 183.2 ± 6.1 cm, 75.3 ± 9.5 kg, 9.1 ± 1.8 years' experience) basketball player have participated in this study. Participants were acquainted with the purpose of the study and methods in details, and also, signed an informed consent form to participate in the study.

Instruments and procedures

After a 10-minute dynamic warm up, and prior to data collection, manner of performing CMJ was explained by an expert trainer. Afterwards, each participant performed CMJ, interspersed by 1 min intervals of rest to prevent fatigue, to a self-selected depth on force platform (Kistler, 9290AD, Winterthur, Switzerland), which measured three dimensional components of GRF at a frequency of 1000 Hz (Sarvestan et al., 2018). The CMJ performance authenticated by trainer and each participant performed three CMJs. The effect of arm swing on jump height is reviewed more than four decades and previous studies indicated that arm swings, during takeoff phase, can increase vertical velocity of center of mass for 10% (Markovic, 2007). For this reason, to prevent the effect of arm swing and focusing on lower extremity, participants put their hands on their waist (Figure 1).

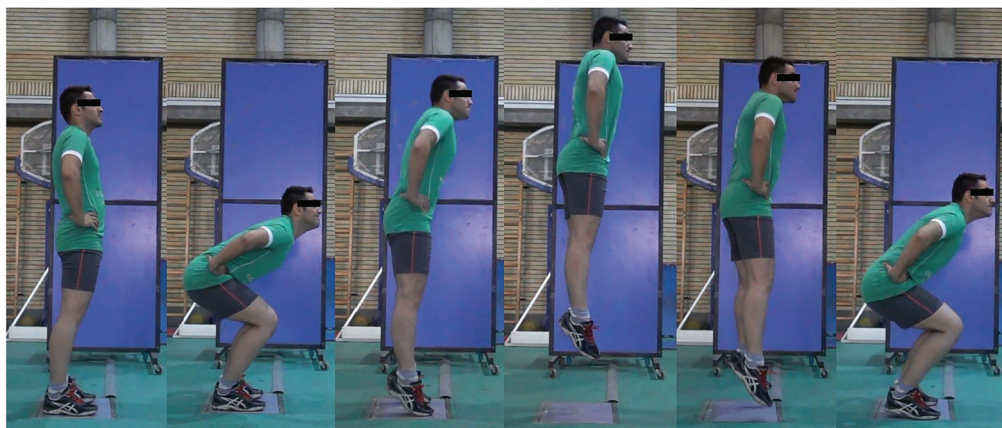


Figure 1. Manner of Performing Countermovement Jump – Akimbo Style

Data analyses

Values measured by a force platform was analyzed in Excel 2016 software. After achieving the F-T curve through the force platform, data analysis of F-T curve variables was accomplished in three phases, namely the unweighting phase, eccentric phase, and concentric phase. A few studies divided CMJ into the following three phases: unweighting, eccentric, and concentric phases (Laffaye et al., 2014; Pupo, Detanico, & Santos, 2012; Sarvestan et al., 2018); however, in this study, CMJ was divided into eccentric and concentric phases to review the special impact of each F-T curve variables on JH.

Instantaneous COM velocity was calculated by dividing the vertical force (excluding body weight) by the body mass and then integrating the product by using the trapezoid rule (Sarvestan et al., 2018). Instantaneous power was calculated by multiplying vertical force and velocity data at each time point, and COM displacement was determined via double integration of the vertical force data (McMahon, Rej, & Comfort, 2017; Owen, Watkins, Kilduff, Bevan, & Bennett, 2014). Eccentric (E) and concentric (C) peak force (PF), peak power (PP), and peak velocity (PV) were defined as the maximum values attained during the eccentric and concentric phases. All kinetic

data were divided by the body mass to allow a normalized comparison of these data between athletes. The JH was derived from the vertical velocity at take-off (Moir, 2008).

Statistical analyses

Kolmogorov-Smirnov test was employed to check normality of data distribution. A paired sample T-Test was also used to determine F-T curve variables' differences among elite and collegiate players. Pearson Product Moment correlations were performed to determine the relationships among eccentric and concentric phase's variables with ultimate jump height. The level of significance was set as $p < 0.05$. This analysis was performed using the SPSS software (version 22.0, IBM Corp., Armonk, NY). In order to increase statistical power of results and prevent the effect of small sample size on the outcomes, all the variables for the entire participants were assessed after the intergroup analysis.

Results

Descriptive measures of F-T curve variables, MRSI and JH and the differences between elite and collegiate players are illustrated in Table 1.

Table 1. Descriptive measures of all variables in eccentric and concentric phases and differences between elite and collegiate players

Variables	Descriptive Measures (Mean \pm SD)			Differences		
	Collegiate	Elite	t	df	Sig. (2tailed)	
Time (s)	ETT	0.203 \pm 0.13	0.184 \pm 0.09	0.92	11	0.44
	CTT	0.537 \pm 0.13	0.470 \pm 0.08	-3.94	11	0.02†
	TtE	0.280 \pm 0.17	0.291 \pm 0.22	0.16	11	0.82
	TtC	0.483 \pm 0.13	0.475 \pm 0.08	-0.23	11	0.74
	TtEPP	0.482 \pm 0.18	0.475 \pm 0.04	-0.22	11	0.71
	TtCPP	0.975 \pm 0.11	0.901 \pm 0.09	-5.74	11	0.01‡
Force (N)	EPF	885 \pm 109	903 \pm 386	0.11	11	0.89
	CPF	2041 \pm 346	2165 \pm 726	1.59	11	0.12
	ERPF (N/kg)	11.76 \pm 0.04	10.54 \pm 0.09	-1.73	11	0.10
	CRPF (N/kg)	27.16 \pm 4.35	24.28 \pm 5.64	2.84	11	0.04†
Velocity (m/s)	EPV	0.58 \pm 0.06	0.65 \pm 0.10	1.02	11	0.28
	CPV	1.37 \pm 0.19	1.60 \pm 0.23	-6.12	11	0.01‡
	EPP	816 \pm 149	849 \pm 201	0.81	11	0.52
	CPP	4697 \pm 1742	5118 \pm 3047	1.92	11	0.01‡
Power (W)	EAP	461 \pm 79	423 \pm 41	-1.03	11	0.27
	CAP	1267 \pm 593	1620 \pm 819	4.96	11	0.01‡
	ERPP (W/kg)	10.88 \pm 1.93	9.54 \pm 1.82	-1.81	11	0.09
	CRPP (W/kg)	62.59 \pm 18.74	57.51 \pm 21.38	-4.08	11	0.02†
MRSI		0.361 \pm 0.015	0.419 \pm 0.018	7.16	11	0.00‡
JH (m)		0.389 \pm 0.052	0.441 \pm 0.037	-6.81	11	0.01‡

Legend: Eccentric Total Time (ETT), Concentric Total Time (CTT), Time to Eccentric (TtE), Time to Concentric (TtC), Time to Eccentric Peak Power (TtEPP), Time to Eccentric Peak Power (TtCPP), Eccentric Peak Force (EPF), Concentric Peak Force (CPF), Eccentric Relative Peak Force (ERPF), Concentric Relative Peak Force (CRPF), Eccentric Peak Velocity (EPV), Concentric Peak Velocity (CPV), Eccentric Peak Power (EPP), Concentric Peak Power (CPP), Eccentric Average Power (EAP), Concentric Average Power (CAP), Eccentric Relative Peak Power (ERPP), Concentric Peak Power (CRPP), Modified Reactive Strength Index (MRSI), Ultimate Jump Height (JH).

† Significantly different ($p \leq 0.05$); ‡ Significantly different ($p \leq 0.01$)

The results indicate that CMJ execution time was significantly higher in collegiate players in comparison with elites, particularly in concentric phase (0.067 s). Consequently, elites could reach to CPP significantly sooner than collegiate players (0.074 s) in their jumps. Although elite players produced relatively higher force measures, the amounts of CRPF were significantly higher in collegiate players ($p=0.04$). Similarly, albeit CPP ($p=0.01$) and CAP

($p=0.01$) measures were significantly higher among elite players, collegiate players produced significantly more CRPP values ($p=0.02$). Recorded MRSI measures were meaningfully more in elites in comparison with collegiate players (14%), and elites jumped significantly higher compared with collegiate players (≈ 5 cm). Furthermore, as could be seen in Figure 2, elites bent approximately 8 centimeters more than collegiate players ($p=0.00$).

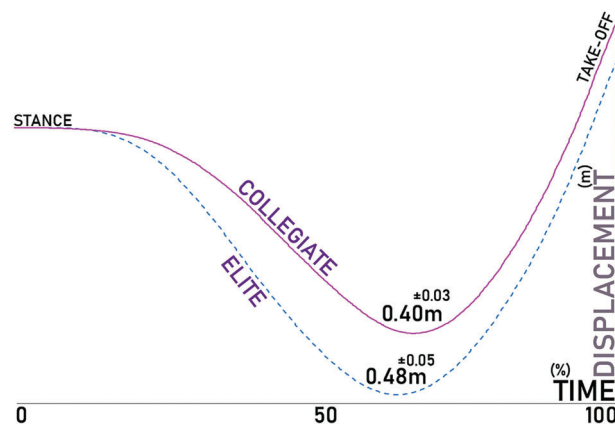


Figure 2. CoM Displacement before Take-Off

The correlations between F-T curve variables of eccentric and concentric phases and MRSI with JH among elite and collegiate players are shown in Table 2.

According to the Table 2, and despite entire eccentric variables, ETT exhibited a significant correlation with JH among total players ($r=-0.58$), albeit no strong correlation exists among groups. Of force variables, CPF was shown a significant correlation with collegiate ($r=0.77$) and total players ($r=0.68$). Significant correlation was also observed between CRPF and

JH in collegiate players ($r=0.80$), elites ($r=0.69$) and total players ($r=0.82$). In contrast with elites, significant correlation was observed between CPP and JH in collegiate ($r=0.56$) and total players ($r=0.49$). CRPP was the sole power variable that has a significant correlation among both elite ($r=0.83$) and collegiate ($r=0.79$) groups and also total players ($r=0.87$). MRSI measures have also exhibited a strong correlation with JH in collegiate ($r=0.71$), elite ($r=0.83$) and total players ($r=0.84$).

Table 2. Correlation between force time variables of eccentric and concentric phases with ultimate jump height

Variables	JH		
	Collegiate (12)	Elite (12)	Total Participants (24)
ETT	-0.47	-0.23	-0.58*
CTT	-0.05	-0.12	-0.10
TtE	-0.14	0.08	0.03
TtC	0.08	-0.05	-0.02
TtEPP	-0.12	-0.04	-0.16
TtCPP	0.18	-0.15	0.07
EPF	0.42	-0.18	0.29
CPF	0.45	0.49	0.56*
ERPF	0.12	-0.26	-0.15
CRPF	0.79**	0.71*	0.80**
EPV	-0.22	-0.11	-0.29
CPV	0.98**	0.99*	0.99**
EPP	0.26	0.03	0.21
CPP	0.65*	0.38	0.53*
EAP	0.13	-0.01	0.08
CAP	0.65*	0.23	0.49*
ERPP	-0.09	-0.01	-0.12
CRPP	0.81**	0.83**	0.89**
MRSI	0.83**	0.71**	0.81**

Legend: * Represents Moderate Correlation ** Represents Strong Correlation

Discussion

This study was aimed to a) review the relationship between F-T curve variables of eccentric and concentric phases with JH, and b) compare these variables among elite and collegiate basketball players. The main founding of this study was that elites performed the CMJ significantly faster than collegiate players and produced higher measures of force, velocity and consequently power. Collegiate players, on the other hand, produced higher amounts of relative force and power, which seems rational for the case that they owned a lower weight.

Correlation outcomes also reveals that ETT, CPF, CRPF, CPV, CPP, CRPP and MRSI had a significant correlation with ultimate JH among total basketball players.

Time variables

It has been pointed out that reducing the eccentric phase time could be used as a pragmatic manner leading to increases in the JH (Laffaye et al., 2014). Additionally, it is mentioned that a reduction in the eccentric phase time could lead to an increase in the muscle fibers recruitment, which in turn, could

develop jump performance in order to obtain a higher jump (Sarvestan et al., 2018). Furthermore, based on force–velocity relationship, increases in the muscle lengthening contraction velocity result in the generation of additional force, and this can increase JH. As it is shown in Table 2, ETT exhibits significant negative correlation with JH among total participants, which is in line with previous studies mentioned above. This outcome indicates that a proper short eccentric phase provides muscle-tendon units with sufficient time for recruiting muscle fibers and help in employing the most possible fiber before depleting the calcium from sarcoplasmic reticulum. In terms of experience differences, elite players performed the CMJ, whether in eccentric or concentric phase, shorter than collegiate players. Based on this fact, it could be contemplated that elite players, based on their higher levels of experience, were aware of the proper timing in jump to reach the greater heights.

Force variables

Previous studies indicate that CPF is significantly correlated with JH (Laffaye et al., 2014; Pupo et al., 2012; Riggs & Sheppard, 2009), which similar to the results of this study. As shown in Table 2, CPF is significantly correlated with JH among total participants. Mathematically, an increase in produced force leads to an increment in acceleration measures and, consequently, velocity measures during take-off. Hence, the higher take-off velocities, the greater jump heights. On the other hand, although CPF did not show any significant correlation with JH among elite and collegiate players, the number of participants must be taken into account as of research limitations in this study, and to this end, the total players statistical outcomes are more reliable for interpretation.

It is also reported that the CRPF is significantly correlated with JH (Pupo et al., 2012; Riggs & Sheppard, 2009). Similarly, CRPF measures are significantly correlated with JH for elites ($r=0.79$), collegiate players ($r=0.71$), and total participants ($r=0.80$) in this study. Review on most studies conducted on CMJ revealed the scarcity of attention to the CRPF of athletes. Study on the relative measures of variables can provide a more precise criteria of athlete capability due to the nature of sports such as volleyball and basketball in which the ability of jumping and rapid movements are factors that affect performance, and the ability to overcome body weight or relative measures of force is potentially vital (Riggs & Sheppard, 2009). Furthermore, although elites produced higher CPF in comparison with collegiate players, the amounts of CRPF were significantly higher in collegiate group, which seems rational because of lower weight of collegiate group.

Velocity variables

Elite players exhibited considerably higher concentric velocity measures compared with collegiate players (≈ 0.23 m/s). Similarly, the eccentric velocity measures were greater in elite players, which seems to be the main reason for shorter ETT. It is observed that eccentric velocity is not significantly correlated with JH in both groups; however, concentric velocity is strongly correlated with JH among both groups and total players, which was predictable because of JH calculation formula ($h=v^2/2g$) (Sarvestan et al., 2018). Nevertheless, optimal utilization of SSC in elite players, resulted in higher COM velocities during eccentric and concentric phases and finally aided in greater measures of height.

Power variables

Irrespective of whether power is relative or absolute, it is considered as critical factor for athlete performance (Pupo et al., 2012; Sarvestan et al., 2018). Studies conducted on CMJ indicate that athlete peak power evidently affects JH (Pupo et al., 2012). Significant correlation between absolute peak power, relative peak power and average power measures with JH is reported formerly (Cronin & Hansen, 2005; Pupo et al., 2012; Riggs & Sheppard, 2009), which is similar to the outcomes of the present study. As it is depicted in Table 2, there is significant correlations between CPP, CAP and CRPP with JH for all participants. These results indicate that not only CPP, as a product of multiplication of force and speed, have an impact on ultimate JH, but also individual power generated by each athlete could specifically influence JH. Based on the outcomes, the importance of employing specific concentric exercises, such as plyometric or weightlifting, to improve force and power is obvious (Carlock et al., 2004; Markovic, 2007). In terms of comparison, elites produced higher amounts of CPP and CAP; However, collegiate players produced significantly greater amounts of CRPP, which is still because of their lower weight.

The results of the study highlight the importance of absolute and relative measures of force and power in order to achieve higher jumps among basketball players. Given that these variables and peak velocity of concentric phase undeniably affect the ultimate jump height, athletes could significantly rely on them and enhance their performance by focusing on the fore-mentioned factors in their training program. Elite players, in addition, performed CMJ in a shorter period of time with higher amounts of velocity. Kinematics and kinetics outputs are significantly affected by jump style. To this end, it should be noted that a few parameters, such as sport specific training, sport specific requirements, and players' experience levels, significantly impact Kinematics and kinetics parameters and lead to misinterpretations in designing a training program.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Transformational Leadership Style, Psychological Empowerment and Job Satisfaction in Greek Municipal Sport Organizations

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Abstract

The aim of the present research was to examine the effects/correlations of transformational leadership style on employees' psychological empowerment in the context of Greek municipal sport organizations. Moreover, the second aim of the present study was to examine the correlation of employees' psychological empowerment on their job satisfaction in the same context of Greek municipal sport organizations. The sample of the research constituted of 30 managers and 247 employees of Greek municipal sport organizations, of Eastern Macedonia and Thrace, of Western Macedonia and of Central Macedonia. In an effort to investigate the specific concern, the managers completed the multifactor leadership questionnaire of Bass and Avolio (1997), while the employees completed the psychological empowerment instrument of Spreitzer (1995) and Minnesota Satisfaction Questionnaire (MSQ). SPSS 20 was used for the statistical data analysis. More specifically, regression analysis and Pearson's rank correlation was used for the variables that satisfied the affair of regularity, while for those variables that were not satisfied the affair of regularity was used non parametric Spearman's rank correlation coefficient. The results showed that self-determination, the dimension of psychological empowerment, had strong positive correlation with idealized influence attributes (IIA) ($r=0.492$; $p=0.007$), and strong negative correlation with idealized influence behavior (IIB) ($r=-0.421$; $p=0.023$) of transformational leadership style. Also, the study found significant positive correlation on psychological's empowerment dimensions with all job satisfaction's dimensions. Implications and directions for future research are discussed.

Key words: transformational style, meaning, self-determination, impact, competence, extrinsic satisfaction, intrinsic satisfaction

Introduction

Transformational leadership consists of five dimensions which are enough for the leaders to impel their followers overcome any personal interests and, against all odds, be more effective: a) idealized influence attributed, (IIA) b) idealized influence behavior, (IIB) c) inspirational motivation, (IM) d) intellectual stimulation (IS) and e) individualized consideration (IC).

The idealized influence attributed (charisma) is referred to those talented and gifted leaders who act as role models

to their followers and as a result, they gain respect, trust and admiration by them. The idealized influence behavior refers to the charismatic actions of the leader, whereby individuals transcend their self-interest for the sake of the organization and develop a collective sense of mission and purpose. This dimension broadens the traditional leadership role into that of a 'manager of meaning'. The inspirational motivation is referred to those leaders who inspire and impel their followers so as to succeed high-flying goals which have been difficult to be materialized. The intellectual stimulation is referred to the



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awakening and directions of the followers, the awareness and the management of difficult situations they may face, with creative and free-wheeling thought, using their imagination and innovative methods. The individualized consideration is referred to the leaders who provide socio-emotional support, tailored to their followers' needs, and at the same time they strengthen and evolve them (Antonakis, Avolio, & Sivasubramaniam, 2003).

Empowerment of human resources covers needs, culture and the structure of each organization separately, because it constitutes one of the most fundamental elements of administrative and organizational effectiveness which is strengthened when power and control are distributed in the organization (Ergeneli, Saglam, & Metin, 2007; Faulkner & Laschinger, 2008).

Empowerment has been empirically studied from two different perspectives. The first perspective is Structural Empowerment, which is reported in the transfer of more power an initiative to the employees in the workforce. The second perspective is Psychological Empowerment. For Spreitzer (1995a), Thomas and Velthouse (1990), the psychological empowerment is a complicated and cognitive psychological dimension, which is mostly connected with self-confidence and emotions of the subordinated rather than the specific managerial practices that related to the structures and policies which the workforce is enforced through them (Menon, 1999). It is also specified by four cognitive dimensions: a) meaning, b) competence, c) self-determination, and d) impact. Meaning is referred to the matching of the work-role demands with the perceptions, views, values, attitudes and standards of the employer (Spreitzer, 1995). Competence is related to the employer's self confidence that he is productive enough (Thomas & Velthouse, 1990). Self-determination is referred to the variety of options upon the tasks that an employer feels he/she has throughout his duties. Impact is defined as the belief of the employer that he/she holds sway over the functions and procedures of an organization as well as the tactical, administrative and operational results of it (Spreitzer, 1995b).

The significance of empowerment is derived from its impact on several factors that are related to organizational success, particularly the human factor. For instance, empowerment has proved to be positively influencing employees as it was linked in many studies with increase in employee job satisfaction and reduce in employee turnover (Cai & Zhou, 2009; Chang, Shih, & Lin, 2010; Manojlovich & Spence Laschinger, 2002) increasing performance quality (Donahue, Piazza, Griffin, Dykes, & Fitzpatrick, 2008; Spence Laschinger, 2008), increasing organizational commitment (Chang et al., 2010; Manojlovich & Spence Laschinger, 2002), and employee loyalty (Chang et al., 2010), and reducing employees' burnout.

The most popular definition of job satisfaction was supplied by Locke (1976), who defined it as "...a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences" (p. 1304). According to Locke (1976), the dimensions of job satisfaction are analyzed to a) job, b) salary, c) promotions, d) recognition, e) profits, f) conditions of work, g) supervision, h) colleagues i) leadership and management.

The main objective of the current research was to examine the effect/correlation of transformational managers' style of Greek municipal sport organizations on the psychological empowerment of their employees and, to examine the correlation between the dimensions of employees' psychological empowerment on their job satisfaction.

Methods

Thirty managers and their 247 employees, permanent and contract fitness instructors, of Greek municipal sport organizations of East Macedonia and Thrace, West Macedonia and Central Macedonia, took part at the study in question. However, one manager of them was excluded from the further analysis while his employees were not replied to the questionnaires, which were given to them. Afterwards, 247 employees were grouping depending on their organization and match to their manager.

The a) Multifactor leadership questionnaire (M.L.Q) of Bass and Avolio (1997), given to the sports managers, consists of 45 questions, 5 scaled Likert, closed-questions of high validity and credibility for all the aforementioned dimensions (.91 to .94) b) Psychological Empowerment scale (Spreitzer, 1995; 1995a) consists of 12 questions, seven scaled Likert, closed-questions, the validity of the dimensions range approximately to .80, and c) Minnesota Satisfaction Questionnaire (MSQ) (Weiss et al., 1967) consists of 20 questions, five scaled Likert, closed -questions, the validity of the dimensions range approximately to .70 to .80, given to the employees.

The collection of data for the specific project included two phases: a) the pilot research and b) the main research. The questionnaires that were used, for that study, were translated from English to Greek and inversely. The pilot research is based on the answers that were given by 25 individuals with the purpose of testing the reliability and validity of the questionnaires. Afterwards, some slight necessary improvements took place.

The distribution of the questionnaires was a part of the main research, which was completed through e-mails, towards the persons in charge of the sports organizations. Those individuals, with whom retained a regular telephone contact, participated in the mass athletic program at the districts of East Macedonia and Thrace, West Macedonia and Central Macedonia.

The first part of the questionnaire referred to the demographic features of the respondents such as the sex, age, location, family status, education, monthly earnings, experience and years of employment at the organization. Filling out the questionnaire for every dimension was the second part of the procedure.

Results

The analysis of data was carried out with the help of SPSS 20. Firstly the factors of the questionnaires were calculated as the average of the responses to the corresponding questions in each factor. Then, the factors were checked towards the test for Normality (Razali, Wah, & Sciences, 2011; Shapiro & Wilk, 1965). For the analysis of the results, $p=0.05$ was defined as the level of statistical significance. For the investigation of the first statistical hypothesis regarding the effect/correlation of the transformational style of leadership upon the dimensions of psychological empowerment Linear regression was applied for the dimensions that fulfilled the Test of Normality, whereas, Spearman correlation was applied for non-parametrical analysis about the dimensions that couldn't fulfill the Test of Normality. The results proved that only self-determination of psychological empowerment had a major positive correlation with the idealized influence attributed (IIA) of the transformational style ($r=0.492$; $p=0.007$) and considerable negative correlation with the idealized influence behavior (IIB) of the same style ($r=-0.421$; $p=0.023$; Table 1).

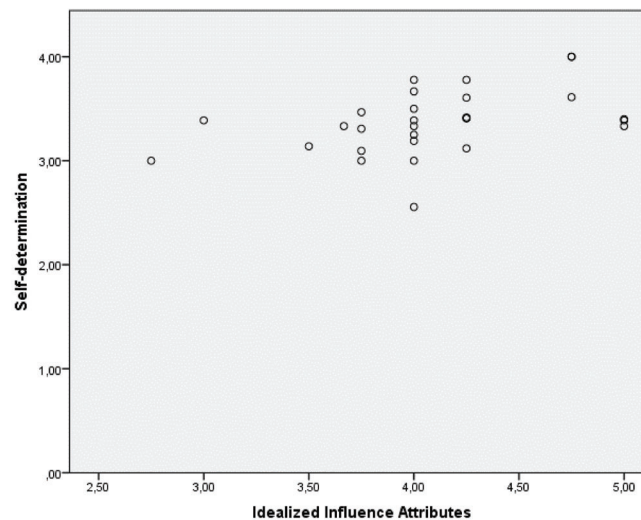
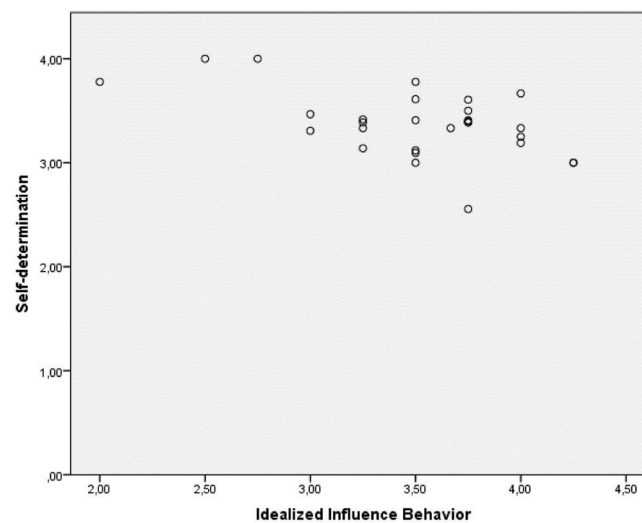
Table 1. Results of the Correlation/Effect of Transformational Leadership towards the Subordinates' Psychological Empowerment

	IIA	IIB	IM	IS	IC	Total transfor. style
Meaning	$r=0.131$; $p=0.497$	$r=0.054$; $p=0.782$	$r=0.240$; $p=0.209$	$r=0.035$; $p=0.857$	$F(1,27)=0.079$; $p=0.781$ $R^2=0.3\%$	$F(1,27)=0.032$; $p=0.858$ $R^2=0.1\%$
Competence	$r=0.006$; $p=0.976$	$r=0.029$; $p=0.881$	$r=0.016$; $p=0.934$	$r=-0.119$; $p=0.537$	$r=0.229$; $p=0.233$	$r=0.067$; $p=0.728$
Determination	$r=0.492$; $p=0.007^*$	$r=-0.421$; $p=0.023^*$	$r=-0.085$; $p=0.660$	$r=-0.147$; $p=0.447$	$F(1,27)=2.376$; $p=0.135$; $R^2=8.1\%$	$F(1,27)=5.702$; $p=0.024^*$; $R^2=17.4\%$
Impact	$r=0.191^*$; $p=0.320$	$r=-0.055$; $p=0.776$	$r=0.065$; $p=0.738$	$r=0.093$; $p=0.632$	$F(1,27)=0.266$; $p=0.610$; $R^2=1.0\%$	$F(1,27)=0.149$; $p=0.702$; $R^2=0.5\%$
Psych. emp.	$r=0.302$; $p=0.112$	$r=-0.171$; $p=0.375$	$r=0.011$; $p=0.955$	$r=0.091$; $p=0.640$	$F(1,27)=0.043$; $p=0.837$; $R^2=0.2\%$	$F(1,27)=0.910$; $p=0.349$; $R^2=3.3\%$

Legend: * - $p < 0.05$

More specifically, the more idealized influence attributed is increasing, the better self-determination is strengthened. Whereas, the more idealized influence behavior is

enhancing, the more considerable decrease is noted towards self-determination (Figures 1, 2).

**Figure 1.** The factor idealized influence on attributes of the transformational leadership seems to be considerably and positively related to the subordinates' self-determination ($r=0.492$, $p=0.007$).**Figure 2.** The factor idealized influence on behavior of the same style had a quite negative relation with self-determination ($r=-0.421$, $p=0.023$)

Furthermore, on the whole transformational leadership can significantly provide for self-determination ($F(27,1)=5.702$;

$p=0.024$; $R^2=0.174$) and transformational style justifies the 17.4% of the subordinates' self-determination (Figure 3).

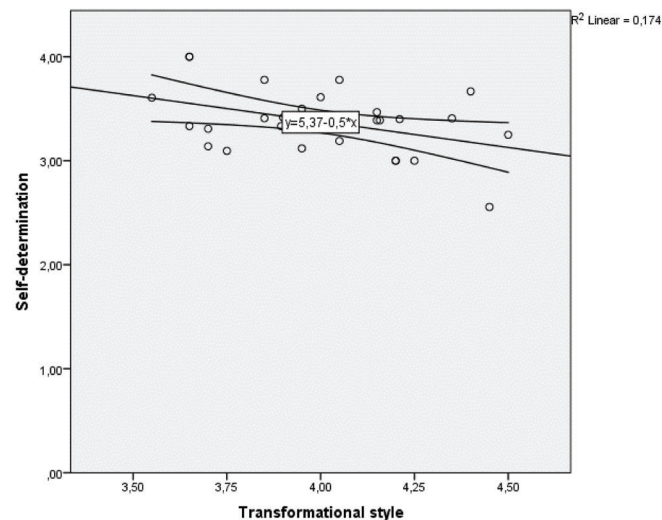


Figure 3. The transformational style seems to provide for self determination

For the investigation of the second statistical hypothesis regarding the correlation of four dimensions (meaning, competence, self-determination, and impact) of psychological empowerment upon the dimensions of job satisfaction (intrinsic, extrinsic general satisfaction) initially examined to 247 employees. Spearman correlation was applied for non-parametrical analysis because the dimensions couldn't fulfill the Test of Normality. The results proved that all dimensions of psychological empowerment (meaning, competence, self-determination, and impact) had significant positive correlation

with all dimensions of job satisfaction (intrinsic, extrinsic and general satisfaction). More specifically, when each dimension of psychological empowerment (meaning, competence, self-determination, impact) is increasing each dimension of job satisfaction (intrinsic extrinsic and general satisfaction) is enhancing. Whereas, when each dimension of psychological empowerment (meaning, competence, self-determination, impact) is decreasing each dimension of job satisfaction ((intrinsic extrinsic and general satisfaction) is decreasing as well (Table 2).

Table 2. Results of the Correlation of Employees Psychological Empowerment towards Their Job Satisfaction (N=247)

	Meaning	Competence	Self-determination	Impact	Psychological empowerment
Internal satisfaction	$r_s=0.497$; $p<0.001$ **	$r_s=0.393$; $p<0.001$ **	$r_s=0.506$; $p<0.001$ **	$r_s=0.420$; $p<0.001$ **	$r_s=0.596$; $p<0.001$ **
External satisfaction	$r_s=0.304$; $p<0.001$ **	$r_s=0.174$; $p=0.006$ **	$r_s=0.199$; $p=0.002$ **	$r_s=0.256$; $p<0.001$ **	$r_s=0.324$; $p<0.001$ **
General satisfaction	$r_s=0.447$; $p<0.001$ **	$r_s=0.334$; $p<0.001$ **	$r_s=0.396$; $p=0.001$ **	$r_s=0.376$; $p<0.001$	$r_s=0.518$; $p<0.001$ **

Legend: * - $p<0.01$

Afterwards, the above correlations were examined to the sample of 29 employees, which resulted after their grouping depending on their organization and matching to their manager. In this team were not observed important correlations between dimensions of psychological empowerment and internal satisfaction (Table 3). However, statistically important

positive correlations were found between dimensions of psychological empowerment, meaning, self-determination, and total psychological empowerment with external satisfaction and general dimension. Moreover, competence of psychological empowerment was statistically positive correlated with general satisfaction (Table 3).

Table 3. Results of the Correlation of Employees Psychological Empowerment towards Their Job Satisfaction (N=29).

	Meaning	Competence	Self-determination	Impact	Psychological empowerment
Internal satisfaction	$r=-0.069$; $p=0.723$	$r_s=-0.119$; $p=0.537$	$r=0.033$; $p=0.866$	$r=0.050$; $p=0.796$	$r=-0.015$; $p=0.939$
External satisfaction	$r=0.627$; $p<0.001$ **	$r_s=0.354$; $p=0.059$	$r=0.373$; $p=0.0047$ *	$r=0.347$; $p=0.065$	$r=0.545$; $p=0.002$ **
General satisfaction	$r_s=0.720$; $p<0.001$ **	$r_s=0.460$; $p=0.012$	$r_s=0.552$; $p=0.002$	$r_s=0.201$; $p=0.295$	$r_s=0.638$; $p<0.001$ **

Legend: * - $p<0.05$; ** - $p<0.01$

Discussion

The purpose of the current study was twofold. Firstly, it was the investigation of the effect/correlation of transformational leadership style that is applied by the managers of Greek municipal sport organizations to their employees' psychological empowerment, permanent or contract fitness instructors. Secondly, it was the investigation of the correlation of employees' psychological empowerment, permanent or contract fitness instructors, to their job satisfaction.

Therefore, it must be mentioned that the results of the particular survey came up after collecting the necessary data taken from a specific number of sport organizations and not throughout the country as a whole. There was a major positive correlation of the idealized influence attributed of the transformational leadership, with the self-determination of the psychological empowerment. However, statistically emerged a negative correlation of the idealized influence on behavior of the transformational leadership with the same dimension of self-determination.

More specifically, the transformational leaders, through their enthusiasm, high moral role models, rectitude and optimism, create a team spirit providing in that way meaning and challenge to the work area of their employees, enforcing their subordinates' level of self-effectiveness, trust, intention and self-determination. The main goal is the empowerment and commodity of their employees in order to achieve their objectives (Avolio, 1999; Avolio, Zhu, Koh, & Bhatia, 2004; Bass & Avolio, 1994; Kark, Shamir, & Chen, 2003; Luthans & Avolio, 2003; Walumbwa, Avolio, Luthans, May, & Gardner, 2004).

The above findings are fortified with those of Özaralli (2003), who examined the effect of transformational leadership upon the four dimensions of the psychological empowerment, both on the industry field and the banking one in Turkey. The results indicated the significant effect of the transformational leadership upon every dimension of the psychological empowerment. Equally, Avolio et al., (2004), conducted a survey among the nurses in a public hospital of Singapore so as to investigate the role of the transformational leadership upon psychological empowerment. It is proved that the specific style of leadership improves the psychological empowerment of the workforce in hospitals and as a result it strengthens their bonds with the organization. The best intermediate factor for strengthening the dimensions of the meaning and competence of the psychological empowerment is the dimension of the idealized influence of the transformational leadership, while the best intermediate factor of boosting the dimension of self-determination is the inspirational motivation.

Also, there was positive correlation between the four dimensions of psychological empowerment and the dimensions of job satisfaction for the sample of 247 employees. Similarly, there was positive correlation between dimensions of psychological empowerment, meaning, self-determination, and total psychological empowerment with external satisfaction and general dimension for the sample of 29 employees after their grouping. Moreover, competence of psychological empowerment was positive correlated with general satisfaction for the same sample of 29 employees.

The above findings are fortified with the results of Jungkai Lee (2000), who examined the correlation of psychological empowerment upon the dimensions of job satisfaction on employees in hotels on South Korea (Hechanova, Alampay, & Franco, 2006). Recently, Pelit, Yüksel Öztürk and Arslantürk

(2011), investigated the effect of psychological's dimensions on job satisfaction on five stars hotels employees' in Turkey. The findings show positive correlation between dimensions of psychological empowerment on job satisfaction. Equally, these findings agree with those in the aspect of health in Malaysia, where there was a strong correlation of employee's psychological empowerment with their job satisfaction (Ahmad & Oranye, 2010; Thorlakson & Murray, 1996; Yang, Liu, Chen, & Pan, 2014). Such results could be attributed to the important role of psychological empowerment while it restructures the environment of the workforce and decreasing the feelings of weakness between the employees.

Overall, this study extends theory and empirical research in the domain that transformational leadership is positively associated with psychological empowerment (Avolio et al., 2004) and confirmed the significant role of psychological empowerment on job satisfaction (Hechanova et al., 2006). The results of this study provide a theoretical basis for leadership management. According to the findings, organizations should enhance their top management leadership skill in terms of visionary motivating, moral modeling, charisma and individualized consideration.

Furthermore, future research should address the relationships of transformational leadership, psychological empowerment and job satisfaction as well as study these latter forms in more depth and their correlation in different aspects.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Changes in Physiological Indicators during the first Bungee Jump

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Abstract

During a bungee jump, numerous physiological responses occur in the body of a jumper, such as mild dizziness, increased sweating, and rapid breathing. The aim of this study was to determine the changes in the physiological parameters of subjects before, immediately before and after the first bungee jump, by monitoring the heart rate, blood pressure and perception of fear. Subject sample was formed by 17 students of the Faculty of Kinesiology from Zagreb, who did not have experience with bungee jumps until the beginning of the research. The sample of variables was made of the values of heart rate, systolic and diastolic blood pressure, and perception of fear. The results indicated that prior to the jump, the heart rate and blood pressure values were within the limits of normal values and the perception of fear was very small. Immediately before the jump, the heart rate and blood pressure increased and the perception of fear increased significantly. After the jump, there was a normalization of the heart rate, blood pressure, and reduced perception of fear. The results of this study suggest that there are many physiological reactions in the human body happening during high-adrenaline activities.

Key words: blood pressure, extreme sports, heart rate, perception of fear, student population

Introduction

The development of sports in the past century was intended to reduce health risks of athletes. Without risk factor, some sports would probably lose their main characteristics and interest of the public. For the risk to be a factor that makes a sport attractive there must be a real possibility for injury and the presence of death. According to this characteristics, the term extreme sports have become a universal name for adventure sports with serious health risks and possible fatal outcomes. Brymer (2005), defined extreme sports as independent leisure activities where the most likely outcome of a mismanaged mistake or accident is death. The free climbing, mountain biking, extreme skiing, parkour, free running, bungee jumping, rafting, free diving, cliff diving, hang gliding, ice climbing, surfing, B.A.S.E. jumping are the most known examples of extreme sports.

Bungee jumping is one of the most popular extreme sports today and it is characterized by a jump from the top of a tall structure (bridge, platform, mountain) to the sea or land with

an elastic rope tied to the feet.

The first bungee jumps can be traced to the South Pacific islands and the initiation ritual of young boys into manhood in the Vanuatu tribe, in which boys jumped from the high ground into the sea with vines tied to their feet, demonstrating their masculinity (Ronca, 2009). The beginnings of modern bungee jumping date back to the 1980s, where there was jumping off of the bridge in Bristol, England. Later this sport spread to America, New Zealand, Australia and France and from there to the entire world (Sagert, 2008). This sport is especially popular among young people who are prone to activities that cause strong emotional reactions and the result is increased levels of adrenaline hormone.

During the bungee jump, there are numerous physiological reactions happening in the jumper's body, such as changes in heart rate, increased blood pressure and stress hormone activation (Zimmerman, Loew, & Wildt, 1992). Williams, Taggart and Carruthers (1978) observed electrocardiogram and plasma catecholamine concentrations of 11 healthy men



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monitored during two rock climbing ascents. Mean heart rates were 166 ± 20.4 bpm and 120 ± 10.2 bpm during first and second ascent. Authors concluded that heart rate values were significantly increased during rock climbing ascents. Schwaberg (1987) was investigated a group of 20 drivers during car races (Formula Ford and Renault-5-Cup) and during progressive bicycle ergometer in the laboratory. Heart rate during car racing reached a mean level of 174.3 ± 14.1 bpm, corresponding to 90% of the maximal heart rate achieved at the end of exhaustive ergometer. The author concluded that heart rate values were significantly increased during car racing. Hennig, Laschewski and Oppel (1994) on a sample of 12 volunteers between the ages of 25 and 30, monitored their mood, heart rate, blood pressure and saliva. Authors found that the blood pressure was increased before and after the jump and subjective estimate of anxiety suddenly increased before the jump and significantly decreased after the jump.

Height vertigo, a visually induced syndrome commonly experienced on top of high structures is manifested by a subjective instability of posture and locomotion coupled with a fear of falling and vegetative symptoms. It is similar to motion sickness in that both are acute 'physiological symptoms' which spontaneously remit after termination of the inducing stimulus situation. Height vertigo generally has been attributed to psychopathological processes such as neurotic acrophobia or neurasthenic dizziness (Brandt, Arnold, Bles, & Kapteyn, 1980). Alpers and Adolph (2008) conducted a study on a sample of 35 healthy males between 18 and 42 years of age and investigated the relationship between fear, dizziness, and body sway during height exposure. Results indicated that participants experienced less fear during pre-exposure and post-exposure than during exposure. Fear was also greater during pre-exposure as compared to post-exposure. Participants experienced less dizziness during pre-exposure and post-exposure than during exposure. Dizziness was also greater during pre-exposure as compared to post-exposure. Increased body sway was evident during exposure in comparison to the pre-exposure situation and the post-exposure situation. Authors found that the perception of fear and body sway was increased before, during and after the height exposure. Brymer and Schweitzer (2013) conducted a study on a sample of 15 extreme sports participants (10 men and five women aged 30 to 70 years). They explore participants' experience of fear associated with participation in extreme sports. Participants in this study report that facing fear in extreme sports and learning to participate despite the intensity of the fear facilitates the management of fears in other aspects of life.

According to the literature review, there are a few studies who investigated physiological reactions in extreme sports. This topic is important for research because of the increasing number of people who are participating in this type of sports.

Therefore the aim of this study was to examine changes in the physiological parameters of participants before, immediately before and after the first bungee jump, by monitoring their heart rate, blood pressure and perception of fear.

Methods

A sample of subjects was formed by students of the Faculty of Kinesiology from Zagreb. A total of 17 subjects (8 female and 9 male subjects), aged 20-25 and who had no prior experience with bungee jumping, participated in the research. Before the start of the research, the subjects' health status was assessed to be satisfactory and they were explained the goals, the procedure and the possible consequences of the research. Study was approved by the Ethics Commission of the Faculty of Kinesiology in Zagreb. Each participant voluntarily provided written informed consent before participating.

The research was conducted near Zadar at Maslenica bridge (55 m height) under the supervision of licensed bungee jumping supervisors. A sample of variables was made of the heart rate values measured 10 min before the jump, immediately before the jump and 10 min and 20 min after the jump. The automatic blood pressure monitor was used to measure the systolic and diastolic blood pressure values 10 min before the bungee jump, 2 min before the jump, 2 min after the jump and 10 min and 20 min after the bungee jump. From the obtained values, mean arterial blood pressure was calculated for each subject. The perception of fear was estimated 20 min, 10 min and 1 min before the bungee jump using a fear scale (Chapman, & Kirby-Turner, 2002).

Statistical data processing was conducted using a software package Statistica ver. 10.0 for Windows. Descriptive indicators (arithmetic mean and standard deviation) of the variables heart frequency, blood pressure and perception of fear were calculated for the obtained data. In order to determine the differences in the heart rate frequency, blood pressure and fear perception between the series of repeated measurements, Friedman's Anova was used, and for determining sex differences the Mann - Whitney U test was used. All analysis was used at the statistical significance $p=0.05$.

Results

Heart rate

Descriptive heart rate indicators of the total sample ($N=17$) and sample by sex (8 female and 9 male subjects) are shown in Table 1. The heart rate (bpm) 10 min before the jump was significantly higher than the usual average values (60-90 bpm). Immediately before the bungee jump, the heart rate reached the highest values during the measurement (159-160 bpm). Ten minutes after the bungee jump, the number of heart beats per minute dropped to almost normal levels, and 20 min after the jump, the heart rate was within the limits of normal values (Table 1).

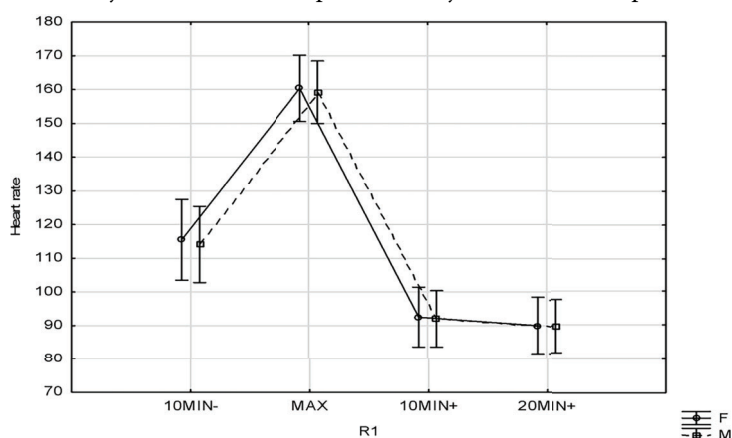
Table 1. Average heart rate values (beats/min) before and after the bungee jump, and results of Mann - Whitney U test

HR	Mean \pm SD (female)	Mean \pm SD (male)	Rank Sum (female)	Rank Sum (male)	U	Z	p
10MIN-	115.50 \pm 15.30	114.11 \pm 16.44	73.50	79.50	34.50	0.10	0.92
MAX	160.38 \pm 8.68	159.22 \pm 15.86	78.00	75.00	30.00	0.53	0.60
10MIN+	92.50 \pm 12.21	92.00 \pm 11.50	72.50	80.50	35.50	0.00	1.00
20MIN+	90.00 \pm 10.86	89.56 \pm 11.47	72.50	80.50	35.50	0.00	1.00

Legend: (HR) heart rate; (10 MIN-) heart rate 10' before the jump; (MAX) heart rate immediately before the jump; (10MIN+) heart rate 10' after the jump; (20MIN+) heart rate 20' after the jump

The average heart rate of the male subjects 10 min before the bungee jump was 114.1 bpm, while in the female subjects it was 115.5 bpm (Picture 1). The average heart rate of the male subjects immediately prior to the bungee jump was 159.2 bpm, while in the female subjects it was 160.4 bpm.

The average heart rate of the male subjects 10 min after the bungee jump was 92.0 bpm, while in the female subjects it was 92.5 bpm. The average heart rate of male subjects 20 min after the bungee jump was 89.5 bpm, while in the female subjects it was 90.0 bpm.



Picture 1. Heart rate values (beats/min) for males and females before and after the bungee jump

Friedman's Anova was used to determine the significance of differences in heart rate values measured at four time points (10 min before the jump, immediately before the jump and 10' and 20' after the jump). Significant differences in results at all four time points were found in heart rate values (ANOVA Chi Sqr.=47.95; $p=0.00$), but statistically significant differences were not found in the results by sex (Table 1).

Blood pressure

Blood pressure variables are expressed by the values of systolic and diastolic blood pressure measured 10 min, 2 min before the bungee jump, and 2 min, 10 min and 20 min after the bungee jump and the median arterial blood pressure (Lurbe et al., 2009). Descriptive indicators of blood pressure variables of the sample by sex (8 female and 9 male subjects)

are presented in Table 2. Systolic blood pressure values 10 min before the bungee jump was lower in female subjects, while diastolic blood pressure was lower in male subjects compared to female subjects. Two minutes before the bungee jump, blood pressure values increased, and at that point, the systolic pressure was lower in female subjects, while the diastolic pressure was lower in the male subjects. Two minutes after the bungee jump, the blood pressure values decreased and at this point, the systolic and diastolic blood pressure values were lower in the female subjects than in the male subjects. Blood pressure values ten minutes after the bungee jump further decreased and at that point, the systolic and diastolic pressure values were lower in the female subjects than in the male subjects. Twenty minutes after the bungee jump, the systolic blood pressure values decreased even more.

Table 2. Average blood pressure values (systola/diastola) before and after the bungee jump, and results of Mann - Whitney U test

BP	Mean \pm SD (female)	Mean \pm SD (male)	Rank Sum (female)	Rank Sum (male)	U	Z	p
10 - sys	137.13 \pm 16.96	144.33 \pm 14.12	61.50	91.50	25.50	-0.96	0.34
10 - dia	86.25 \pm 7.44	84.44 \pm 7.78	76.00	77.00	32.00	0.34	0.74
2 - sys	147.25 \pm 25.18	157.89 \pm 29.59	64.50	88.50	28.50	-0.67	0.50
2 - dia	93.88 \pm 12.84	91.78 \pm 13.27	78.00	75.00	30.00	0.53	0.60
2 + sys	140.75 \pm 27.92	142.89 \pm 9.55	65.00	88.00	29.00	-0.63	0.53
2 + dia	83.50 \pm 11.81	88.33 \pm 9.54	66.00	87.00	30.00	-0.53	0.60
10 + sys	123.25 \pm 18.75	134.89 \pm 12.23	56.50	96.50	20.50	-1.44	0.15
10 + dia	83.25 \pm 10.50	84.33 \pm 7.05	62.50	90.50	26.50	-0.87	0.39
20 + sys	119.38 \pm 13.93	133.89 \pm 16.47	56.50	96.50	20.50	-1.44	0.15
20 + dia	87.88 \pm 6.58	82.33 \pm 8.79	87.00	66.00	21.00	1.40	0.16

Legend: (BP) blood pressure; (10 - sys) systole 10' before the jump; (10 - dia) diastole 10' before the jump; (2 - sys) systole 2' before the jump; (2 - dia) diastole 2' before the jump; (2 + sys) systole 2' after the jump; (2 + dia) diastole 2' after the jump; (10 + sys) systole 10' after the jump; (10 + dia) diastole 10' after the jump; (20 + sys) systole 20' after the jump; (20 + dia) diastole 20' after the jump

The average value of mean arterial blood pressure in the male subjects 10 min before the bungee jump was 104.4 and in the female subjects, it was 103.2. Immediately before the bungee jump, the mean arterial blood pressure value in the male subjects was 113.8, while in the female subjects it was 111.7. The mean arterial blood pressure of the subjects 10 min after the bungee jump was 101.2, while in the female subjects it was

96.6. The average value of mean arterial blood pressure of the male subjects 20 min after the bungee jump was 99.5, while in the female subjects it was 98.4. The average values of mean arterial blood pressure of female subjects were lower than the values of male subjects at all time points of measurement. In blood pressure variables, Friedman's Anova was used to determine the significance of differences in values measured at

five time points (10', 2' before the jump and 2', 10', 20' after the jump). Significant differences in results at all five time points were found in blood pressure values (ANOVA Chi Sqr.=21.54 $p=0.00$), but statistically significant differences were not found in the results by sex (Table 2).

Perception of fear

The perception of fear was estimated at 20 min, 10 min and 1 min before the bungee jump using a fear scale. Descriptive indicators for the total sample and sample by sex (8 female subjects and 9 male subjects) are shown in Table 3. The perception of fear 20 min before the bungee jump was very small, the subjects perceived almost no fear at all

at that moment. Ten minutes before the bungee jump, the perception of fear increased, but the values were still low. Immediately before the bungee jump, the perception of fear in all subjects was further increased and at that point reached the highest level during the research. The average perception of the fear in the male subjects 20 min before the bungee jump was very low while in the female subjects it was moderate. The average perception of fear in the male subjects 10 min before the bungee jump was still low while in the female subjects it was moderate. The average perception of the fear of the male subjects immediately before the bungee jump was moderate while in the female subjects it was very high.

Table 3. Average fear perception before the bungee jump, and results of Mann - Whitney U test

FP	Mean \pm SD (female)	Mean \pm SD (male)	U	Z	p
20'-	3.13 \pm 2.23	0.56 \pm 1.01	13.50	2.12	0.03*
10'-	3.50 \pm 2.51	1.11 \pm 0.93	17.00	1.78	0.08
1'-	4.75 \pm 2.49	1.78 \pm 1.64	12.50	2.21	0.03*

Legend: (FP) fear perception; (20'-) fear perception 20' before the jump; (10'-) fear perception 10' before the jump; (1'-) fear perception 1' before the jump; * $p<0.05$

Friedman's Anova was used to determine the significance of differences in fear perception. Values measured at three time points found significant differences in results at all three time points (ANOVA Chi Sqr.=16.22 $p=0.00$). Mann Whitney U test determined statistically significant differences between the results of the male and female subjects at 20 minutes and 1 minute before the jump (Table 3). On average, female subjects had a greater perception of fear throughout the study compared to male subjects.

Discussion

The aim of this study was to determine the changes in the physiological parameters of subjects before, immediately before and after the first bungee jump, by monitoring the heart rate, blood pressure and perception of fear.

The heart rate 10 minutes and immediately before the jump for the total sample was significantly higher than the normal values (60 to 90 beats per minute). Ten minutes after the bungee jump, the number of heart beats per minute dropped to almost normal levels, and 20 minutes after the jump, the heart rate was within the limits of normal values. Similar results were also obtained by van Westerloo et al. (2011) who, on a sample of 20 volunteers aged 18-35, divided into two groups, experimental and control, determined the increase in heart rate before the first bungee jump and immediately before the jump and a decrease in heart rate after the jump in the control group which was not treated with beta-blockers. Schedlowski and Tewes (1992), on a sample of 36 parachutists with differing degrees of experience, found greater heart rate values in inexperienced parachutists than experienced ones. Increased arousal and perception of danger activated the sympathetic nervous system and stimulated adrenaline hormone production, which caused a physiological response of accelerated heart rate and blood flow. The body reacted in such a way that large muscle groups rapidly filled with blood to prepare for a quick reaction or to take flight from the threat.

The mean arterial blood pressure before the jump was within the limits of normal values but immediately before the jump increased above normal values. Two minutes after the

jump decreased to normal levels and 10 minutes after the jump dropped to normal levels. Similar results were obtained by Dutch researchers van Westerloo et al. (2011), who found an increase in mean arterial blood pressure immediately prior to the jump and its decrease after the jump in subjects of the experimental group treated with beta-blockers, but also in the control group that was not treated with beta-blockers. An increase in the perception of danger caused adrenaline hormone secretion and sympathetic nervous system activation, which triggered a physiological reaction of cardiovascular system acceleration and narrowing of blood vessels, as well as increased mean arterial blood pressure. Considering the muscular contraction, this physiological response is most similar to the static load, in which the blood supply through the active muscles is reduced or completely shut off, depending on the strength of the muscular contraction that mechanically stops the blood flow through the blood vessels, and a significant increase in systolic and diastolic pressure can be observed.

The values of fear perception before the jump were low. Immediately before the jump, the perception of fear of all subjects reached the highest level during the research. Monasterio et al. (2016) studied psychobiology of stress in B.A.S.E. jumpers. They divided the study sample into three classes of jumpers. "Masterful" jumpers (class 1), "trustful" jumpers (class 2) and "courageous" jumpers (class 3). People in class 3 (N=23) were described as "courageous" because they were anxious, less self-directed and less cooperative than the others, but faced the challenge of the jump with firm determination despite being the least experienced. Their cortisol reactivity was similar to "masterful" class one despite their being much less experienced and confident, but their alpha-amylase levels were the highest of the three groups. The authors concluded that the people with least experience in extreme sport had the highest anxiety level. Similar findings were also recorded by Hennig, Lasciefski and Oppen (1994), who, on a sample of 12 volunteers between the ages of 25 and 30, monitoring their mood, heart rate, blood pressure and saliva, found that the subjective estimate of anxiety suddenly increased before the jump and significantly decreased after the jump. Immediately before the jump

the perception of danger in the subjects was at the highest level and because of the increased secretion of the adrenaline hormone from the adrenal gland, the frequency of breathing, blood pressure, sweating and alertness all increased due to increased perception of danger, while after the jump all these physiological reactions significantly decreased, returning within the limits of normal values.

Future studies have to investigate and other physiological indicators before, during and after bungee jump such as the hormonal reaction of the body with a goal to explain even more specific effects of extreme sports on a human body. Furthermore, the use of appropriate experienced control group with more than one bungee jump in direct comparison to group with just one bungee jump would be helpful to explain these physiological changes even more detailed.

Before, during and after the first bungee jump, many physiological responses occurred. Prior to the jump, the heart rate and median arterial blood pressure values were within the limits of normal values and the perception of fear was very small. Immediately before the jump, due to increased perception of danger and adrenaline secretion, the heart rate and median arterial blood pressure increased, while the perception of fear increased significantly. After the jump, the heart rate and mean arterial blood pressure normalized, and the perception of fear reduced. The results of this study show that many physiological responses occur in the human body during high-adrenaline activities.

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There are no acknowledgements.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Comparative Analysis of the Dynamics of Heart Rhythm Variability Indicators of Long-Distance Runners in Different Training Conditions

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Abstract

It has been established that the dynamics of rest/load indicators, as a rule, depends on the skill level of the athlete. More successful athletes have a high level of sympathetic reaction and activity of the central circuit for the regulation of heart rhythm to the load as a manifestation of functional reserves mobilization. A healthy powerful reaction to load and a high level of mobilization abilities are the most important parameters for the success of training and competitive activities during race running. The findings of a comprehensive assessment of heart rate variability in the evaluation of short 5-minute records and long (weekly) records indicate that, compared with athletes who train at the medium altitude, long-distance runners training on the flat terrain adapt to the conditions of sports activity with higher strain on regulatory systems. This is due to the lack of proper economization against the background of the initially low reserve and aerobic capabilities of the body, due, inter alia, to the low development of the autonomous control circuit. The above leads to overload and depreciation of the central control circuit at rest and, in connection with this, its low response to the impact under the conditions of physical and competitive loads. The cost of adaptation of such an organism increases significantly, its adaptation and competitive potential decreases. Accordingly, with a highly developed autonomous control circuit during training at the medium altitude, we can expect a higher competitive success of the long-distance runners compared to the long-distance runners who train on the flat terrain with poorly expressed control circuit.

Key words: heart rate variability indicators, long-distance runners, stayers, training at the medium altitude, stamina development

Introduction

Today, the practice of training long-distance runners creates constantly increasing requirements for the body of athletes. At the same time, scientific approaches to the preparation of long-distance runners remain poorly developed, which largely limits the possibility of effective use of training tools and methods (Bakaev, Bolotin, & Vasil'eva, 2015; Bohuslavskaya, Furman, Pityn, Galan, & Nakonechnyi, 2017; Bolotin, & Bakayev, 2017a; Dong, 2016).

In the course of adaptation of the long-distance runners' bodies to the conditions of training and competition, all the life support mechanisms of the body are involved. Moreover, the training of long-distance runners on the flat terrain and at the medium altitude have different characteristics (Bolotin, & Bakayev, 2017b; Bakaev, Bolotin, & Aganov, 2016; Bakayev, Bolotin, & You, 2018). This affects the formation of the structural trace of adaptation, which must be considered in the training of these athletes (Bolotin, & Bakayev, 2017c;



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Boullosa, Tuimil, Leicht, & Crespo-Salgado, 2009; Dong, 2016; Bolotin, & Bakayev, 2018; Bolotin, & Bakayev, 2016).

The purpose of the study is to conduct a comparative analysis of the nature of changes in the dynamics of heart rate variability in long-distance runners during training under the conditions of medium altitude and on flat terrain.

Study Objectives

1) Evaluate the initial level of heart rate variability in long-distance runners before training under the conditions of medium altitude and on flat terrain.

2) Investigate changes in heart rate variability in long-distance runners under the influence of physical exertion at medium altitude and on flat terrain.

3) Identify the nature of recovery after the training load of the long-distance runners on the basis of changes in their heart rate variability.

Methods

In the course of the study, two groups of long-distance runners with seven athletes in each group were examined. The first group (EG-1) trained under the conditions of the flat terrain, and the second group (EG-2) trained under conditions of medium altitude at an altitude of 2,100 meters. Studies were conducted at the training camps during their preparation for the competition. The level of sports preparedness of long-distance runners in both groups was the same. Their heart rate variability was examined before the commencement. Then they were examined 35 days later, after exposure to training loads under the conditions of medium altitude and on flat terrain. Five days before the start of the competition, we conducted comparative analysis of changes in heart rate variability in long-distance runners under the influence of physical exertion at medium altitude and on flat terrain. We assessed the dynamics in changes in heart rate variability under the influence of training loads at medium altitude and on flat terrain.

The tasks were solved by using the following methods

1) Theoretical analysis and synthesis of scientific and methodological and special literature, documentary materials and long-distance runners training programs, generalization of modern technologies of their sports training.

2) The pedagogical experiment was multi-level, natural, was ascertaining and comparative in nature and consisted of two series:

- comparative assessment of long-distance runners training on the flat terrain and at medium altitude, as well as of their recovery;

- comparative analysis of the dynamics of heart rhythm variability indicators of long-distance runners during training under the conditions of medium altitude and on flat terrain.

3) Mathematical and statistical analysis of empirical data.

To assess the athletes' adaptation to the conditions of training loads under the conditions of medium altitude and on flat terrain, as well as to assess the regulatory and compensatory mechanisms, the study used the analysis of pulsometry and heart rate variability (HRV) of athletes using rhythmocardiography (RCG).

It was taken into account that if long-distance runners do not have enough functional reserves, then adaptive regula-

tory systems function intensely. On the RCG, this is manifested in a high degree of the heart rhythm stabilization. That is, the heartbeat is characterized by pronounced regularity like a metronome. At the same time, the normal heart rhythm is normally characterized by irregularity, and its degree reflects the adaptation potential of the body to a certain extent. This is due to the predominance of the central or autonomous circuit of heart rhythm regulation by the regulatory systems of the body of the long-distance runners. In addition, it was taken into account that the stress of the regulation systems is also expressed in an increase in the activity of the sympathetic part of the vegetative nervous system. This part regulates the mechanism responsible for the mobilization of energy and metabolic resources under various loads. With a decrease in adaptive capacity, mobilization of the sympathetic nervous system plummets.

Thus, using the assessment of heart rate variability and the stress level of the regulation systems according to the RCG data, it is possible to accurately assess the level of body adaptation to the conditions of sports activity, as well as the effectiveness of any impact on the body of the long-distance runners, including that of sports training (Vesterinen et al., 2013; Dong, 2016; Novak, Saul, & Eckberg, 1997). It was taken into account that rhythmocardiography is an image of consecutive rows of intersystolic intervals of an electrocardiogram in the form of straight line segments whose length is equivalent to the pause between heart contractions in seconds.

The study of heart rate variability in long-distance runners was carried out in the morning, at rest and fasting, and immediately after training in the preparatory period of the training cycle before competitions. The athlete was informed about the time and content of the diagnostic procedure, and provided consent to participate in the experiment. Before recording, a 10-minute rest was given to increase the stationarity of the process of RCG recording.

The study was carried out on a computer analyzer "Cardiometer-MT" by "Mikard Lana" LLP (State Register of Products – No. 98/219-67). The experiment used short 5-minute recordings made and analyzed in accordance with the International Standard (Novak et al., 1997; Rajendra Acharya et al., 2006) and current data on the features of heart rate variability in athletes (Pieralisi et al., 2017; Vesterinen et al., 2013; Aubert, Seps, & Beckers, 2003).

The following RCG indicators most accurately proven in the study of athletes were used

- RRav. – the average interval between cardiocycles in ms;
- RRmin and RRmax – minimum and maximum interval between cardiocycles in ms;
- dX – variation range – difference between the longest and shortest RR interval (cardiocycle) in milliseconds (ms);
- SDNN – standard deviation of the NN interval from the average value in ms. It is calculated as the square root of the RR intervals spread. SDNN reflects all cyclic components responsible for variability during the recording period;
- CV (%) (coefficient of variation) does not differ from SDNN in terms of physiology but is normalized by heart rate;
- RMSSD – square root of the mean squared differences of successive NN intervals in ms.
- Mo – mode (ms) – the range of the most frequently occurring values of cardiointervals – the peak of the histogram.

It shows the most likely (dominant) level of functioning of the sinus node. This is the highest RR interval – peak on the histogram.

- AMO (%) mode amplitude – the percentage of cardio-intervals that fall into the range of mode, in relation to all cardio-intervals. Mode amplitude depends on the influence of the sympathetic part of the VNS and reflects the degree of centralization of the heart rhythm control.

Analysis of the wave structure of the heart rhythm

- TP – the total power (area of waves on the RCG) of the RCG wave spectrum in ms²;

- HF – fast or high-frequency oscillations of the RCG wave spectrum reflecting the work of the parasympathetic nervous system and the autonomous circuit for regulating the heart rhythm (frequency range from 0.15 to 0.4 Hz) in ms²;

- LF – slow or low-frequency oscillations of the RCG wave spectrum reflecting the work of the sympathetic nervous system and the central rhythm control circuit (frequency range from 0.04 to 0.15 Hz) ms²;

- VLF – very slow or very low-frequency oscillations of the wave spectrum of the RCG reflecting the work of the central and humoral channels of heart rhythm regulation (frequency range from 0.04 to 0.015 Hz) ms²

Indices by Baevsky R.M.

- VRI (vegetative rhythm index) $AMO/Mo \times dX$. The smaller the VRI, the higher the activity of the parasympathetic part and the autonomous circuit.

- RPAI (regulatory processes adequacy indicator) AMO/Mo to identify the relationship between the level of func-

tioning of the sinus node and sympathetic activity. This is the indicator reflecting the interaction between the autonomous circuit and humoral regulation channel.

- SI (regulatory systems stress index) $AMO/2dX \times Mo$ reflects the degree of centralization of heart rhythm control.

The training was monitored using FirstBeat SPORT software and hardware, which incorporates special BodyGuard sensor which allows the athlete's cardio signal to be recorded for up to 7 days and FirstBeat BodyGuard software by FirstBeat (Finland).

The software and hardware offer: analysis of the training process using pulsometry and heart rate variability, including – remote analysis, recovery monitoring after exercise, assessment and monitoring of the total stress to account for its after-training component.

The software converts information about pulsometry and rhythm variability into a unique digital model in accordance with advanced methods of mathematical data processing and provides specialized reports.

“FirstBeat SPORT” complex (www.firstbeat.com) is a single-channel electrocardiograph with a large built-in memory capacity that allows recording a pulsogram continuously for up to 7 days.

The exclusiveness of Firstbeat technology is that with the help of equipment it is possible to collect information about the state of the rhythm control circuit around the clock and, at the same time, measure training load and afterload recovery indicators in real time and present the results in graphical and digital forms that reflect the quality of training, daytime activity and night recovery.

Figure 1 presents data on the work of an athlete during training in various training zones in the form of a bar chart.

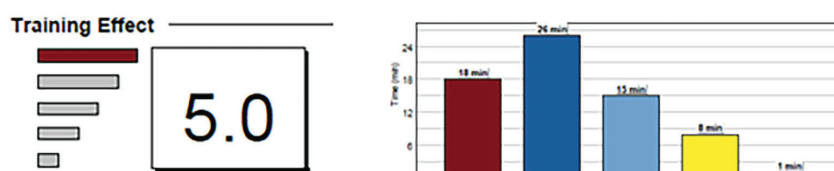


Figure 1. Data on training zones and training effect

Number 5 in the left part of the figure indicates the amount of the training effect (TE) on a scale from 1 to 5

(www.firstbeat.com). Explanation of the values in this figure is given in Table 1.

Table 1. Training Effect (TE)

TE ranges	Description
1.0 - 1.9	Daily activity
2.0 - 2.9	Mild aerobic workout
3.0 - 3.9	Medium intensity workout
4.0 - 4.5	High intensity workout
4.5 - 5.0	Workout with the signs of overtraining

The software calculates the TE automatically according to the amount of oxygen debt for each specific athlete, taking into account their height, weight, as well as the skill level.

The pulsogram and cardiointervalogram were recorded for athletes continuously at a training camp on the flat terrain and at the medium altitude with the help of the BodyGuard sensor. The data was processed on a personal computer using Firstbeat SPORT software. The analysis of the RCG

records was performed in accordance with the 1996 International Standard and FirstBeat recommendations.

Results

The HRV analysis was carried out by means of 5-minute records at rest in the morning before breakfast and immediately after the training on the first day of the training session to study the dynamics of RCG indicators for long-distance runners (EG-1), who trained on the on the

flat terrain, in comparison with the group (EG-2) which trained at the medium altitude. The average values of the training effect on this day in the two groups did not significantly differ 3.5 ± 0.17 (EG-1), versus 3.8 ± 0.24 cu (EG-2), ($p > 0.05$).

These rhythmograms after the workout were compared with the indicators obtained at rest. The median RCG indicators after training session (EG-2), in comparison with those obtained at rest, are presented below in Table 2.

Table 2. Medians of RCG Indicators after Training in Comparison with those Obtained at Rest in Athletes from Groups EG-1 and EG-2

Parameters	Median RCG indicators of athletes before and after training				P
	At rest		After training		
	EG-1	EG-2	EG-1	EG-2	
Mo, ms	1000.3	1050.0	740.5	600.1	>0.05
Amo, %	36.1	24.1	48.3	72.1	<0.05
RR min, ms	863.0	772.1	665.8	568.6	>0.05
RR max, ms	1121.2	1352.2	933.2	650.2	>0.05
dX, ms	258.0	0.4	267.4	81.6	<0.05
CV, %	5.7	7.5	4.7	3.7	<0.05
SDNN, ms	56.1	81.0	40.6	33.0	0.01
RMSSD, ms	53.0	77.0	35.9	13.2	0.02
VRI (cu)	5.5	2.6	8.6	14.5	<0.05
RPAI (cu)	39.7	24.9	36.1	13.6	<0.05
SI (cu)	101.2	47.7	243.6	338.0	0.02
HF, ms2	1126.4	2138.6	571.6	150.6	0.05
LF, ms2	1531.6	1962.4	722.0	540.2	<0.01
VLF, ms2	552.6	1566.3	538.5	156.0	0.04
TP, ms2	3210.6	5666.3	1832.1	846.8	<0.05
LF/HF (cu)	1.4	0.9	1.3	3.6	>0.05
LF, %	47.7	34.6	39.4	63.8	>0.05
HF, %	35.1	37.7	31.2	17.8	>0.05

Legend: RCG - rhythmocardiography; EG - experimental group

The study showed that the differences in the RCG indices between the groups (EG-1) and (EG-2) turned out to be reliable after training for Amo, dX, all complex and spectral indices of the heart rhythm, except for the high-frequency component of the heart rhythm (HF).

At rest, the RCG differences between (EG-1) and (EG-2) were mainly associated with lower rates of heart rate variability (EG-1) initially, which reflected a lower economizati-

on of function at rest. On the contrary, after the load, the rhythmograms (EG-1) were characterized by low rhythm centralization after load compared to group (EG-2), which indicated lower mobilization ability of athletes who train on the flat terrain.

The mobilization degree – changes in % of rhythmogram indicators after a workout versus rest in each group of athletes are presented in Table 3.

Table 3. The Percentage of Changes in the Initial RCG Indicators in Athletes of the Two Groups after Training and the Ratio of the Extent of These Changes

Parameter	EG-1	EG-2	Ratio EG-2/EG-1
Mo, ms	26.0	42.8	1.7
Amo, %	-33.8	-200.4	5.9
RR min, ms	22.9	26.3	1.2
RR max, ms	16.8	51.9	3.1
dX, ms	-3.6	85.9	23.6
CV, %	17.5	50.7	2.9
SDNN, ms	27.6	59.3	2.1
RMSSD, ms	32.3	82.9	2.6
VRI (cu)	-56.4	-457.7	8.1
RPAI (cu)	9.1	45.4	5.0
SI (cu)	-140.7	-608.6	4.3
HF, ms2	49.3	93.0	1.9
LF, ms2	52.9	72.5	1.4
VLF, ms2	2.6	90.0	35.3
TP, ms2	42.9	85.1	2.0
LF/HF (cu)	7.1	-300.0	42.0
LF, %	17.4	-84.4	4.9
HF, %	11.1	52.8	4.8

Positive values in the table indicate the percentage of decline after exercise in relation to the baseline figures, and negative values reflect the percentage increase. The third column of

the table shows how many times the changes in EG-2 exceed the changes in the RCG after training for EG-1 long-distance runners, which are also graphically reflected in Figure 2.

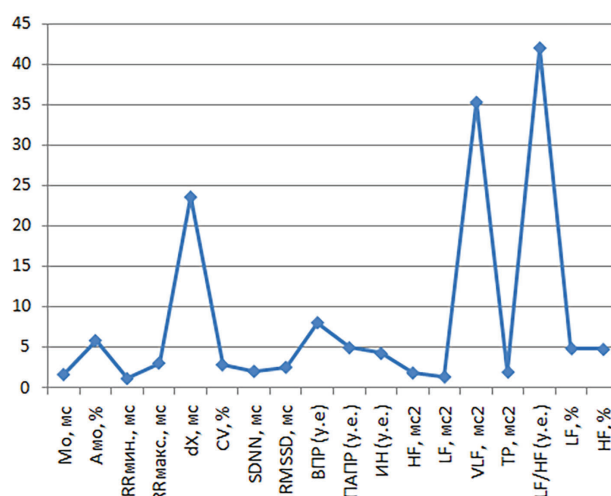


Figure 2. Multiplicity of changes in the RCG in terms of the rest/load ratio in EG-1 in comparison with the EG-2

As can be seen from Table 3 and Figure 2, the maximum difference in changes in EG-1/EG-2 after the load was noted in relation to the growth of dX, VRI, VLF, and the maximum was observed for LF/HF (42-fold). This indicates a lower inclusion of the central control circuit during the load of the long-distance runners in EG-1 as compared to EG-2. It may be associated with the development of protective inhibition of the central nervous system in the long-distance runners from EG-1, low activation and mobilization of the body in response to the load. Such a low mobilization of the central control circuit in long-distance runners from EG-1 reflects the considerable overload of the central circuit at rest, since the functioning of the regulation system is evaluated by its response to the impact.

Discussion

It is known that the dynamics of rest/load indicators, as a rule, depends on the skill level of the athlete and the type of sport. More successful athletes have the highest level of sympathetic reaction and activity of the central circuit for the regulation of heart rhythm to the load as a manifestation of functional reserves mobilization (Bolotin, & Bakayev, 2017c).

In this regard, it was interesting to analyze the initial types of regulation of the two groups of athletes. In EG-1 long-distance runners at rest, the central control circuit prevailed, which was cumulatively observed in 43.9% of EG-1 long-distance runners vs. 10.6% in EG-2, that is, four times more often with a high degree of differences confidence ($p < 0.001$). According to the data obtained, the majority of athletes had the optimal state of the body's regulatory systems, including their response to physical exertion. In aggregate, the types of regulation that are optimal for running were found in 56.1% of long-distance runners in EG-1 versus 89.5% of athletes in EG-2, that is, 1.6 times less often ($p < 0.001$).

Thus, the findings of a comprehensive assessment of heart rate variability in the evaluation of short 5-minute records and long (weekly) records indicate that, compared with EG-2, long-distance runners from EG-1 adapt to the conditions of sports activity with higher strain on regulatory systems at

rest. This is due to the lack of proper economization against the background of the initially low reserve and aerobic capabilities of the body, due, inter alia, to the low development of the autonomous control circuit.

One of the reasons behind such significant differences in HRV of the two groups of athletes is, apparently, that compensation in EG-1 long-distance runners is due to the strain of other regulatory systems of the body that help adapt to the conditions of sports activity. Secondly, low regulatory capabilities and fitness of long-distance runners in EG-1 are certainly lower than in the EG-2 athletes, which also increases the stress of adaptation mechanisms.

The above leads to overload and depreciation of the central control circuit at rest and, in connection with this, its low response to the impact under the conditions of physical and competitive loads. The cost of adaptation of such an organism increases significantly, its adaptation and competitive potential decreases. Accordingly, with a highly developed autonomous control circuit, we can expect a higher competitive success of the EG-2 long-distance runners compared to the EG-1 long-distance runners with poorly expressed control circuit.

Improvement in the process of arranging and expanding the content of training for long-distance runners using multidirectional means under the conditions of medium altitude aimed at developing stamina creates favorable conditions for the further development of the adaptive capabilities of the functional systems of their body. This contributed to the effectiveness of competitive activity of long-distance runners.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Working Experience and Perceived Physical Activity and Exercise Barriers

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Abstract

The purpose of this study was to assess the relationship between physical activity levels and the type of barriers of engaging in physical activity and exercise depending on working experience years among women who have sedentary long hours jobs. Participants of this study were (101) female workers ($M=36.6$, $SD=6.2$ years) who were recruited randomly from (Yarmouk University, Irbid Jordan). Participants were grouped according to years of working experience: less than 5 years ($n=34$), 5-9 years ($n=32$), more than 10 years ($n=35$). Current exercise levels and perceived barriers to physical activity were assessed by the Arabic short form of the International Physical Activity Questionnaire (IPAQ) and the Barriers to Being Active Quiz of the Centers for Disease Control and Prevention (CDC) questionnaire. Results: No significant differences were observed between years of experience and type of barriers. Whereas, the results of this study showed that the physical activity and exercise barrier among all participants where the lack of energy ($M=6.1$, $SD=1.7$), followed by lack of time barrier ($M=5.9$, $SD=1.8$). The findings of this study suggest that working women despite their working experience have similar physical activity and exercising barriers, that might benefit from interventions and strategies to overcome barriers by enhancing physical activity and exercise during working hours.

Key words: physical activity, exercise, barriers, working experience years

Introduction

Incidents of ill health, including chronic health disease, have significantly increased in working populations, and research studies have related it to high job demands and long working hours (Cook & Gazmararian, 2018). The increased working hours and related stress contribute to the obesogenicity increased rates among workers. Research studies have sought that long working hours reduce the availability of leisure and exercise time that impact daily physical activity levels (Steinborn & Huestegge 2016; Lohmann-Haislah, 2013). Also previous literature has demonstrated that the extent working hours could upraise risks of severe work-related injuries (Dembe, Erickson, Delbos, & Banks, 2005), work efficiency (Golden, 2012), affect employees physical and psychological status (Cho, Ju, Paek, Kim, & Jung-choi, 2018) and even cause family conflict (Ronda, Ollo-López, & Goñi-Legaz, 2016). Whereas, the adopted office workers inactivity is tides to be

carried out though their life span and affect family members too as addressed by many researchers. For example, the impact of inactivity habitual of workers on surrounded family members physical activity levels have been studied by Mailey, Huberty, Dinkel, and McAuley (2014) and Floderus, Hagman, Aronsson, Marklund, and Wikman (2008) where they found that working mothers and fathers have low physical activity levels due to fatigue lack of time and feeling of guilt (Floderus et al., 2008; Mailey et al., 2014). Hence, an employee's with sedentary and longer working hours have demonstrated a bigger tendency to smoke, low physical activity levels, and poorer eating habits, also poor medical and health checkups routines (Sparks, Faragher, & Cooper, 2001). Whereas, researchers found that socio-economic backgrounds of employees might play an integral role in lower physical activity rates. For example, younger workers showed higher prevalence to adopt poor life quality habits as addressed previously than more experien-



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ced workers and were closely correlated to primary and secondary risks of developing chronic diseases (Tomei, Cangemi, Giubilati, & Fioravanti, 2007). In the other hand gender plays a significant role when it comes to workers activity rates, researchers have addressed that women, in general, are less active than men (Cook & Gazmararian, 2018) and female workers typically have higher inactivity levels than their male counterparts (Cook & Gazmararian, 2018; El Ansari & Lovell, 2009). A recent study by Klingberg et al. (2018), have investigated the impact of work demands and stress on workers overall life equality through the use of questionnaires and included 3,872 working men and women. The researchers followed study participants over twenty years tracking their body weight, demands, and control at work. The results of this study founded three main aspects of the effect of working environments on workers life quality. The first was that work demands had a significant impact on women's weight gain whereas no similar association was found in men participants. Similar results have been indicated by other researchers (Jang, Kim, Lee, Myong, & Koo, 2013; Luckhaupt, Cohen, & Calvert, 2014; Park, Pan, & Lankford, 2014) indicating that women inactivity was higher and associated with higher stress levels. Longer working hours have also been suggested to impact leisure time significantly that could be spent in exercising (Jang et al., 2013; Luckhaupt et al., 2014; Park et al., 2014). In an attempt to address and increase physical activity levels for women's, environmental interventions have been suggested and carried out in neighborhoods and working places (Knox, Musson, & Adams, 2015). Most commonly cited barriers to participating in physical activity include a perceived lack of time due to work demands and responsibilities (Gidlow, Johnston, Crone, Ellis, & James, 2006). Nonetheless, these findings correspond with previous study results suggesting incongruences between perceived and actual barriers, with lack of time and work demands presenting a "convenient excuse" to avoid demanding activity (Gidlow et al., 2006). Besides, physical activity barriers type founded to be sex depended as women were found to be less active than men despite the socioeconomic backgrounds. Whereas, family responsibilities, household, society norms, and tradition have been defined as the main factors that impact women's leisure time that could be spent in physical activity and exercising. Besides long working hours, employees and characteristically female workers have also addressed that lack of energy and will power have been integral to barriers of their participation in physical activities (Borodulin et al., 2016).

Inactivity is defined as one of the main risk factors of mortality in this century, globally at least 25% of adults are insufficiently active according to the World Health Organization 2016 report. Whereas, studies showed that these numbers increase in the Arab world due to norms and traditions especially for women (Kahan, 2015; Sharara, Akik, Ghattas, & Obermeyer, 2018). The strong relationship between life quality and daily habits has been a critical factor for interventions aim for consolidation of building up healthy behaviors. Likewise, interventions focused on the overcoming physical activity barriers have defined lack of time due to long working hours as a significant obstacle that leads to inactivity. Further research is needed due to the uniqueness of the environments and lifestyles of working women which demand customized interventions which also consider the sociodemographic variables of the populations. The purpose of this study was to assess the type of barriers of engaging in physical activity and exercise

depending on working experience years among women who have sedentary long hours jobs at Yarmouk University.

Methods

This study is a cross-sectional study recited a connivance sample size from Yarmouk University working body. The sample size included female employs who had a full time working job and had sedentary desk tasks. One hundred one females from Yarmouk University working body volunteered to participate in this study ($M=36.6$, $SD=6.2$ years). Study's inclusion criteria were healthy with no medical recommendation not to exercises or are physically active. Also, had no injuries or surgeries during the past six months. This study was conducted during the spring semester of 2018 at Yarmouk University, Irbid-Jordan. Participants were then grouped into three categories depending on their years of working experience at Yarmouk University; the first group consist of ($N=34$) with (less than five) years of working experience, the second group consisted of ($N=32$) with (6 to 10) years of working experience, and the third group cosseted of ($N=35$) with (more than ten) years of working experience. This grouping was done according to previous research studies and regarding the Yarmouk University working code.

A brief explanation of the purpose and the procedures of the study were given to the participants. Also, confidentiality, the anonymous of the subjects were explained and insured. Participants then were asked to sign an informed consent that also included participants demographic data (age, sex, years of working experience, higher education level and job type: teaching, office worker, worker) were as the data of females, years of experience and only office worker job type were analyzed for this study. This study has fulfilled the ethical and safety standards and accomplished Yarmouk University code of ethics, that have been developed and followed the ethical principles of the Declaration of Helsinki Human rights.

Data collection were collected using well-known and valid self-administrated questionnaires, to indicate participants physical activity and exercise levels and barriers of physical activity and exercise. As physical activity levels were assessed using the Arabic Short Form of the International Physical Activity Questionnaires (IPAQ). IPAQ include seven items that represent the time that is spent in walking, physical activity with viragoes moderated intensity and time spent in sedentary behaviors during the past week of reporting. Physical activity intensity was assessed following the questioner protocol and based on the compendium of physical activity IPAQ (Ainsworth et al., 2011) as vigorous physical activity is defined as an activity that increases heart and respiration rates, in addition to sweating for at least ten-minute duration. This has a metabolic equivalent value above 6 (Morrow, Mood, Disch, & Kang, 2015).

Whereas, the moderate physical activity is defined as activities that moderately increases respiration rates, heart rates and sweating for at least ten minutes duration; which is equivalent to 3-6 metabolic equivalents (Morrow et al., 2015). As the number reported represent how many days of the week participants were active, in moderate and/or vigorous activities in the last seven days for at least one hour a day. The mean of both activity levels during the reported days (moderate and vigorous) was used to assess participants activity levels (0 to 4) un-active from (5-7) active (Grao-Cruces, Fernández-Martínez, Nuviala, & Pérez-Turpin, 2015). The internal consistency

cy of participants responses to the questionnaire items was high (Cronbach $\alpha = 0.849$).

Participants barriers of being active and excessing in this study were assessed by using the Barriers to Being Active Quiz (CDC) this tool is available from the Centers for Disease Control and Prevention and can be found at their official Website, this questionnaire is designed to assess self-identifying barriers of being physical active and participation in exercises. The questionnaire contains 21 items that represent the following barriers: lack of energy, lack of willpower, lack of time, social influence, fear of injuries, lack of skills and the availability of resources. Whereas, these barriers indication items were rated on a five-point Likert type scale. Health status and ability to exercise were approached from participants self-report.

Statistical analysis of the perceived physical activity and exercise barriers among the working experience groups were analyzed through the use of Statistical Package for the Social Sciences for Windows version 19.0 (SPSS Inc, Chicago, IL, USA). Scores on all 21 items were computed as the mean item response on each perceived barrier to facilitate sympathetically and the interpretation of obtained scores of participant responses. Whereas, descriptive statistics to express the results in terms of mean \pm standard deviation were used. Independent t-test was used to measure the differences in the means of each

item and the total scores for the external and internal barriers. The significance level was set at 0.05. The assumption of equality of variance and normality was determined using Levene's and Shapiro-Wilk tests, respectively.

The Statistical Package for the Social Sciences (SPSS 15.0) for Windows was used to perform all data analyses. Scores on all measures were computed as the mean item response on each instrument in order to facilitate understanding and interpretation of the meaning of scores in terms of participant responses. Data were summarized by using descriptive statistics, and the measurement characteristics of the BHADP were examined by using factor analysis. The primary analyses included a multivariate analysis of variance and hierarchical regression analysis. Multivariate analysis of variance (MANOVA) was used to determine whether participants in the three functional disability groups differed from each other on the two subscales for perceived health barriers to physical activity.

Results

The recruited female working body of Yarmouk University, had overall low physical activity level as calculated according to the (IPAQ). Participants had grouped it three categories based on their working experience years at Yarmouk University. Table 1 shows participants characteristics.

Table 1. Participants Characteristics

Working Experience Groups	Sample	Age (Mean \pm SD)	Activity level
less than 5 years	34	29.2 \pm 3.8	2
between 6 and 10 years	32	35 \pm 4.1	3
more than 10 years	35	41.1 \pm 4.3	2

No significant differences were observed between years of experience groups and type of barriers. Whereas, the results of this study showed that the physical activity and exercise barrier among all participants where the lack of energy (M=6.1, SD=1.7),

followed by lack of time barrier (M=5.9, SD=1.8) and lack of willpower (M=5.6, SD=1.7). Whereas, fear of injuries and lack of skills were not reported as barriers. Table 2 shows working experience groups and physical activity and exercise barriers.

Table 2. Physical and Exercise Barriers among Working Experience Groups

Psysical activity and exercise barriers	Working Experience Group	Sample	Mean	St. Dev.
Lack of Time	less than 5 years	34	6.5	1.7
	6 to 10 years	32	5.8	1.9
	more than 10 years	35	5.7	1.8
	Total	101	6.0	1.8
Social Support	less than 5 years	34	5.6	1.8
	6 to 10 years	32	5.3	1.8
	more than 10 years	35	5.1	1.9
	Total	101	5.3	1.8
Lack of Energy	less than 5 years	34	6.1	1.9
	6 to 10 years	32	6.3	1.5
	more than 10 years	35	5.9	1.8
	Total	101	6.1	1.7
Willpower	less than 5 years	34	5.9	1.7
	6 to 10 years	32	5.5	1.7
	more than 10 years	35	5.3	1.9
	Total	101	5.6	1.8
Fear of Injury	less than 5 years	34	4.3 *	2.3
	6 to 10 years	32	4.5 *	2.3
	more than 10 years	35	4.4 *	2.1
	Total	101	4.4 *	2.2

(continued on next page)

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Psychical activity and exercise barriers	Working Experience Group	Sample	Mean	St. Dev.
Lack of Skilled	less than 5 years	34	4.7 *	2.4
	6 to 10 years	32	4.3 *	1.8
	more than 10 years	35	4.4 *	2.6
	Total	101	4.5 *	2.3
Lack of Resources	less than 5 years	34	6.1	2.3
	6 to 10 years	32	5.1	1.7
	more than 10 years	35	5.7	2.1
	Total	101	5.6	2.1

Legend: (*) Indicates non-physical and exercise barrier among groups

Discussion

The current study aimed to seek for the barriers that are effecting Yarmouk University female workers physical activity and exercising levels. In addition to investigating if there are any differences between working experience years of the participants and perceived physical activity and exercising barriers. Results of this study demonstrated that levels of physical activity in Yarmouk University females working body were generally low. The inactivity levels were related to the perceived barriers of lack of time, lack of energy and willpower among participants. These results were consistent with earlier findings of studies that addressed time and fatigue as the main barriers of working women despite of their sociographic background (Neil-Sztramko, Gotay, Demers, Muñoz, & Campbell, 2017).

Notwithstanding the benefits of physical activity and exercising are well established and working demands and related stress are an integral barrier of health and life quality. Extended working hours could have a significant negative impact on time management and leisure periods that could be spent on improving physical activity levels (Lohmann-Haislah, 2013). Sedentary desk work and increase levels of stress are the characteristics of nowadays working environments (Walters & Wadsworth, 2016) which have been linked directly to the decline in employees' health and increased the bad health habits especially in younger employees (Justine, Azizan, Hassan, Salleh, & Manaf, 2013). However, when it comes to working women, more barriers could be suggested to affect their leisure time, which could be due to the combination of job and household responsibilities. Where it conceivably makes it challenging to find time to be physically active and enhance life quality. In a study conducted by Bengoechea, Spence, and McGannon (2005) have reported that focus groups meetings addressed the lack of time barrier due to traditional roles of women where they face an increased domestic responsibilities (in work and houses) than their men component, which significantly reduces time for leisure time activities (Bengoechea et al., 2005).

Which also could affect participants willpower of spending their leisure time in exercising and increasing physical activity levels especially after work. The current study has indicated that the willing power barrier was the third most significant barrier of physical activity and exercise among participants. Despite women's awareness of the benefits and need of meeting the recommendation of daily physical activity, participants of previous research studies have reported that they know how to enhance their daily physical activity but wouldn't because they feel "Lazy" (Cook & Gazmararian, 2018). Women's willpower as perceived barrier could also be related to the fact that it has been reported as not a priority when planning leisure

time schedules (Segar, Taber, Patrick, Thai, & Oh, 2017). Even when, scheduled and supervised exercise programs have been recommended and offered by health professionals (Kelly et al., 2016). Participants hesitated to register themselves to the professional physical activity sessions and tend to drop off (Pavey et al., 2012). Whereas the tendency not to participate or chose not to proceed with physical activities training sessions rates have been reported to be higher in young populations (≤ 29 years and 30–39 years) than in seniors (50–69 years) (El Ansari & Lovell, 2009) and suggested to be even higher in inactive adult women (Gidlow et al., 2006).

Whereas, another explanation of the lack of willpower as results of the current study addressed as a barrier, could be psychological as the feeling of guilt of being away from their families. A study conducted by Mailey and colleagues (2014) showed that working mothers and fathers who had low activity levels did report the feeling of guilt as a barrier of exercising during their leisure time (Mailey et al., 2014). The feeling of guilt is driven by the belief that they are limiting the time they spend with their children farther to exercise whereas, their leisure is already limited due to daily responsibilities (Guendouzi, 2006). Dixon (2009), conducted focused groups meeting to investigate the physical activity and exercise levels and barriers among forty-four working mothers from a university in the Southwestern United States. The results of his study indicated that high work demands, guilt, and lack of participating and facilities in physical actives and exercising programs, where the main barriers. Also, the author reported that the reported barriers were correlated by marital status and socioeconomic background (Dixon, 2009). Long working hours, household and social responsibility of working women's, could be driving the perceived barrier of lack of energy that has been addressed by participants of the current study. As described by researchers and working women's the "role overload" experienced by many working mothers is in fact declining their life quality, increasing levels of stress, depression, and anxiety (Guendouzi, 2006; El Ansari & Lovell, 2009; Cook & Gazmararian, 2018).

The author prophesied that long years of experience might play a significant role in better managing time and energy during working hour; thus, more time could be dedicated to physical activity and exercise. While this study did not find significant differences between working experience groups workers with lower experience years (less than 5 years) tend to be more affected by physical activity barriers than the group with more extended experience (more than 10 years). The current results are in agreement with evidence that suggested that the effect of long work hours on physical activity levels and meeting the recommendations among employees working

status (including occupations type, and years of experience) consider as an effect modifier in the relationship, affecting differently across occupations (Cook & Gazmararian, 2018). Research studies have related the impact of working hours on employees physical activity levels to the professional level occupation, whereas, those with higher occupational level were more likely to be more active and meet the leisure-time physical activity recommendations (Kirk & Rhodes, 2011). On the other hand, some studies have demonstrated differences in the effect of long working hours across occupational groups. The results suggested that higher occupation status corresponds to more sedentary desk working style, whereas, a lower working status report to have complex occupational activity, resulting in higher levels of total physical activity than their co-workers in higher working positions (Kirk & Rhodes, 2011).

Moreover, in the current study results showed that participants with less than five years of experience showed a higher impact of time barrier and the availability of resources than participants with higher working experience years more than ten years. These differences could be attributed to the fact that social norms and traditions affect younger women and could negatively impact exercising and engaging in physical activity outside the house and the availability of gyms in late hours after work. In a study conducted by Samara and colleges (2015) also founded that adults females reported that the lack of facilities and encouragement were the main barriers of engaging in physical activities, whereas, restrictions by society norms and families barriers had less impact on female physical activities engagements (Samara, Nistrup, Al-Rammah, & Aro, 2015). The findings of this study could be used to promote the importance of interventions that teach strategies for overcoming barriers and enhancing physical activity for women's during working hours.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

The Perception of International Students on the Facility and Sport Tourism Event Management

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Abstract

The new challenges facing event sport tourism are explored in two parts: from an economic perspective, and social field as the tool to improve decision-making processes when organising sport events. The aim of this paper is to develop a deeper understanding of the perception from customers on the facility of sport tourism event management in order to allow continuance business. This study was a descriptive research with mixed methods. The subjects of this research were 51 international students from in 45 countries taken by representative random sampling. Data analysis techniques using correlation and linear regression among indicators-variables, and between variables themselves with Software SPSS.21 and PLS-SEM. The results showed that there was a significant effect from environment of the tourism place to the tourists'satisfaction, the relationship between satisfaction-perception was largely weak because of the transaction fees which are not moderated, and the deep lacking of types of sports in the Malang tourism place. Thus suitable environment, types of sports, tariff moderated become strong management tools that help sports managers to decide how to allocate resources to improve satisfaction, customer loyalty Originality/value: This study is the first to apply to explain career to the current situation in Malang tourism place.

Key words: perception, facility, sport tourism event management

Introduction

Tourism plays an important role in accelerating economic growth and is currently one of the largest industries in the world (Mhanna, 2018). One of the fastest growing travels is tourism related to sports or exercise, where sport tourism is one of the most extensively studied (Gibson, Lamont, Kennelly, & Buning, 2018). Infrastructure, environments and facilities at various locations tourism have become very interesting (Buning, 2018). Sport event tourism has become an activity that enhances the potential of cities or countries to compete in this globalized world (Allen, Drane, Byon, & Mohn, 2010). It is also important to know that tourists are interested in sport tend to spend more, stay longer duration and stimulating the tourism sector so as well. The tourism industry plays an important role in the economies of all countries in the world, as it can generate substantial income for the nation and create jobs for the entire population. It is

also an industry that contributes to other businesses, which contributes to investment, employment, and distribution of income to the local community (Homafar, Honari, & Heidary, 2011).

Tourism industry has started to recognize sport tourism, i.e. the experience of travel to engage in or view sport-related activities as an important market. In order to compete in the growing sport tourism market, it is crucial for communities to develop a profound understanding of the benefits and impacts of sport tourism, of the process of bidding for events, possible sponsorship opportunities and other elements involved in the planning and hosting of a successful sport event. Sport tourism refers to the experience of travel to engage in or view sport-related activities. It is generally recognized that there are three types of sport tourism: Sport event tourism, active sport tourism, and nostalgia sport tourism. Sports event tourism includes hallmark events such as



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the Olympic Games and the World Cup, football is part of this type of sport tourism. Nostalgia sport tourism involves traveling to famous sport-related attractions. Visits to various Sporting hall of fames such as the Women's College Basketball Hall of Fame in Knoxville, Tennessee and the Baseball Hall of Fame in Cooperstown (Shin, Chiu, & Lee, 2018).

Tourism organisations strongly depend on the strategically right employment who could take information from customers, and become the strong tool for manage the business. This research was very important because the results showed the strong and weak points belong to Malang tourism place, so it will be an opportunity to improve it. Finally the information from this study was to help Malang tourism place to prepare for the competition and maintain the customers, not only Malang tourism but for all business owners such as development guidelines.

Sports tourism is the act of traveling from one location to another with the goal of being an audience member to a sports recreation, competition of any kind (Van Rheenen, Cernaianu, & Sobry, 2016). While different sports have different sports tourism consumers, all sports have taken a popularity increase in recent years, sports tourism has gained popularity in recent years. The types of sports tourism consumers vary from sport to sport. one must stop and consider what it really is and why it has become so popular among the sports fan crowds. The more you learn about whom sport-tourists are, where they are coming from and their motives and expectations for their visit, the better one can plan events and services (Osman, Cole, & Vessell, 2006).

Intensive market analysis and research into people's tastes, preferences and attitudes are now the backbone of market planning. Market research is the tool for listening to customers. Before organizations can offer new events, they must understand what sport-tourists need, how they think, and what their questions are. Much of the marketing research process therefore aims to get close to the customer, there by permitting the organization to understand the customer's perspective and needs (Higham, 1999). Why is it important to gather information about sport tourists. The marketing concept asserts that the key to achieving organizational goals consists in determining the needs and wants of target markets and delivering the desired satisfaction more effectively and more efficiently than competitors (Mousavi Gilani, & Sajadi, 2013).

Methods

This is the descriptive research with mixed method qualitative

and quantitative approaches. The population in this study was 51 international students representatives from in 45 different countries, who study in Indonesia. The study sample was determined by representative sampling. Data collection techniques used questionnaires. Data analysis techniques using PLS - SEM and SPSS. The research hope was to show the actual situation in tourism place of Malang through the below Indicators and variables: (1) Streets, (2) Hygiene, (3) Toilet, (4) Places, (5) Equipment the later are indicators for the Environment variable, however the facility, (6) was an indicator of Variable customer satisfaction at the tourism place, (7) Rafting, (8) River, and types of sports were indicators of event sport dependent variable, (8) Ticket or price were indicators of transactions fees dependent variable also, in add more Attitude was the perception indicator. Secondly the all variable (dependent and independent) were the following below:

- Environment variable (X1): dependent variable
- Transaction fees variable (X2): dependent variable
- Variable customer satisfaction at Fitness (Y1): independent variable
- Perception customer on the tourism event (Y2): independent variable

The research model and hypothesis in this study can be described and explained:

Research Hypothesis

- There is correlation between indicators and Variable.
- There is correlation between dependent variable and independent variable.
- There is linear regression between dependent variable and independent variable

The Research Structural Equation Modeling

The Diagram 1. below will help us to find the correlation that will exist between the indicators and the variables, and secondly the correlation that will exist between the variables themselves as the research hypotheses demonstrated above.

This research structural equation modeling has five variables and eleven indicators, 5 indicators (street, toilet, hygiene, equipment, and places) for the environment variable; 3 indicators (rafting, river, and kind of sport) for event sport dependent variable; one indicator attitude perception independent variable; one indicator facility for satisfaction independent, and one indicator ticket or price for transaction fees dependent variable all will be showed on the Diagram 1. below.

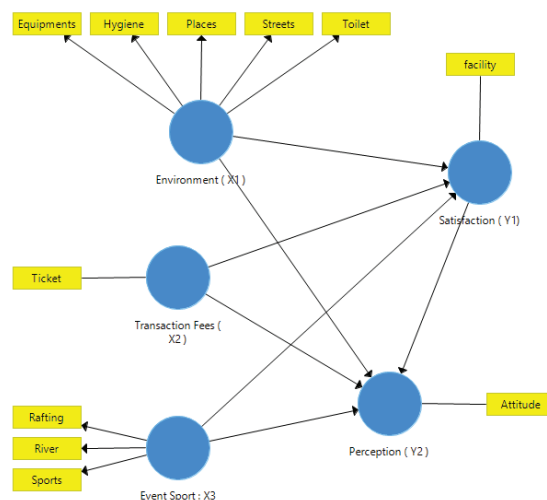


Diagram 1. The Research Structural Equation Modeling

Results

The result from this research has been presented and explained such as: In the Table 1. latent Variables Cronbach's Alpha rho-A Composite Reliability CR Average Variance Extracted (AVE). Reliability of internal consistency is assessed by evaluating of the combination reliability of all constructions. In our study, all composite reliability values were well above the 0.70, except to the environment dependent variable where Cronbach's Alpha rho-A, and Average Variance are less than the significant values, this one is

explained by the strong weak of the condition of the toilet in the tourism place which need to be improve more than others indicators, and variable. Secondly the event sports also Cronbach's Alpha rho-A, Average Variance Extracted (AVE) were strongly weak because of the strong lacking of the types of sports in this tourism place, for others threshold, indicating that the combined reliability of each reflective latent variable was acceptable and confirmed construct reliability (Hiba & Faisal, 2018).

Table 1. Internal consistency reliability (CR) and convergent validity (AVE)

Matrix	Construct Reliability and Validity			
	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted
Environment: (X1)	0.699	0.721	0.802	0.455
Event Sport: (X3)	0.260	0.682	0.699	0.550
Perception: (Y2)	1.000	1.000	1.000	1.000
Satisfaction: (Y1)	1.000	1.000	1.000	1.000
Transaction fees	1.000	1.000	1.000	1.000

Construct validity is the extent to which items measure (Hiba & Faisal, 2018). To test construct validity, we tested convergent validity and discriminant validity. Convergent validity is the extent to which an AVE measure reflects the average communality for each latent factor factor (Nimon, 2012), and must be 0.50 or higher (Hiba & Faisal, 2018). In our study, all AVE values above 0.50, except one factor or indicator belonging to the environment variable as it has been

explained above. The dimensions showed that convergent validity of each latent factor is acceptable (Table 1).

To assess collinearity, we consider the variance inflation factor (VIF). As can be concluded from Table 2., the VIF values in our study are well below the threshold value of 0.50, indicating that collinearity is not a problem (Hiba & Faisal, 2018).

Table 2. Collinearity Assessment (VIF)

Collinearity	Statistics (VIF)
Attitude	1.000
Equipment	1.325
Hygiene	1.297
Places	1.591
Rafting	1.975
River	2.034
Sports	1.056
Streets	1.557
Ticket	1.000
Toilet	1.235
Facility	1.000

The Diagram 2. below describes the relationship or correlation between indicators and variables, is there any influence from the indicator on the variable or the influence between variables themselves. The outcome of the research focused on the type of correlation like: a strong positive correlation from 1 to (0.5) and a strong negative correlation from -1 to (-0.5) while the weak correlation is positive from between 0.5 to 0.00 and a weak negative correlation from -0.5 to 0.00, the finding proved the strong correla-

tion between equipment (0.670), hygiene (0.680), places (0.785), streets (0.737), to the environment variable, but one of its indicator toilet (0.455) is characterised with the weak correlation which give the following meaning: toilets in the tourism place Malang need to be improve because its conditions not allowed the ease for tourists, and it is the prerequisite for human life in any place in other to protect our health from diseases.

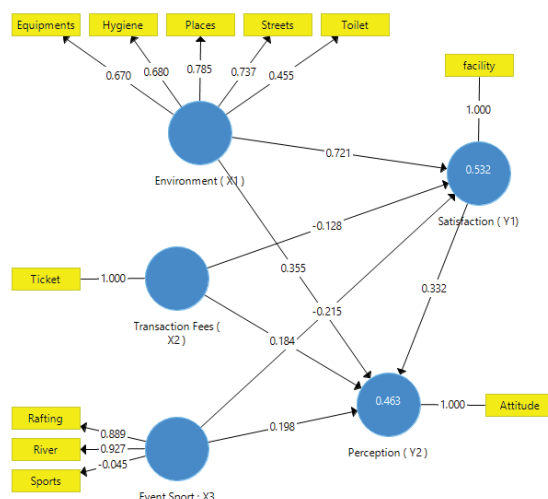


Diagram 2. The Research Structural Equation Modeling Result

Tourist's satisfaction was strongly influenced by the environment current situation with relationship of r (0.721), the simple explanation of the strong relationship between environment and tourist satisfaction was the good management allocated to the previous indicators (equipment hygiene, places, and street). The correlation between transaction fees and tourist 'satisfaction was negative (-0.128), this means that the two variables are characterised with opposite relationship: so in this tourism place the price, entered ticket, ticket for join the sport event, price for food and drinking were expensive the reason why the satisfaction of tourists was decreased. It is up to the manager to balance the facilities in every fielder of his business in other to maintain the customers. However the sport event was very interesting in the size of rafting ($r=0.889$), river ($r=0.927$), the strong positive correlation was the product from the good management in rafting by the authors of rafting. Nevertheless the negative correlation between different types of sports and sporting event ($r=-0.045$) evoked a deep need to increase the participation in the different sport domains that means: the more the lack degree of types of sports increases negatively the more flow decreases the participation of the tourists. The lacking of types of sports had indirectly influenced the satisfaction of tourists through the sporting event with $r=-0.215$: the more lack the types of sports it decreases the tourist 'satisfaction

In general the perception of international student on the sport tourism stills need a kind of improving in other to make sure satisfaction of tourists which will directly influence the loyalty tourist as the outcome showed those relationship:

environment-perception ($r=0.355$), satisfaction-perception ($r=0.332$), transaction fees- perception ($r=0.184$), sport event- perception ($r=0.198$), all of the relation of the different paired combination were weak which means in each variable stills some key indicator which need to be improve more than others like: toilet in the environment, increase types of sports in the tourism place, to balance the price of every transaction in the business.

There is linear regression between dependent variable and independent variable

Linear regression is a common Statistical Data Analysis technique. In simple linear regression a single independent variable is used to predict the value of a dependent variable. Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. A linear regression line has an equation of the form $Y=a+bX$, where X is the explanatory variable and Y is the dependent variable. In this research the explanatory variable are sport event (X_3), transaction fees (X_2) environment (X_1), and the satisfaction (Y_1), perception (Y_2) dependent variables. With the software SPSS this research hypothesis have been verified:

H0: There are no relationships among variables: environment, Satisfaction, transaction fees, sports event and perception.

Ha: There are significant relationships between variables: environment, Satisfaction, transaction fees, sports event and perception.

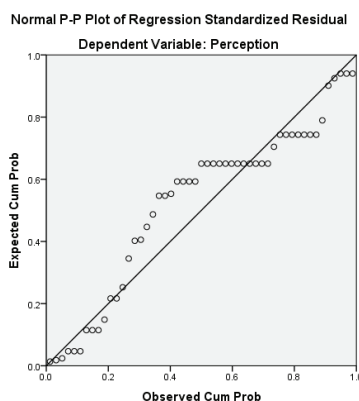


Diagram 3. Regression Standardized Residual environment, Satisfaction, transaction fees, sports event and perception

The finding of Diagram 3. and Table 3. showed a significant relationship between environment, Satisfaction, transaction fees, sports event and perception with confidence inter-

val of 5%. H0 is rejected and received Ha: there is a significant relationship between the variables.

Table 3. Analyse Regression Tariff-Loyalty

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.294	4	.824	10.979	.000 ^b
	Residual	3.451	46	.075		
	Total	6.745	50			

a. Dependent Variable: Perception

b. Predictors: (Constant), Satisfaction, Picture ticket, Kind of Sports, Environment

The outcome on the Table 4. is general evaluation which help the manager to know strong or weak points of his business, so in this study pair number: 1, 5, and 6 were significant, but pair number: 2, 3, 4, 7, and 8 were not significant which means that there is a weak relationship between the combination indicators-variables, and between variable themselves. According to this study it up to the manager of Malang tourism place to improve relation between

environment – equipment, environment-toilet, transaction-perception, sport event-perception, and sport even-satisfaction.

In general the study was centred on the search of the correlation which would be between indicators - variable, and the variables between themselves. The regression search allowed to see if the independent variables predict on the values of the dependent variables.

Table 4. Significance testing results of the structural model path coefficients Correlation

	N	Correlation	Sig.
Pair 1: Facilities & Satisfaction	50	.565	.000
Pair 2: Toilet & Environment	51	.037	.798
Pair 3: Equipment & Environment	51	.213	.133
Pair 4: Kind of Sports & Satisfaction	50	-.083	.568
Pair 5: Satisfaction & Perception	50	-.694	.000
Pair 6: Condition Street & Environment	51	.278	.048
Pair 7: Pictures ticket & Satisfaction	50	.024	.870
Pair 8: Perception & Kind of Sports	51	.042	.771

Discussion

The most important contribution of a research is to show how the auctions can be effectively operated by facilitating the service quality of auctioneer and seller. Yen and Lu (2008) the proposed research model examines perception of tourist on intention regarding trough environment, sport event, transaction fees in all fielder of tourism places, facilities in this place and the satisfaction . Recreational sport is a strong indicator of positive outcomes Lower, Turner, and Petersen (2013), with the above statement, it can be seen the strong positive relationship among indicators and variables. The results of original sample, Structural Equation Modeling (SEM) and linear regression Statistics calculations prove that there is a significant between some dependent variables and independent variables, nevertheless correlation of some indicators with dependent and independent variable, or between variables themselves was not significant like: perception-sport event ($0.771 > 0.05$), satisfaction-transaction fees ($0.870 > 0.05$), sports event-satisfaction ($0.568 > 0.05$), equipment environment ($0.133 > 0.05$), toilet-environment ($0.798 > 0.05$) in the business it necessary to care of the customer 'need in other to maintain them and to increase or to develop the outcome .The finding above showed point which need to be improved. In today's turbulent economic environment service quality is an invaluable asset that business should manage in order to survive and gain a competitive

advantage (Kranias, & Bourlessa, 2013). All hypotheses were verified and confirmed.

Based on the outcome of the study and discussion that have been put forward, conclusions can be drawn: the perception of international students on the tourism place has demonstrated the kind of guidelines to increase participation in the tourism place, to increase economy field because the tourist pay money for enjoying every activity in the tourism place. In this study the types of sports have to be multiplied, condition of toilet must be improved in the case to allow the good ease to the tourists, transaction fees have to be moderated, in shaping users' continuance intention is very great to maintain the customers. Thus, the suitable environment, multiple kind of sports, tariff moderated become strong management tools that help sports managers to decide how to allocate resources to improve satisfaction, customer loyalty. Appearance of tourism place directly affects customer satisfaction. It can be said that customers will believe in in the Malang place tourism if Malang increase attention to health facilities, including toilet, physical activities: swim pool, football playground, basketball playground, tennis, volleyball, handball, wood ball playground, fitness room ..., procedures, such as, inform the customers appropriately, providing the service to the visitor sincerely (wholeheartedly), and to reduce the tariff. In addition, employees are able to create close family relationships and while communicating using

empathy, where employees hear more when customers complain, so employees can dig deeper into customer wishes and complaints, which employees can then offer the solution.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Male's Level of Personal Well-Being and Anxiety Trait Regarding a Sport Activity Level

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Abstract

The aim of the paper is to identify the level of male's well-being and anxiety trait regarding their level of sport activity. The research group consists of 86 males (20.40 ± 1.08 years; n : 29 recreational athletes, 21 elite athletes, 36 nonathletes). We used the BDP questionnaire to determine the level of male's wellbeing and STAI questionnaire to determine the level of anxiety trait. We used the Kolmogorov-Smirnov test to test the normality of the data and Kruskal-Wallis test, with post-hoc Mann-Whitney U-test to test the differences between the samples. We have noticed a difference in level of well-being as well as the anxiety trait. Pair comparison of groups have showed a significant difference in level of physical problems between recreational and elite athletes. We have also noticed a difference in the level of positive attitude towards life, self-esteem, and depressive mood between recreational athletes and nonathletes. Differences were also observed between elite athletes and nonathletes – in the level of both positive dimensions of well-being and in the level of physical problems and depressive mood as well. The difference in the level of anxiety trait was noticed only between recreational athletes and nonathletes.

Key words: *well-being, anxiety trait, sport activity level, late adolescence, males*

Introduction

Sports activities can be considered in broader and narrower contexts. The main themes in the narrower context of sports activities are human performance and competition. In the broader context, sports activities are important for reinforcing or improving health, physical appearance and coping strategies, as well as for physical movement per se (Fuchs, Klaperski, Gerber, & Seelig, 2015).

In the present time, sports activity is seen as an important aspect of life from several points of view including health, regeneration, social relationships and as a feature of lifestyle. It is possible to distinguish multiple levels of sports activity – from the elite, high-performance level to the recreational level associated with leisure activities.

In our country, we distinguish “sport for all” and competitive and elite sport. The essence of sport for all is recreational activity involving various forms of physical exercise and other enjoyable physical activities. Competitive and elite

sports focus on performance and involve activities defined by rules, skills developed in a training process and participation in competitions organised on a voluntary basis (Act No 28/2009 on physical culture, as amended). Of course, recreational athletes can themselves be performance-oriented and may participate regularly in competitions.

The highest level of sport, elite sport, often leads to representing one's country and can provide a source of livelihood for the individual athlete. Elite athletes are individuals with the highest performance level in sport (Kučera & Dylevský, 1994).

Sports activity on any level is linked to an individual's quality of life – sport is associated with quality of life both for active athletes and for ordinary people. The performance-level of sport that an individual participates in is often linked, amongst other things, to lifestyle, which affects quality of life (Stejskal & Zusková, 2010).

The relationship between the concept of quality of life



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and subjective personal wellbeing is an issue in several lines of research, one of which considers personal wellbeing as an indicator of a person's quality of life (Džuka, 2004). In this case, the concept of personal wellbeing can be considered a sub-category of the concept of quality of life that also functions as an indicator of its level.

Personal wellbeing is a persistent emotional state that is reflected in a person's overall satisfaction with their own life. A state of personal wellbeing can be expressed by varied emotional experience and cognitive content and therefore it is not considered a simple construct, but rather a broad and diverse category of psychological variables (Blatný et al., 2010).

Aspects of personal wellbeing can be seen as positive or negative depending on their content. Positive aspects include a positive outlook on life and an optimal level of self-evaluation (Džuka, 1995). The negative aspects of personal wellbeing are associated with concepts such as anxiousness and anxiety. Their link to personal wellbeing is evident because the symptoms of anxiety and depression are considered to have a negative influence on this construct. The differences in the content of these terms must be clarified because they are treated differently in research. Anxiety trait is a longer-lasting personality trait involving a stable, elevated tendency to experience uncertainty and to react with anxious behaviour (Vágnerová, 2004). This personality trait is mainly related to the individual's constitution and causes them to experience frequent and excessive states of anxiety (Matějček, 2011).

Other possible negative dimensions of personal wellbeing include aspects such as the individual's level of awareness of problems and their physical problems (Džuka, 1995).

The nature of these aspects of personal wellbeing and the content of the construct clearly indicate that personal wellbeing may be influenced by the benefits and other aspects of sport. At present there is a tendency to see sports as being linked to personal wellbeing a person's anxiety trait level, as has been demonstrated by many research findings (Aidar et al., 2018; Pačesová & Šmela, 2018; Balatka, 2007).

In the context of previous findings, the aim of this study is to find out the differences in the level of individual aspects of wellbeing and anxiety trait of male elite athletes, recreational athletes and nonathletes in late adolescence.

Methods

The research sample comprised 86 men (mean age 19.94 ± 1.38 years). In terms of age, all respondents were in the period of late adolescence, although from a formal viewpoint, they could be considered adults. In the following text "adolescent" and "man" will therefore be used as synonyms. Respondents were categorised according to their level of participation in sport as recreational athletes ($n=29$), elite athletes ($n=21$) and nonathletes ($n=36$).

Their level of personal wellbeing was measured in several aspects (dimensions) using the Bern Questionnaire on Subjective Wellbeing (BSW) by Grobä (1991). It was translated and adapted into Slovak by Džuka (1995).

The questionnaire consists of 28 questions covering several aspects of an individual's subjective wellbeing. The questionnaire implicitly works with three basic components of subjective wellbeing: habitual mental wellbeing, current mental wellbeing and current physical wellbeing (Džuka, 1995). Participants respond using a Likert scale. The items in the questionnaire can be plotted in five dimensions (Džuka, 1995):

1. Positive attitude to life – items on the respondent's attitude to life events and the belief that one is leading a meaningful life.

2. Awareness of problems – items on the respondent's awareness of problems in their personal and social environment.

3. Physical problems and reactions – items measuring physical reactions and related problems.

4. Self-evaluation – items on the respondent's self-acceptance and their belief in their own value and ability to achieve goals.

5. Depressive mood – items where a high score indicates the absence of enjoyment and meaning in life.

Anxiety trait level was measured using the State-Trait Anxiety Inventory (STAI). The standard version of the inventory used in Slovakia is by Ruisel, Mullner, and Farkaš (1980). It is a questionnaire based on the assumption that there is a measurable difference between a temporary, transient state and a relatively permanent predisposition (Ruisel et al., 1980). The anxiety scale is designed to measure anxiety trait as a characteristic or tendency while respecting "individual differences in the tendency to perceive the world, the disposition to respond in a specific and predictable manner, individual differences in the expression of special emotional states and the positive correlation between the strength of personality and the intensity of the corresponding emotional state" (Ruisel et al., 1980). The anxiety scale is a whole number obtained by totalling the scale values (taking account of reversal scoring). The higher the score, the higher the level of anxiety trait. The possible score range is 20 to 80.

Statistical tests of the data were conducted – a Kolmogorov-Smirnov test to test for normality of distribution, a Kruskal-Wallis test of variance between ranks and a post hoc Mann-Whitney U-test. Effect size was calculated using the coefficient r ($r \geq 0.9$ – very strong relationship; $r = 0.7-0.9$ – strong relationship; $r = 0.5-0.7$ – medium-strong relationship; $r = 0.3-0.5$ – weak; $r \leq 0.3$ – very weak relation) (Pett, 1997) and coefficient η^2 (eta squared) ($\eta^2 \geq 0.01$ – small effect, $\eta^2 \geq 0.06$ – medium effect, $\eta^2 \geq 0.14$ – strong effect (Cohen, 1988)).

This study was approved in advance by the Ethics committee of the Faculty of physical education and sport, Comenius University (no. 1/2019).

Results

The results showed differences in the levels of the aspects of personal wellbeing depending on men's level of participation in sport during adolescence. Each aspect (dimension) of personal wellbeing was assessed individually.

There were significant differences between men with different levels of sports participation in the two positive aspects of personal wellbeing positive attitude towards life [$H(2)=21.16$, $p=0.00$, $\eta^2=0.26$] and self-evaluation [$H(2)=15.67$, $p=0.00$, $\eta^2=0.17$]. Significant differences were also found in two negative aspects of personal wellbeing – physical problems [$H(2)=16.45$, $p=0.00$, $\eta^2=0.20$] and depressive mood [$H(2)=20.62$, $p=0.00$, $\eta^2=0.24$].

The remaining negative aspect of personal wellbeing – awareness of problems – did not show significant differences between different levels of participation in sport [$H(2)=1.81$, $p=0.41$, $\eta^2=0.02$].

The analysis of the results also looked at differences in anxiety trait level between men who participated in sport on an elite level, on a recreational level or not at all. The results showed significant difference between men with a 5% threshold of statistical significance [$H(2)=6.63$, $p=0.04$, $\eta^2=0.05$].

The specific values of the median and p-value for each aspect of personal wellbeing at each level of men's participation in sport is shown in Table 1.

Table 1. Mean values of aspects of male's personal wellbeing regarding the sport activity level

Aspects of wellbeing	Median \pm SD			p-value (KW)
	Elite athletes	Recreational athletes	Nonathletes	
Positive attitude towards life	4.56 \pm 0.57	4.16 \pm 0.69	3.73 \pm 0.84	0.00**
Awareness of problems	2.29 \pm 0.78	2.40 \pm 0.97	2.88 \pm 0.68	0.41
Physical problems	1.65 \pm 0.72	2.30 \pm 0.69	2.54 \pm 0.71	0.00**
Selfevaluation	4.44 \pm 0.93	4.93 \pm 0.81	3.94 \pm 1.00	0.00**
Depressive mood	1.75 \pm 0.67	1.91 \pm 0.69	2.54 \pm 0.53	0.00**
Anxiety trait	35 \pm 5.55	32.00 \pm 8.70	38.00 \pm 5.00	0.04*

Paired comparison of the groups of men based on their level of participation in sport for each dimension brought to light deeper information on the level of personal wellbeing in its several aspects. The only aspect of personal wellbeing to show differences between recreational athletes and elite athletes was physical problems [$U=174.00$, $p=0.01$, $r=0.36$]. Recreational athletes scored 2.30 \pm 0.69 whereas elite athletes had a significantly lower score – 1.65 \pm 0.72. The differences in other aspects of personal wellbeing and in the level of anxiety trait were not statistically significant.

The comparison of men who participate in sport on a recreational level and men who do not participate in sport at all revealed more differences that were significant. There were differences in the level of both positive dimensions of personal wellbeing – positive attitude towards life [$U=262.00$, $p=0.00$, $r=0.43$] and self-evaluation [$U=233.00$, $p=0.00$, $r=0.48$]. In the level of positive attitude towards life, recreational athletes scored 4.16 \pm 0.69 compared to nonathletes' score of 3.73 \pm 0.84. Higher scores were also found in the case of self-evaluation – recreational athletes scored 4.44 \pm 0.93 whereas nonathletes had 3.94 \pm 1.00.

Of all the negative aspects of personal wellbeing, there was a significant difference in only one – depressive mood [$U=268.50$, $p=0.00$, $r=0.42$]. Recreational athletes had a score of 1.91 \pm 0.69 whereas nonathletes scored significantly higher – 2.54 \pm 0.53. There was also a significant difference in the level of anxiety trait [$U=332.50$, $p=0.00$, $r=0.31$]. A higher level of anxiety trait was found in nonathletes (38.00 \pm 5.00)

than in recreational athletes (32.00 \pm 8.70).

Differences in the level of individual aspects of personal wellbeing and anxiety trait were also compared for elite athletes and nonathletes. This produced several interesting significant differences. There were differences in the level of both positive dimensions of personal wellbeing – positive attitude towards life [$U=131.50$, $p=0.00$, $r=0.54$] and self-evaluation [$U=233.00$, $p=0.02$, $r=0.32$]. The results show that elite athletes have higher levels of the positive aspects of personal wellbeing. Their level of positive attitude to life reached 4.56 \pm 0.57, while nonathletes' level was significantly lower – 3.73 \pm 0.84. In self-evaluation, elite athletes' level was 4.44 \pm 0.93, and, again, nonathletes' level was significantly lower – 3.94 \pm 1.00.

As regards the negative aspects of personal wellbeing, there was a significant difference in the level of physical problems [$U=140.00$, $p=0.00$, $r=0.53$]. Elite athletes had lower levels in this dimension of personal wellbeing than nonathletes – 1.65 \pm 0.72 compared to 2.54 \pm 0.71 respectively.

There was also a significant difference in the level of depressive mood [$U=132.00$, $p=0.00$, $r=0.55$]. Elite athletes had a lower level of depressive mood (1.75 \pm 0.67) than nonathletes (2.54 \pm 0.53). No significant differences were found between elite athletes and nonathletes in the level of awareness of problems or in the anxiety trait.

The differences in individual aspects of personal wellbeing and anxiety trait between the different levels of men's participation in sports are set out in Table 2.

Table 2. Differences in the level of male's personal wellbeing aspects and anxiety trait regarding the sport activity level

Physical activity level	p - value (MW)					
	Positive attitude towards life	Awareness problems	Physical problems	Selfevaluation	Depressive mood	Anxiety trait
Recreational ath.						
Elite ath.	0.18	0.66	0.01**	0.28	0.27	0.17
Recreational ath. nonathletes	0.00**	0.46	0.10	0.00**	0.00**	0.01**
Elite ath. nonathletes	0.00**	0.16	0.00**	0.02*	0.00**	0.28

Discussion

The relationship between level of participation in sport and personal wellbeing has not yet been adequately researched, with research tending to focus on the effect of sports activity itself on the level of personal wellbeing. Moreover, the evidence base regarding the mental health and wellbeing

of elite athletes is limited by a paucity of high-quality, systematic studies (Rice et al., 2016).

The findings of the present research suggest that level of participation in sport may be a variable that is linked to young men's personal wellbeing during adolescence. The findings suggest that the levels of positive aspects of personal wellbe-

ing – positive attitude towards life and self-evaluation – are significantly lower in men who do not participate in sport compared to men who participate in sport on a recreational or elite level. No difference was found between recreational and elite athletes in positive aspects of personal wellbeing, and we can thus conclude that regular sports activity helps to increase the level of positive aspects of personal wellbeing. Similar findings of increased levels in positive aspects of personal wellbeing resulting from participation in sports were reported by Penedo and Dahn (2005), and McAuley and Rudolph (1995).

Although the present research did not find significant differences between recreational and elite athletes in the levels of the positive aspects of personal wellbeing, there is reason to believe that each level of sports activity is affected by different variables. Cronin and Allen (2018) have demonstrated that elite athletes' level of personal wellbeing is related to "life skills" like teamwork, goal setting, time management, emotional skills, interpersonal communication, social skills, leadership, problem solving and decision making. The interpretation of the results indicates that a trainer's support for such skills can increase elite athletes' level of personal wellbeing.

On the other hand, Rice et al. (2016) showed that the risk of mental disorders such as anxiety or depression in elite athletes was comparable to that in the general population. The population of elite athletes is sensitive to a range of mental health problems (including substance abuse) that may be linked to sports factors (e.g. injury, burnout) as well as factors that have nothing to do with sport and a significant effect on wellbeing.

The results on negative aspects of personal wellbeing are unclear. Although levels were lowest in nonathletes, the differences were not always statistically significant.

As regards level of physical problems, it can be said that the lowest level was found in elite athletes. This result may appear paradoxical, but it may be due to the fact that the research population is made up of men who are still young, and elite level sports can be expected to provide a certain standard of health care. Study of the motivation for recreational athletes' participation in sports would benefit the picture of this aspect of personal wellbeing.

The level of depressive mood was found to be highest in nonathletes compared with athletes at any level of participation. This finding reinforces the findings on nonathletes' low levels in positive aspects of personal wellbeing. The same applies to anxiety levels – a substantial body of literature has shown that sports activity reduces symptoms of both anxiety / state anxiety (Hassmén, Koivula & Uutela, 2000) and trait anxiety (Aidar et al., 2018). These findings add to the evidence of sports' benefits for people's mental health. The present research found the highest anxiety trait level in nonathletes and the lowest in recreational athletes.

The highest levels of the positive aspects of personal wellbeing are found in men who participate in sport on a recreational or elite level. A further conclusion is that any level of participation in sport increases men's experience of positive aspects of personal wellbeing. The lowest levels of negative aspects were found in men who did not participate in sport. Since there are many factors that could affect the personal wellbeing of men who participate in sport on a recreational or elite level, more detailed research is needed on this aspect of the issue.

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Conflict of Interest

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ORIGINAL SCIENTIFIC PAPER

Importance of Loyalty to a Sport Event for the Level of Sponsorship Awareness

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Abstract

Over the past twenty years there has been a need to explore the process of achieving the goals of sports sponsorship, which is widely accepted in academic circles as well as in practice as an effective marketing communications tool. Mass communication through traditional media is replaced by a much more credible form of communication. Sponsorship can be seen as a B2B relationship that provides benefits for both parties. Previous literature suggests that greater brand exposure by consumers, as well as congruence between the sponsor and the sponsored, makes it easier to identify the sponsor. Loyalty is a form of psychological relationship with a brand, a sports team, or a manifestation that results in a positive attitude and behavior towards that subject. True loyalty exists when a consumer regularly purchases the products of that brand and has positive associations on the brand and its products. In the event of manifestations, a loyal customer can be defined as the one who regularly watch the event, either live or via the media. So, the assumption is that fans who are dedicated to the team have a higher level of knowledge about the event and its environment, and therefore also about the sponsors of their favorite club, which will be the research topic of this paper.

Key words: sport sponsorship, consumer loyalty, sponsorship awareness, brand awareness

Introduction

Considering the fact that the strong brand is one of the main factors of competitiveness, special attention should be paid to its construction and strengthening, with the aim of equalizing the identity and image of the brand. If the brand does not clearly communicate its attributes, it will not be adequately recognized by the consumer. One of the ways of communication is sponsorship, and the effects of this type of communication are the subject of research in this paper. The growing trend of sponsoring investments stems from the unsustainable commercialization of everything that the marketing and media industry can exploit. Sleight (1989) defines sponsorship as a business relationship between a provider of funds, resources or services and an individual, event or organisation which offers rights that may be used for commercial advantage in return. Media activity, public relations and branding process through sponsorship present influential factors at a wider psychological level, and their long-term effect leave

consequences for the consumer and potentially influence their purchasing decisions.

Having a unique and memorable brand helps raise awareness about it and create a long-term favourable position on the market. Brand awareness is a measure that shows how well the brand is recognized within the target markets. Brand awareness is a key step in the process of communicating with the consumer and strengthening the value of the brand. If there is no brand awareness, other communication effects cannot be expected (Macdonald & Sharp, 2003). Brand awareness is also treated in AIDA marketing model (Awareness/Attention, Interest, Desire and Action), which describes stages in the purchasing decision-making process (Barry, 1987). Aaker (1991) further emphasizes the importance of investing in brand awareness as a key factor that influences the creation and maintenance of competitive advantage, as well as the strengthening of brand values in the long term. Moreover, Smith, Graetz and Westerbeek (2008) state that one of the main sponsors-



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hip goals is brand awareness, as a way to improve the overall image and value of the brand and the company itself. Before a company is able to induce positive associations and motivate consumers to purchase, it must contribute to raising awareness of its existence. If consciousness does not exist, the sponsor is more difficult to achieve other, more demanding goals, which ultimately lead to a rise in sales.

Global brands have integrated sport sponsorship into their strategic marketing programs, as it represents a long-term investment in creating a dynamic relationship between the brand and the consumer. Today, it's not unusual to see a few company logos in places such as sports facilities or equipment, because sport and corporations have become inseparable. In addition, the development of sponsorship in the field of football is such that it is almost unimaginable to think about professional football without sponsorship.

When talking about football, we need to highlight the difference between two types of supporters - loyal with season tickets, who regularly support their team and ordinary spectators who do not feel such strong connection with the team as the previous group. In a survey conducted by Biscaia, Correia, Ross and Rosado (2014), the focus was on comparison of brand awareness between these two target groups. The results showed that spectators first remember those sponsors whose logo is on team jerseys. Additionally, the highest level of recall exists with the sponsor whose logo is on the stadium for both categories of supporters. It is expected that loyal fans were more successful in identifying other sponsors than average viewers. However, two companies that were not sponsors, and are often present in the world of football, have been wrongly identified. This result shows that companies that generally sponsor sport can have long-term benefits - even in situations where they are not sponsoring the specific events. Nike, which has never been a sponsor of the Olympic Games, is often referred to as an example in the literature, and is always among the top five mentioned sponsors in research, precisely because of its engagement in sports and partnerships with athletes (Forbes, 2016).

During 2015, the club that earned the most through sponsorship is Manchester United (\$140 million). For a logo on the front of their jerseys, Chevrolet (General Motors) annually allocates \$80 million, Aon pays \$24 million a year for the stadium (for a secondary facility instead of the official Old Trafford stadium), and Nike allocated \$36 million for the sports equipment (Cheat Sheet, 2015).

Rising trend of sponsorship investment is explained by the fact that advertising through traditional media is becoming more expensive, while sponsorship is cost-effective and more reliable than conventional advertising (Meenaghan, 2001). Following the exponential growth of sponsorship investments, it is necessary to understand their efficiency for sport clubs and companies. A widely accepted mechanism for determining the effectiveness of sponsorship activity is awareness of sponsorship, and it is precisely the aim of this paper to evaluate the level of sponsorship awareness among Montenegrin consumers, loyal spectators of certain events or supporters of individual athletes, in order to confirm or reject the thesis that has been proved correct on the other markets.

From the perspective of the sponsor, brand awareness among fans is crucial in understanding the value and return on investment. Previous literature suggests that brand exposure by consumers, as well as congruence between sponsors and sports

entities, are crucial aspects for raising awareness of sponsorship (Biscaia et al., 2014). Numerous studies suggest that consumers who are loyal to the team or event can easily identify sponsors, which confirms their higher level of awareness. In his study, Madrigal (2004) found that consumers with a higher level of knowledge of the sport, and who are more emotionally involved, are more likely to observe and form opinions about the sporting event than the average viewer. He states this group of consumers will process more information about sponsorship than other groups, and at the same time it's more likely to seek additional information about sponsors. Therefore, the role of fans' attitudes toward the club must be taken into account when assessing brand awareness and sponsorship in the sphere of professional football, and sports in general. All in all, past empirical research on sponsorship effectiveness highlights fans' involvement and loyalty to sport entity as a necessary step in forming positive attitudes towards sponsor's products (Tsotsou & Alexandris, 2009; McDonald, 1991; Nassis, Theodorakis, Afthinos, & Kolybalis, 2014).

Taking the previous research into consideration, authors assume that loyal fans who are dedicated to a team or an event, have a higher level of knowledge about the event and its environment, and therefore, they are likely to be aware of the sponsors of such team or event. Therefore, the aim of this paper is testing the sponsorship awareness among loyal fans and sport consumers.

Methods

Empirical research was conducted through an anonymous online survey. The questions were formulated in a way that the obtained data clearly contributed to the conclusion of the research problem.

In order to explore brand awareness, two measures are most commonly used - recall and recognition (Keller, 1993). By researching consumers' recall, consumers are asked to list the brand name, without any incentives. On the contrary, recognition refers to the ability of the consumer to indicate the prior exposure to the brand after being presented with a list of brands as an incentive. Therefore, a number of questions were of an open type, in order to facilitate the formulation of own responses by respondents, as well as revealing the level of awareness about sponsorship, which is especially important when examining the recall of sponsors. In contrast, closed-type questions, with multiple choice, are significant for the segment of the survey regarding recognition of the sponsor.

The survey was conducted in the first quarter of 2018. Sample consists of 250 respondents from Montenegro - 47.2% of men (118 respondents) and 52.8% of women (132 respondents). For the purpose of segmented access and data precision, five age intervals have been created. The age structure of the respondents is directly related to the defined primary target group of research, comprised of young people aged up to 35, as 86.8% of respondents belong to this sample segment. Besides age and gender, the level of education is the last criteria of the respondents' classification. Namely, students and respondents with a university degree are the dominant segment of the sample - 82.4%.

In order to interpret and analyze data from the survey, content analysis was conducted and the statistical method has been applied to the data processing for the purpose its graphical presentation and conclusions execution.

Results

Previous literature suggests that greater brand exposure by consumers, as well as an adequate link between the sponsor and the cause, makes it easier to identify the sponsor. Sponsorship awareness strongly influences the attitude towards sponsors, while the attitude towards the sponsor is one of the strongest predictors of purchase intentions (Biscia, Correia, Rosado, Ross, & Maroco, 2013).

Following the established methodology for creating the order of the questions, before testing the level of sponsorship awareness for specific sport organizations and events, the

respondents, in the form of open questions, listed teams and athletes who they have been following for more than two years, as well as their sponsors. The results showed an extremely high level of sponsorship awareness when dealing with sport organizations and individual athletes, which is in line with the assumption that fans that follow a certain sport organization or athlete in the long run have a greater sponsorship awareness. Namely, as much as 90.6% of such respondents managed to accurately name companies sponsoring sport teams, while 72.7% were precisely named sponsors of individual athletes, which can be seen in the graph below (Figure 1).

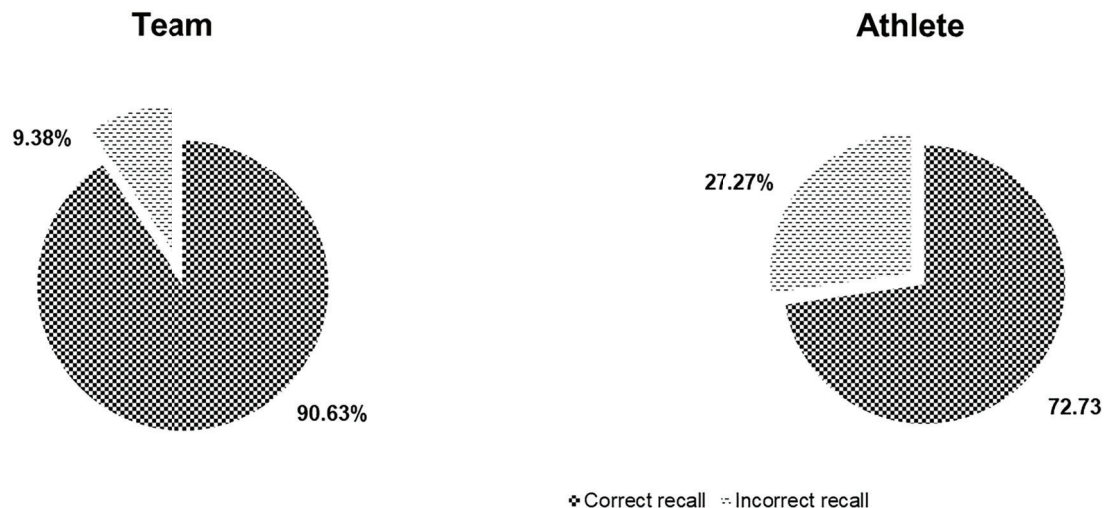


Figure 1. The degree of accuracy of the sponsorship recall

A lower level of sponsorship awareness when it comes to individual athletes can be explained by the misidentification of a sponsor of a club or a national team with a sponsor of an individual athlete. For example, among the respondents who incorrectly mentioned the sponsors, in 11% of cases, Legea, a sponsor of the Montenegrin national football team, is named as a sponsor of its member - Stevan Jovetic.

In contrast, respondents who listed athletes from individual sports (e.g. tennis players) linked tennis players and sponsors with 89.5% accuracy. In either case, respondents in both cases showed a high level of awareness of sponsorship, when it comes to their known sports organizations or individuals.

The most accurate linking of two parties is made for the sponsors who incorporate its brand name into the name of a sport club, as well as for jersey sponsors. This type of sponsorship, such as the cooperation between the Basketball club Crvena Zvezda Mt:s and Telekom Srbija (the name sponsor), as well as Real Madrid football club and Fly Emirates (jersey sponsor), is characterized by an extremely high level of recall. Namely, the level of recall when it comes to Montenegrin basketball club Buducnost Voli amounts to 91.2% for Voli, which is at the same time the name sponsor and sponsor whose logo stands out on the team's jersey.

In comparison, Bemax, which is also the sponsor of the club, whose logo is on the jersey, was listed by only 16.8% of respondents who follow Buducnost Voli. This difference can be explained by the participation of the club's basketball players in Voli's advertising campaigns, which are adequately presented by the media, as well as the general involve-

ment of Voli in the sponsorship activation in relation to other companies that support this club.

Similar results were achieved when referring to the sponsorship of the Montenegrin football team. Namely, out of the respondents following this team, 67.3% correctly identified the sponsors of the Football Association of Montenegro. Most recognized sponsors by the respondents are: Trebjesa Brewery (Niksicko Pivo) 35.5%, Crnogorski Telekom 28.4% and Legea 28.4%. Niksicko Pivo stands out on the basis of sponsorship activation. This company carries out extensive promotional campaigns and activities in which its brand relates to the national team. The obtained results are in line with the results of previous research, which highlight the sponsorship activation as an important factor in achieving competitive advantage among the group of sponsor companies (Papadimitrou & Apostolopoulou, 2009).

In the next set of questions, respondents expressed their opinion about a specific event - the Olympic Games, as the most important sport event in the world. The Olympic Games are especially significant from the aspect of sponsorship, given the global character and mass audience, as well as the amount of sponsorship investments. The results support this thesis - 56.4% of the respondents follow this event. Unlike the previous research segment, where recall was tested, this section examines recognition through multiple-choice questions, which is indicated in the literature as being easier for respondents. The results are shown in the graph below (Figure 2).

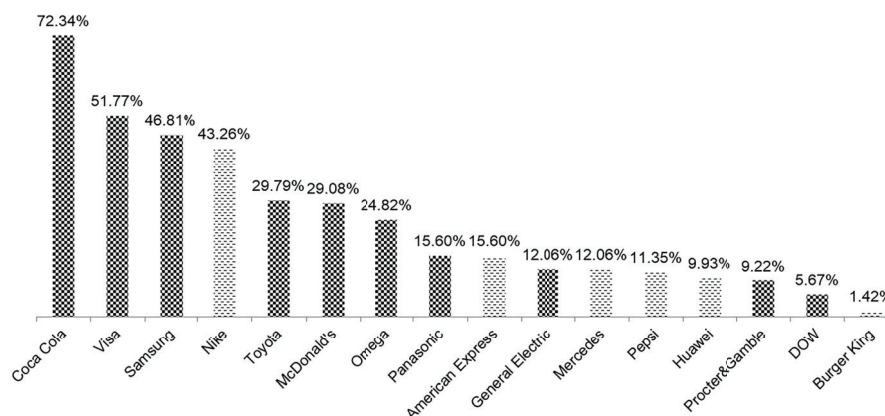


Figure 2. Identified sponsors of the Olympic Games

As shown in the figure, Coca Cola is recognized by the majority of respondents (72.3%) as a sponsor of the Olympic Games. The obtained results are not a surprise, since Coca Cola is the oldest sponsor of the Olympic Games. Its sponsorship activities date from the Amsterdam Olympic Games in 1928 (Coca Cola, 2018). In addition, this company is distinguished by the frequency and intensity of advertising related to the Olympic brand, the amount of sponsorship investments, the amount of money invested in sponsorship activation, and the number of Olympic athletes participating in its promotional campaigns. For the Olympic Games in Rio de Janeiro in 2016, Coca Cola has hired 79 athletes from 23 countries within its “#ThatsGold” campaign, which has been placed in over 50 markets (AdAge, 2016). Also, this company is trying to tie its brand strongly to Olympic values, and, for example, it sponsored the Olympic torch relay through 320 cities around the world (AdWeek, 2016b).

One of the interesting results is the high level of Nike's identification as a Olympic sponsor, although this company has never been a sponsor of this event. Even 43.3% of respondents mistakenly identified this company as a sponsor.

The obtained results are explained by the fact that Nike was pursuing ambush marketing activities from the first commercial Games held in Los Angeles in 1984. One of the most striking examples originate from the 1996 Olympics in Atlanta, when Nike resorted to unfair trading by purchasing

a large amount of advertising space and time during the broadcast on NBC TV, largest radio stations and press, paying this media commitment \$ 35 million, which is almost twice as much as the amount the actual sponsor - Reebok paid for exclusivity (\$ 20 million). The ads featured Nike sport promoters - Olympic and NBA stars, while more than 1000 athletes competed wearing Nike Equipment at the Games. In addition to this campaign, around 130 billboards were posted in the vicinity of the courts (Trkulja, 2008). According to a survey conducted by Performance Research, 13% of sport enthusiasts recognized Reebok as an official sponsor and 18% identified Nike (Performance Research, 1996). This trend continued, and at 2016 Olympics, Nike's „Unlimited“ campaign was the most effective one related to the Games, according to Google research (AdWeek, 2016). Namely, 34.4% of consumers in the US remember Nike's TV ads, in competition with 12 brands with the highest frequency of online advertising, while the official sponsor - Coca Cola was second with 33% (Google Marketing Platform, 2016).

As the results of this empirical research show - global trends are present in our market. From the presented results, it is clear that Montenegrin consumers recognize companies as sponsors which tie their brand with the Olympic Games, such as Nike.

The following Figure 3. shows the relationship between the accurately and incorrectly identified Olympic sponsors.

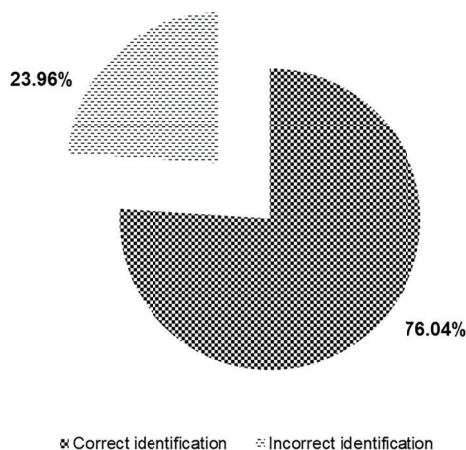


Figure 3. The degree of accuracy of the identification of the sponsor of the Olympic Games

Over $\frac{3}{4}$ of respondents, who are regularly watching the Olympic Games successfully recognized the sponsors of this event. This data indicates that consumers who follow a particular event have a higher degree of sponsorship awareness.

When it comes to other sport events, such as the Champions League in football, respondents showed a high level of sponsorship awareness, with a correct identification in 71.8% cases (Figure 4.)

Champions League sponsors recognition

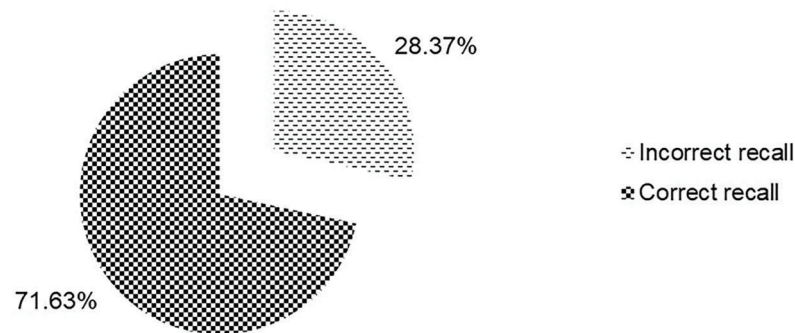


Figure 4. The degree of accurate recognition of the Champions League sponsors

Of all the listed brands, 83.6% of respondents identified Heineken as a sponsor of the Champions League, 75.8% and 34% recognized MasterCard and Gazprom, respectively. On the other hand, Samsung was incorrectly recognized by 24.1% of respondents, and Coca Cola by 4.9% of respondents. These results support the thesis that loyalty to the event positively influences the high level of sponsorship awareness. These results support the previous research conducted by Biscaia with a group of authors (2014), who also tested the level of sponsorship awareness of football and basketball fans. They came to the conclusion that those fans who have season tickets (making them loyal fans) demonstrated a higher level of knowledge and sponsorship awareness.

Discussion

In the last two decades, the concept of sponsorship, in response to the growing need for two-way communication, has developed from simple philanthropic activities to one of the most important ways of communication, and according to the IEG agency, companies are investing 23% of the total marketing budget in sponsorship, with a projected growth of 4.5% per annum (IEG, 2017). It allows connecting with consumers as no other medium so far, primarily because it involves a degree of altruism that does not exist in conventional marketing strategies and therefore is widely accepted and perceived as a marketing form that offers something in return. Sponsorship provides an efficient way of communicating with the target group, deepens the connection between businesses and consumers and leads to an increase in brand loyalty through the transfer of positive associations from sponsored events, organizations and personalities to the company. It gives a better impression, looks credible, and increases awareness of the company's social responsibility.

The results of the empirical research, on specific examples of sports events, organizations and athletes, have shown that greater brand exposure by consumers facilitates recognition of the sponsors. Additionally, the research identified factors that influence the effectiveness of sponsorship, in the form of sponsorship activation and management, as well as ambush

marketing. Results emphasize the importance of sponsorship activation, as the sponsorship investment itself is not enough to achieve the goals and the full sponsorship effect. In addition, ambush marketing contributes to creation of consumer confusion, and is a threat to corporate sponsorship, but also an efficient tool for companies that carry out such activities. Hence, the activities of ambush marketing, through contributing to the wrong identification of sponsors, have a significant impact on the sponsorship awareness.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Public Perception of Fine Dust: A Comparative Research of Participation Motives in Outdoor Physical Activities Depending on Fine Dust Concentration

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Abstract

Since the concentration of fine dust concentration in the atmosphere is rapidly increasing, recently to severe levels, and it has a fatal effect on human health, a change in people's awareness of outdoor physical activities is necessary. Nevertheless, people still take part in outdoor physical activities, even on days when a fine dust risk alert is issued, which shows that people's awareness of the danger of fine dust to their health is still lacking. This study used 341 surveys that was conducted to analyze and compare people's motives for participation in physical activities in relation to the fine dust level. After an exploratory factor analysis and reliability analysis using SPSS 23.0, the level of fine dust concentration in the atmosphere was divided into "dangerous" and "normal," while the respondents to the survey were divided into a "with fine dust group" and a "without fine dust group." People's participation motives were compared and analyzed by using a multivariate analysis of variance (MANOVA). People who participated in outdoor physical activities on days with a severe fine dust concentration showed higher scores for the motives of Competition, Appearance, Physical Condition, and Mastery, while those who participate in outdoor physical activities on days without a fine dust alert showed higher scores for the motive of Psychological Condition. Countermeasures against the danger of fine dust that are more effective should be established by analyzing the motives of people who participate in outdoor physical activities despite the dangerous level of fine dust concentration in the atmosphere.

Key words: particulate matter (PM_{10}), physical activity, participation motives, public health

Introduction

Climate change is a natural phenomenon that cannot be controlled by humans, and it involves a significant part of our everyday lives (Kim, 2018). Human life is greatly affected not only by major natural phenomena, such as earthquakes or hurricanes, but also by minor changes in climate such as hot or cold weather. In addition, environmental pollution caused by human beings has become the greatest global challenge and a problem that requires everyone to find a solution. Abnormal global climate patterns, including heavy snow, heatwaves, and heavy rain, are posing a significant threat to human be-

ings (Berry, Waite, Dear, Capon, & Murray, 2018). Recently, the amount of fine dust in the atmosphere has been passing an acceptable level, due to pollutants generated by factories, dust generated at construction sites, and the large number of vehicles, all the consequence of industrialization (Noh, Lee, & Yu, 2018; Stone, Yoon, & Schauer, 2011).

Fine dust (PM_{10}) has a very fine particle size that cannot be seen by the human eye; it is a pollutant only 10 μm in size (1 μm equals to 1/1,000 1 mm) (Kang, 2016). Kwak (2019) explained the serious health impact of fine dust as follows. First, fine dust causes an inflammatory response in the bronchial tubes,



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with negative effects in the respiratory system, such as chronic bronchitis, allergic rhinitis, and respiratory obstruction. In addition, it can cause or aggravate cardiovascular diseases, such as stroke, heart attack, and heart rate anomaly. The Korea Environment Corporation (K-eco) (2018) recently tightened the criteria for fine dust alerts into “good” for 0–15 $\mu\text{g}/\text{m}^3$ of fine dust concentration; “average” for 16–35 $\mu\text{g}/\text{m}^3$; “bad” for 36–75 $\mu\text{g}/\text{m}^3$; and “very bad” for 76 $\mu\text{g}/\text{m}^3$ or higher. Since air pollution can have fatal consequences for human beings, who cannot live without air, many countries around the world are endeavoring to reduce fine dust (J. Park, E.H. Park, Schauer, Yi, & Heo, 2018). The Korean government is measuring air pollutant concentration and implementing a system of fine dust alerts. The government suggests dos and don'ts for citizens according to the fine dust concentration level. Notably, Korea is also implementing a total pollutant load system for businesses in order to control the fine dust emanating from industrial establishments, expanding the supply of low-pollution vehicles, strengthening global cooperation with other countries, and implementing joint studies with them to curb environmental pollution. Despite such efforts, the maximum hourly average concentration of fine dust on the days of fine dust alerts has consistently increased, from 192 $\mu\text{g}/\text{m}^3$ in 2014 to 245 $\mu\text{g}/\text{m}^3$ in 2015, 373 $\mu\text{g}/\text{m}^3$ in 2016, and 423 $\mu\text{g}/\text{m}^3$ in 2017 (Yonhap News, 2019). Consequently, the government recommends that people refrain from outdoor activities on the days when a fine dust alert is issued, but many people still engage in outdoor activities, even without wearing masks, on days of severe fine dust concentration.

Many studies have suggested that outdoor physical activities bring many advantages, regardless of fine dust. Previous researchers have found that greater leisure participation may provide various physical benefits. In particular, given that regular physical activity participation allows people to reduce their negative cholesterol, obesity, high blood pressure, and diabetes, it has been suggested that they avoid sedentary leisure activities (Kemperman & Timmermans, 2008). These physical health benefits will lead to better mental health with strengthened self-efficacy (Priest, Armstrong, Doyle, & Waters, 2008) and will reduce stress (Henderson & Bialeschki, 2008). Previous research has also revealed that leisure participation is the best way of reducing work-related stress because of (a) its challenging nature and (b) its more recuperative nature (Trenberth & Dewe, 2002). Furthermore, the positive results related to physical and mental benefits can make individuals into valued members of society (Kim, Dattilo, & Heo, 2011). According to Ingen and Eijck (2009), given that leisure activity participation may improve a person's social network, such activities can have a positive influence on social capital.

Despite the fact that outdoor activities performed when fine dust alerts are issued may have more disadvantages than advantages, many people still work out outdoors on such days, without any sense of concern. However, they should reconsider doing outdoor activities on days of severe air pollution. Participation in leisure and sports can entail regular engagement in physical activities, with a positive impact on people's psychological well-being (Roychowdhury, 2018). Therefore, it is true that the motive for participating is regarded as a very important factor in people's continuous participation in leisure activities (Frederick-Recascino & Morris, 2004; Lloyd-Jones et al., 2010). People exhibit various motives for participation in leisure activities, including fun, enjoy-

ment, health, a sense of achievement, and communication with other people (Bandura, 1997; Gaston-Gayles, 2005; Mouratadis, Vansteenkiste, Lens, & Sideridis, 2008; Murcia, Coll, Martin-Albo, & Gimeno, 2010; Waldron & Dieser, 2010). By contrast, those who do not derive any fun from sports activities, who have trouble with sports coaches, or who are excessively obsessed with winning tend to discontinue their participation in leisure and sports activities (Weiss & Ferrer-Caja, 2002). In addition, gender is also a factor that affects the motive for participation. After conducting a questionnaire survey on students, Egli, Bland, Melton, and Czech (2011) reported that male students have a tendency to participate in leisure and sports activities due to intrinsic factors, such as the competition and challenge involved, whereas female students participate for weight or appearance management. In conclusion, people have their own motives for participating in leisure and sports activities and for continuing or discontinuing with those activities (Ntoumanis, 2005). However, regardless of the diverse demographic factors that have been used by other studies, given the fine dust levels that have emerged as the biggest social issue of the present day, it is extremely urgent that a study on the outdoor physical activities of people be conducted.

Therefore, the purpose of this study is to analyze the differences in the motives of people who participate in outdoor physical activities on the days when an air pollution (fine dust) alert has been issued, as well as on other days when the air quality was fine. By doing so, it will explore the motives of people to engage in outdoor physical activities on days with different fine dust levels. The results of this study will contribute to the understanding of people's awareness of fine dust and to establishing effective countermeasures. To this end, the study has posed the following research question: What are the differences in participation motives for physical leisure activities according to fine dust concentration?

Methods

Participants and data collection

To investigate the differences in participation motives according to fine dust concentration, this study conducted a survey of people who participate in outdoor physical activities (such as walking, jogging, and cycling). The survey was conducted in the Han River National Park, located in Seoul, Republic of Korea. The survey targeted people who enjoyed various outdoor physical activities. It took approximately 10 minutes for a respondent to complete the survey, and all respondents voluntarily completed it through a self-administration method.

To meet the research design, the data collection procedure was performed on the basis of air pollution in terms of fine dust. The questionnaire survey was conducted separately for a period when the fine dust alert, including the two-day rotation system for vehicles and a warning to refrain from outdoor activities was issued (January 14/15, March 26 in 2018, January 14/15 in 2019), and for a period when the fine dust concentration level was “good” or “average” (August 2018). A total of 430 surveys were distributed, and 359 were collected (an approximately 83.5% response rate). After excluding 18 incomplete surveys, 341 surveys were utilized in this research. On the basis of the fine dust concentration, this study divided survey respondents into two groups: (a) with fine dust ($n=140$, 41.1%) and (b) without fine dust ($n=201$, 58.9%).

Measures

To measure the participation motives the Physical Activity and Leisure Motivation Scale utilized in the study by Molanorouzi, Khoo, and Morris (2014) was revised and used accordingly. The instrument had revealed acceptable reliability scores (a Cronbach's alpha level of 0.78 to 0.81) in the previous study. The seven subfactors—(a) Competition (three items), (b) Appearance (four items), (c) Affiliation (three items), (d) Physical Condition (four items), (e) Psychological Condition (four items), (f) Mastery (three items), and (g) Enjoyment (four items)—had a total of 25 items measured on a 7-point Likert scale, ranging from 1 (“Strongly disagree”) to 7 (“Strongly agree”). With the instruments above, a multivariate analysis of variance (MANOVA) was conducted to compare and analyze the differences in the participation motives of outdoor physical activities based on atmospheric fine dust concentration.

Results

Descriptive statistics

The first group (with fine dust) consisted of 86 (61.4%)

male and 54 (38.6%) female participants. In terms of age, 27.9% (n=39) were in their 20s, the largest group, followed by those in their 30 s (n=34, 24.3%), over-60 s (n=31, 22.1%), 40 s (n=23, 16.4), and 20 s (n=13, 9.3%). In relation to sports participation, survey respondents engaged in Walking (n=38, 27.1%), Jogging (n=34, 24.3%), and Cycling (n=29, 20.7%). The results also revealed that all respondents (n=140, 100%) in this group checked the weather report for the fine dust concentration before participating in their activities, and 73.6% (n=103) wore dust filter masks.

The second group (without fine dust) consisted of 96 (47.8%) male and 105 (52.2%) female participants. With regard to age, 24.4% (n=49) were in their 50s, the largest group, followed by those in their 30 s (n=47, 23.4%), over-60 s (n=40, 19.9%), 20 s (n=34, 16.9%), and 50 s (n=31, 15.4%). Most respondents participated in Jogging (n=54, 26.9%), Walking (n=52, 25.9%), and Cycling (n=42, 20.9%). In addition, 73.1% of respondents (n=147) in this group checked the concentration of fine dust, while 24.4% (n=49) wore dust filter masks. More detailed information is shown in Table 1.

Table 1. Descriptive Statistics

Groups	Category	Group 1	Group 2
Outdoor psysical activity		With particulates n=140 (41.1%)	Without particulates n=201 (58.9%)
Gender	Male	n=86 (61.4%)	n=96 (47.8%)
	Female	n=54 (38.6%)	n=105 (52.2%)
Age	20s	n=13 (9.3%)	n=34 (16.9%)
	30s	n=34 (24.3%)	n=47 (23.4%)
	40s	n=23 (16.4%)	n=31 (15.4%)
	50s	n=39 (27.9%)	n=49 (24.4%)
	60s+	n=31 (22.1%)	n=40 (19.9%)
	Walking	n=38 (27.1%)	n=52 (25.9%)
Participated sport	Jogging	n=34 (24.3%)	n=54 (26.9%)
	Cycling	n=29 (20.7%)	n=42 (20.9%)
	Badminton	n=16 (11.4%)	n=21 (10.4%)
	Basketball	n=15 (10.7%)	n=19 (4.0%)
	Soccer	n=8 (5.7%)	n=5 (2.5%)
	Rarely	n=41 (29.3%)	n=31 (15.4%)
Frequency of participation	Sometimes	n=30 (21.4%)	n=39 (19.4%)
	Often	n=27 (19.3%)	n=47 (23.4%)
	Frequently	n=29 (20.7%)	n=42 (20.9%)
	Very often	n=13 (9.3%)	n=42 (20.9%)
Check weather forecast	Yes	n=140 (100%)	n=147 (73.1%)
	No	n=0 (0%)	n=54 (26.9%)
Mask for particulates	With mask	n=103 (73.6%)	n=49 (24.4%)
	Without mask	n=37 (26.4%)	n=152(75.6%)

Legend: Group 1=outdoor physical activity with fine dust pollution; Group 2=outdoor physical activity without fine dust pollution.

Scale validity & reliability

An exploratory factor analyses was performed, using the PCA with Varimax of Participation Motives (7 factors, 24 items). Under Motives, the Kaiser Meyer-Olkin measure identified the sample adequacy for the analysis: KMO=.783

(Field, 2009). Barlett's test of sphericity ($\chi^2=6863.810$, $df=276$, $p=.000$) was statistically significant. The seven extracted factors (Appearance, Psychological Condition, Physical Condition, Mastery, Competition, Enjoyment, and Affiliation) explained 84.36% of the total variance (Table 2).

Table 2. Factor Structure Matrix for Participation Motives in Outdoor Physical Activities

Items	1	2	3	4	5	6	7
To maintain toned body	.952						
To lose weight, look better	.943						
To define muscle, look better	.936						
To improve body shape	.862						
Because it helps maintain a healthy body		.939					
To improve cardiovascular fitness		.925					
To maintain physical health		.897					
Because it keeps me healthy		.893					
Because it helps me relax			.934				
To take my mind off other things			.924				
To get away from pressures			.901				
To cope with stress better			.889				
Because I perform better than others				.949			
To compete with others around me				.945			
To work harder than others				.901			
To get better at an activity					.949		
To keep current skill level					.925		
To obtain new skills/activities					.902		
Because I have a good time						.924	
Because it's interesting						.918	
Because it makes me happy						.849	
Because I enjoy spending time with others							.925
To be with friends							.902
To talk with friends while exercising							.787
E-value	4.288	3.331	3.125	2.755	2.553	2.221	1.972
Variance (%)	17.86	13.87	13.02	11.48	10.63	9.254	8.215
	6	9	2	1	8		

Legend: All Cronbach's alphas showed excellent internal consistency for reliability based on the .70 cutoff (Nunnally & Bernstein, 1994): (a) Participation Motive (Appearance, $\alpha=.948$; Psychological Condition, $\alpha=.934$; Physical Condition, $\alpha=.935$; Mastery, $\alpha=.925$; Competition, $\alpha=.926$; Enjoyment, $\alpha=.882$; Affiliation $\alpha=.853$)

MANOVA

The multivariate test revealed statistically significant differences in Participation Motives based on the fine dust concentration: (a) Motives [Wilks' $\lambda=.707$, $F(7, 333)=19.757$, $p=0.00$, partial $\eta^2=.293$]. To find statistical

results, an adjusted alpha level using a Bonferroni correction ($P=0.05/7=.007$) was applied. In participation Motives, univariate tests for (a) Competition, (b) Appearance, (c) Physical Condition, (d) Psychological Condition, and (e) Mastery were statistically significant (Table 3).

Table 3. Results of MANOVA: Differences in Participation Motives by Fine Dust Concentration

Source	DV	df	F	p	η^2
Motives	Competition	1	16.713	.000 *	.047
	Appearance	1	77.711	.000 *	.186
	Physical condition	1	10.753	.001 *	.031
	Psychological condition	1	16.815	.000 *	.047
	Mastery	1	19.785	.000 *	.055

Legend: * $p<0.007$.

Specifically, the mean scores of each factor based on groups are shown in Tables 4.

Table 4. Mean Scores of Motives Factors between Groups

	1	2	3	4	5	6	7
Group 1	4.140	4.532	3.421	4.293	3.416	4.260	3.890
Group 2	3.506	3.188	3.657	3.782	4.046	3.536	4.020

Legend: Group 1=outdoor physical activity with fine dust pollution, Group 2=outdoor physical activity without fine dust pollution; 1=Competition, 2=Appearance, 3=Affiliation, 4=Physical Condition, 5=Psychological Condition, 6=Mastery, 7=Enjoyment

Discussion

This study deals with people's awareness of the danger of fine dust, which has emerged as a major social issue recently. Specifically, it analyzed people's motives when taking part in outdoor physical activities with varying levels of air pollutant concentration in the atmosphere, including fine dust. When considering the seriousness of the fine dust issue mentioned above, the importance of this study and the possibility of its contribution to relevant fields can be seen.

Along with basic demographic questions, basic questions about fine dust were asked (such as whether people checked the weather forecast for the fine dust concentration level before participating in outdoor physical activities and whether they wore anti-dust masks to block fine dust while doing outdoor physical activities). The respondents' answers were very interesting. The results showed that even though 100% of those who engaged in outdoor physical activities on days of severe fine dust concentration had checked the weather forecast for the fine dust level before going out and thus knew that the air was in a dangerous condition still participated in those outdoor physical activities. In addition, 26% engaged in outdoor physical activities without wearing anti-dust masks to protect them from fine dust. This percentage was higher than that for the group of people who engaged in outdoor physical activities on days with clean air without fine dust; such figures indicate that people are still not fully aware of the dangers of fine dust and the need to protect themselves against it. This result also reveals the need for the central or local governments of Korea to be more active in providing information that is more precise and detailed about the dangers of fine dust and the need to protect against it. Citizens of Korea should also be made more aware of the dangers of fine dust so that they can protect themselves in practical ways, concurrent with the government's protection measures, from the health risks of fine dust.

Differences of participation motives according to fine dust

The percentages for Competition, Appearance, Physical Condition, and Mastery were statistically higher in the motives of people who engage in outdoor physical activities on days of high fine dust concentration than of those who engage in such activities on days with clean air. These motives for participation are ones that bring about physical benefits or developmental benefits from physical activities. They are also motivators whose goals can be realized only with a relatively more continuous investment of time and effort than those of other factors, such as Affiliation, Enjoyment, and Psychological Condition. Kleiber, Larson, and Csikszentmihalyi (1986) explained that such activities are "serious physical activity," which requires a degree of effort above a certain level and brings about developmental benefits as a result. This explanation can be supported by the result of this study, which showed that most of the people who answered that they engage in physical activities more consistently to the question about the frequency of their physical activities were also those who continued to take part in outdoor physical activities on days with risky levels of fine dust. Thus, people who engage in physical activities more consistently and actively continue to do so on days of severe fine dust without changing their routine and taking proper protection measures, even though they are aware of the danger of fine dust. Such people need a better awareness of the risks of frequent exposure to fine dust over a long period, which are greater than the benefits they can derive from outdoor physical

activities on days with high fine dust concentration.

By contrast, people who engaged in outdoor physical activities on the days of clean air answered that they did so for their mental well-being, which is in line with the results of other studies indicating that outdoor physical activities are helpful for stress relief (Henderson & Bialeschki, 2008). Notably, the result of a study by Parfitt, Pavey, and Rowlands (2009), which revealed that physical activities have a positive influence on the psychological well-being of people in all age groups, can support the findings of this study. Recent studies have also revealed that modern people's sedentary lifestyle hampers their psychological health (Kobriger, J. Smith, Hollman, & A. Smith, 2006). The group of people who engaged in outdoor physical activities on days with clean air reported a lower frequency of participation in response to the question about the frequency of their outdoor physical activities, but as argued by Dishman (2003), it is important to encourage people to take part in outdoor physical activities with proper protection measures and after checking the fine dust concentration levels, rather than encouraging them simply to raise their rate of participation in outdoor physical activities. In conclusion, due to the recent increase in the severity of air pollution, people need to take it into account when they engage in outdoor physical activities.

The results of this study are meaningful in that they can raise people's awareness about the health risks of fine dust, an issue of importance to society. The fact that people are not applying proper protection measures against fine dust even though they are aware of its danger demonstrates that people still do not have precise information about the health risks of fine dust. Even though previous studies have indicated that physical activities give physical, psychological, and social benefits, it may be necessary to re-examine whether outdoor physical activities in air filled with fine dust really does have more advantages than disadvantages. In addition, more proper protection measures and a greater understanding of the dangers of fine dust are necessary. The results of this study should not just remain as a research result, and further studies on the impact of fine dust on public health should be conducted.

The results and the experimental trial of this study are meaningful, but the study also has limitations. First, a long-term tracking study and massive data are needed to study air conditions and their impact on human health. Whereas cross-sectional data collected over a short period of time were used for this study, future studies will be able to produce results that are more accurate by applying a longitudinal research design. Second, this study is limited in terms of its analysis of people's complex decision-making processes and their awareness of the risk of fine dust, since it analyzed people's motives for engaging in outdoor physical activities only in relation to fine dust concentration levels. Once the constraints on people's outdoor physical activities are analyzed, for example, it may be possible to determine whether fine dust is actually one of the important factors constraining people's outdoor physical activities. Thus, future studies will need to include more factors. Third, this study was limited to Korea, where fine dust has recently emerged as a serious social problem. Results that are more meaningful could be generated by studies conducted in other countries, such as China or India, where the air pollution levels are the most serious in the world.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Elite Football Players from Bosnia and Herzegovina and Kosovo and their Body Composition

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Abstract

The aim of this research was to determine the differences among the top football players of the club in Bosnia and Herzegovina, CSC Zrinjski Mostar and the top football players of the club in Kosovo FC Trepca '89, the champions in their countries, in the morphological characteristics and body composition. A sample of 43 subjects was divided into two sub-samples. The first sub-sample of the subjects consisted of 28 players of CSC Zrinjski Mostar of the average age 24.36 ± 4.14 , the champions of the Bosnia and Herzegovina in the season 2016/17, while the other sub-sample consisted of 15 players of FC Trepca '89 of the average age 21.80 ± 3.57 , the champions of the Kosovo Championship in the season 2016/17. Football players were tested immediately after the end of the competition season 2016/17. Morphological characteristics in the body composition were evaluated by a battery of 10 variables: body height, body weight, waist circumference, triceps skinfold, biceps skinfold, skinfold of the back, abdominal skinfold, body mass index, fat percentage and muscle mass. The standard central and dispersion parameters of all variables were calculated. The significance of the differences between the players of the top two football clubs in the morphological characteristics and variables for assessing body composition was determined by a t-test for independent samples. It was found that the football players of the two mentioned clubs don't have statistically significant differences by the variables.

Key words: soccer, morphological characteristics, football players, Bosnia and Herzegovina, Kosovo

Introduction

A football game is said to be the most important secondary thing in the world, it gathers huge masses at stadiums and in front of TVs (Gardašević, 2010; Gardašević, Bjelica, Popović, & Milašinović, 2016). It is a highly dynamic and fast team game which, with its richness of movement, falls under category of polystructural sports games (Bjelica, 2005; Gardašević i Goranović, 2011; Gardašević i Bjelica, 2013; Gardašević & Bjelica, 2014a; Gardasevic i Bjelica, 2014b). Football is a sport that is characterized by numerous and various complex and dynamic kinesiological activities which are then characterized by either cyclical (Gardašević, Vasiljević i Bojanić, 2015; Bjelica, Popović, & Gardašević, 2016a; Bjelica, Popović i Gardašević, 2016b; Sermaxhaj, Popovic, Bjelica, Gardasevic, & Arifi, 2017;

Gardasevic, Bjelica & Vasiljevic, 2017a; Gardasevic, Bjelica & Vasiljevic, 2017b) or acyclical movement (Gardasevic, 2015; Gardašević i sar., 2015; Gardašević, Bjelica i Vasiljević, 2016a; Gardašević, Bjelica i Vasiljević, 2016b; Gardasevic, Bjelica, Milasinovic i Vasiljevic, 2016; Gardašević i Vasiljević, 2016; Gardasevic, Popovic, & Bjelica, 2016). In football, top score can be achieved only under conditions of well-programmed training process (Gardašević, Bjelica i Popović, 2015). High quality management of the training process depends on the knowing of the structure of certain anthropological capabilities and player's characteristics, as well as their development (Bjelica i Popović, 2012; Bjelica, 2013). Various researches are to be done in order to establish certain principles and norms for the transformational processes of the anthropological cha-



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characteristics important for football (Gardašević, Bjelica, Georgiev, & Popović, 2012); with morphological characteristics and body composition among them as expected. Findings regarding morphological characteristics and body composition are of crucial importance for complex sports games such as football. The morphological space is defined by the longitudinal dimension of the skeleton, the transversal dimensionality of the skeleton, the mass and volume of the body (Bjelica & Fratrić, 2011). The purpose of knowing morphological characteristics is to improve skills in many sports (Carter & Heath, 1990). The morphological status of top level athletes is relatively homogeneous, depending on the sport, and it can be defined as a model of athletic achievement (Mišigoj-Duraković, Matković, & Medved, 1995). Research on morphological characteristics and body composition among athletes of different sports indicates that athletes of different sports have their own specific characteristics. Muscle mass improves performance in activities that require muscular strength and endurance, but also in those that require enviable aerobic ability (Ramadan & Byrd, 1987; Green, 1992; Rico-Sanz, 1998).

Today, football is certainly the number one sport in the world for its view and popularity (Gardašević, Georgiev & Bjelica, 2012; Vasiljević, Gardašević, & Bojanić, 2013; Gardasevic, Bjelica, Vasiljevic, Arifi, & Sermahaj, 2019), and the same applies to Bosnia and Herzegovina and Kosovo (Bjelica, Gardasevic, Vasiljevic, Arifi, & Sermahaj, 2019). The two clubs that are at the top of the Premier League of Bosnia and Herzegovina and of the Super League of Kosovo, in the 2016/17 competitive season, they both have achieved a staggering success, CSC Zrinjski Mostar was the champion of Bosnia and Herzegovina and FC Trepca '89 was the champion of Kosovo. Based on these two trophies that they have won at the end of the competition season, both clubs have acquired the right to play on the international football scene within the framework of UEFA's Champions League qualification. It became as interesting for researchers to determine the models of anthropometric characteristics and body composition of the players who play for these clubs as to determine the differences among them.

The aim of this research was to determine morphological characteristics and body composition of elite soccer players, players of CSC Zrinjski Mostar who compete in the Telecom Premier League of Bosnia and Herzegovina and players of FC Trepca '89, who compete in the Super League of Kosovo. After which, compare the variables between these players and determine the possible differences between them.

Method

The data obtained in the study of morphological characteristics and body composition are checked and prepared for processing according to the set goal. Data bases are arranged according to the features and prepared for planned statistical processing. The results obtained by statistical analysis are presented in the tables and analyzed by the corresponding logical units. In general, the results of the research, through gradualness in the explanation of individual relationships, allow seeing differences in the observed morphological measures and body composition in accordance with the aim of the research, that is, they contribute to a clearer application of the obtained results in practice. In terms of time constraint, the research is of transversal character, and it consists

of a one-off measurement of the corresponding morphological characteristics and body composition of top-level senior players.

Sample of subjects

A sample of the subjects consists of a total of 43 top-level senior players who performed in the Premier League of Bosnia and Herzegovina and Suoer League of Kosovo, divided into two sub-samples. The first one consists of 28 players of CSC Zrinjski Mostar, the average age of 24.36 ± 4.14 , Bosnia and Herzegovina's Championship winner in season 2016/17, and the second one that consists of 15 players of FC Trepca '89 of the average age 21.80 ± 3.57 , the champions of the Kosovo Championship in the season 2016/17. The football players were tested immediately after the 2016/17 season ended.

Sample of measures

Anthropometric research has been carried out with respect to the basic rules and principles related to the selection of measuring instruments and measurement techniques standardized in accordance with the International Biological Program guidelines. For the purpose of this study, 7 morphological measures have been taken: body height (ABH), body weight (ABW), waist circumference (AWC), triceps skinfold (ATS), biceps skinfold (ABS), skinfold of the back (ASB) and abdominal skinfold (AAS), and 3 body composition assessment variables: body mass index (BMI), fat percentage (AFP) and muscle mass (AMM). Anthropometer, caliper, and measuring tape were used for morphological measurements. To evaluate the body composition, Tanita body fat scale - model BC-418MA, was used. The principle of this scale is based on indirect measurement of the body composition; a safe electrical signal is transmitted through the body via electrodes located in the standalone unit. The Tanita Scale, thanks to its athletics mode, enables athletes to closely monitor their body weight, health condition and form with all relevant parameters.

Method of data processing

The data obtained through the research are processed by descriptive and comparative statistical procedures. For each variable, central and dispersion parameters, as well as asymmetry and flattening measures are processed. Differences in morphological characteristics and the composition of the body of the players of these two clubs were determined by using a discriminatory parametric procedure with t-test for small independent samples, with statistical significance of $p < 0.05$.

Results

In Tables 1 and 2, basic descriptive statistical parameters of anthropometric variables and body composition of the players of the two clubs, where the values of central measurements and dispersion tendencies are calculated, are shown: Arithmetic mean (Mean), Standard deviation (Std. Dev.), Variance (Variance), Minimal (Min) i Maximal (Max) values, coefficient of Curvature (Skewness) and Elongation (Kurtosis). First, the central and dispersion parameters of the variables were analyzed to evaluate the morphological characteristics and body composition of the players of CSC Zrinjski Mostar (Table 1).

Table 1. Central and dispersion parameters of variables for assessment of morphological characteristics and body composition of players of CSC Zrinjski Mostar (N=28)

Variables	Min	Max	Mean \pm S.D.	Variance	Skewness	Kurtosis
ABH	170.8	193.0	182.59 \pm 4.82	23.27	-.07	.25
ABW	70.0	90.5	78.85 \pm 5.80	33.68	.13	-.92
AWC	77.0	98.0	86.39 \pm 4.35	18.91	.34	.95
ATS	4.6	13.0	7.59 \pm 2.09	4.39	.88	.63
ABS	3.3	6.2	4.33 \pm .74	.55	1.07	.59
ASB	3.7	13.8	9.23 \pm 2.18	4.74	.31	.92
AAS	4.0	15.0	8.02 \pm 2.77	7.66	.89	.36
BMI	21.4	26.1	23.63 \pm 1.14	1.30	.16	-.47
AFP	3.9	14.6	8.79 \pm 3.18	10.14	-.05	-.88
AMM	35.5	46.9	40.67 \pm 2.67	7.12	.05	-.03

Legend: ABH-body height, ABW-body weight, AWC-waist circumference, ATS-triceps skinfold, ABS-biceps skinfold, ASB-skinfold of the back, AAS-abdominal skinfold, BMI-body mass index, AFP-fat percentage; AMM-muscle mass

Based on the central and dispersion parameters, the values of the skewness and the kurtosis, it can be noted that all the variables are placed within the normal distribution boundaries. Generally, according to all statistical parameters, it can be concluded that here we have some top football players; that there is a normal distribution in all variables and that the results that prevail are superior to the arithmetic

mean, which is not statistically significant because it is to be expected that regarding players of a professional football club, there is no too large a span between the results of analyzed variables. Table 2 showed the central and dispersion parameters of the variables were analyzed to evaluate the morphological characteristics and body composition of the players of FC Trepca '89.

Table 2. Central and dispersion parameters of variables for assessment of morphological characteristics and body composition of players of FC Trepca '89 (N=15)

Variables	Min	Max	Mean \pm S.D.	Variance	Skewness	Kurtosis
ABH	174.3	188.0	181.95 \pm 4.41	19.424	-.502	-.941
ABW	66.3	86.1	76.61 \pm 6.75	45.576	-.066	-1.565
AWC	79.0	91.0	84.20 \pm 3.76	14.171	.182	-.619
ATS	3.6	10.5	7.11 \pm 1.86	3.454	-.114	.094
ABS	2.6	8.2	4.57 \pm 1.49	2.209	1.015	.957
ASB	6.8	13.4	9.04 \pm 2.07	4.303	1.192	.333
AAS	4.6	16.8	8.33 \pm 3.84	14.746	1.391	.702
BMI	20.0	25.5	23.00 \pm 1.65	2.729	-.252	-.762
AFP	3.8	14.4	9.81 \pm 2.96	8.752	-.426	-.121
AMM	34.9	43.0	39.02 \pm 2.53	6.389	-.276	-1.124

Based on the central and dispersion parameters, the values of skewness and kurtosis of the players of FC Trepca '89, it can be stated that all the variables are within the normal distribution boundaries and that the values are very similar to those of the players of CSC Zrinjski Mostar. It can also be stated that the players of FC Trepca '89 are younger on average, have less body weight than the players of CSC Zrinjski Mostar, and have a higher fat percentage, though insignificantly. However, a comparative statistical procedure, t-test (Table 3), will

show whether it is statistically significant. By the value of the skewness, it can be noticed that in the variables of the biceps skinfold (ABS), skinfold of the back (ASB) and abdominal skinfold (AAS), there was a slight inclination on the side of the lower results, which is good because subcutaneous fat is a disrupting factor for professional athletes. In order to determine whether there are statistically significant differences in the analyzed variables in the top football players of these two clubs, the statistical procedure t-test (Table 3) was applied.

Table 3. T-test values between the arithmetic mean of variables for the evaluation of morphological characteristics and body composition of players of CSC Zrinjski Mostar (N=28) and FC Trepca '89 (N=15)

Variables	Club	Mean \pm S.D.	Mean Difference	t-test	Sig.
ABH	ZRI	182.59 \pm 4.8235	.6395	.427	.672
	TRE	181.95 \pm 4.4073			
ABW	ZRI	78.85 \pm 5.8036	2.2433	1.141	.260
	TRE	76.61 \pm 6.7510			
AWC	ZRI	86.39 \pm 4.3490	2.1929	1.648	.107
	TRE	84.20 \pm 3.7645			

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Variables	Club	Mean \pm S.D.	Mean Difference	t-test	Sig.
ATS	ZRI	7.59 \pm 2.0959	.4760	.737	.465
	TRE	7.11 \pm 1.8585			
ABS	ZRI	4.33 \pm .7418	-.2448	-.724	.473
	TRE	4.57 \pm 1.4864			
ASB	ZRI	9.23 \pm 2.1768	.1921	.280	.781
	TRE	9.04 \pm 2.0743			
AAS	ZRI	8.02 \pm 2.7686	-.3088	-.304	.763
	TRE	8.33 \pm 3.8401			
BMI	ZRI	23.63 \pm 1.1421	.6219	1.452	.154
	TRE	23.01 \pm 1.6520			
AFP	ZRI	8.79 \pm 3.1849	-1.0210	-1.026	.311
	TRE	9.81 \pm 2.9584			
AMM	ZRI	40.67 \pm 2.6689	1.6479	1.965	.056
	TRE	39.02 \pm 2.5276			

Based on the obtained values of t-test results, it was found that the soccer players of the two mentioned clubs don't have statistically significant differences by the variables. In all variables the differences are negligible and not statistically significant.

Discussion

The aim of this study was to determine the difference in the morphological characteristics and body composition of the top football players of the club in Bosnia and Herzegovina, CSC Zrinjski Mostar and the top football players of the club in Kosovo FC Trepca '89, the champions in their countries in the 2016/17 season. A sample of 43 respondents was divided into two sub-samples. The first sub-sample consisted of the 28 players of CSC Zrinjski Mostar of 24.36 \pm 4.14 age on average, who were a statistically significant older than the 15 players of FC Trepca '89, who made the second sub-sample of 21.80 \pm 3.57 age on average. The results were obtained by using a battery of 10 tests in the area of morphological characteristics and body composition. By looking into the basic descriptive statistical parameters, it can be concluded that we have examined professional sportsmen indeed. It can be noticed that the players of both clubs are of the approximately similar mean values of the variables analyzed, which is not surprising because these are the top two clubs in Bosnia and Herzegovina and Kosovo, a states where there are also a great concentration of good players. The t-test results showed that the soccer players of the two mentioned clubs don't have statistically significant differences by the variables. Very similar characteristics of football players were obtained in the region, which shows that football players have similar the anthropometric characteristics and body composition in the whole region (Gardasevic, Bjelica, Popovic, Vasiljevic, & Milosevic, 2018; Bjelica, Gardasevic, & Vasiljevic, 2018; Corluka & Vasiljevic, 2018; Bjelica, & Gardasevic, 2019; Gardasevic, Bjelica, & Vasiljevic, 2019).

For all variables, some values are better for players of CSC Zrinjski Mostar and some for players of FC Siroki Brijeg, although, insignificantly for statistics, which indicates that these players have very similar anthropometric parameters and body composition, which is again, not surprising, considering that these two clubs are the best in their countries in the 2016/17 competitive season. The values obtained in this research can be useful for coaches of these clubs for making a comparison

of their players with others and formulate their work in a way that enables reduction of those parameters that are not good, and raise those that are good to a higher level. That will surely make their football players even better and more successful. Also, both clubs should turn to other researches and check the functional-motoric status, psychological preparation as well as tactical training of their players and analyze whether there is room for their improvement. The results obtained in this research can serve as model parameters for the estimated variables for players of all other football clubs in Bosnia and Herzegovina and Kosovo, because the players that have been analyzed here, were among the best and the most successful football players in those two countries at the end of the competitive season 2016/17.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Sport, Drugs and Health promotion: Pharmacological and Epidemiological aspects

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Abstract

Sport activity, must be directed to the promotion of individual and collective health. Thus, there is no doubt that drugs and pharmacological nutriment have been used by sportsmen and women to improve his physical performance. Doping is defined as "use of substances or adoption of medical practices not justified by pathological conditions, aimed at improving competitive performance". It occurs not only in professional sport, but also affects amateur athletes. The effects of the abuse of add-on substances or the intake of substances that alter the outcome of the competition are in the educational interest of the school and it is a problem concerning not only sports ethics, but also public health. Over time, doping has shown a great ability to discover and always use new substances and appropriated the new scientific discoveries. Unfortunately, new discoveries for the human health are been used in distorted way by the athletes. In fact, the athletes may be able to use gene therapy to re-engineer their bodies for better performances. Drugs dependence depends on several factors: the socio-environmental context of the subject and what effects have the substance in the body. The purpose of the study was to reviewed the use of performance-enhancing drugs in sport in relating to the protection of the health of athletes. We focus our analysis on pharmacological and epidemiological issue.

Key words: *drugs, sport, ergogenic aids, health, prevention*

Introduction

Doping in sport is defined as "the administration to sportsmen or sportswomen, or the use by them, of pharmacological classes of agents or methods doping" (Mazzeo et al., 2016; Mazzeo et al., 2018a). Today the intake illicit and potentially harmful substances in the sporting practice is an important problem for the public health, given the considerable spread of the phenomenon. The current prevalence estimates are inaccurate, since the survey tools used reveal statistical power limited (Valkenburg, de Hon, & van Hilvoorde 2014; Stubbe, Chorus, Frank, de Hon, & van der Heijden, 2014). Nevertheless, the emerging scenario reflects a disturbing underestimation by national organizations. For limited resources, prevention and the fight against doping must presuppose rational strategies,

with the aim to identify suitable contests and accurate procedures, considering carefully ethical issues that may arise from the positivity of the athletes to antidoping controls (Mazzeo et al., 2018a). There are a variety of pharmacological substance and nutriment which are commonly used in sport medicine in competition (Mazzeo, 2016). These are usually used to manage pain or in an attempt to reduce inflammation (Schenone et al., 2003; Motola et al., 2001). Elite athletes may be subject to drug testing. Athletes has always tried to improve his physical performance by any method: legal or illegal, healthy or harmful to health (Sjöqvist, Garle, & Rane, 2008; Mazzeo, 2018). The reasons of these attempts are various and they are changed over time: from to get best results in the hunting to obtain profit. In fact, best performances mean, great earnings (Lippi, Longo, & Maffulli, 2009). Scientific research has also recently



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demonstrated the addictive effects of some doping agents such as anabolic steroids, together with typical drugs of abuse (e.g. stimulants, narcotics) in the past present in the list of prohibited doping substances (Mazzeo & Raiola, 2018; Mazzeo, 2018; Marclay, Mangin, Margot, & Saugy, 2013).

In elite athletes, it involves the repeated and excessive use of substances to realize a certain effect. Furthermore, the desire to enhance their physical abilities did not even spare the disabled athletes (Mazzeo, Santamaria, & Iavarone, 2015; Montesano, Tafari, Mazzeo, 2013).

In our times, in the search for substances able to make it stronger than others, the athlete was matched and complicity in different professionals: coaches, managers, doctors and pharmacists, nutritionist, equally interested in increasing their power, in a common and economic perspective. In the last quarter of the twentieth century, the use of doping in sport activities has become considerable and organized (Mazzeo et al., 2015). With the advent of sponsors and mass media, the success in major sports competitions (Olympics, World Championships, and so on) has been playing an increasingly significant social and economic goal, such as to encourage the use of all means, legal and illegal to catch up (Esseiva et al., 2007). It seriously affects the image of the industry and represents a serious threat to individual health (Mazzeo et al., 2016). Unfortunately, in the past and for a long time, doping was underestimated and public institutions considered it as a problem exclusively of sports organizations that alone had to vanquish a phenomenon in continuous expansion (Møller & Dimeo, 2014).

Pharmacological issues

The misuse and abuse of pharmacologically active substances have become so widespread in present day sports that the safety and the health of far too many athletes are now compromised (Mazzeo et al., 2013). Ergogenic aids are substances used by athletes to increase athletic performance in the face of physical and emotional challenges in a sports competition.

Botrè (2008) distinguishes three main periods about the evolution of substances to identify. The first one – the early age – includes “in competition drugs”; the second period – the andro-

genic anabolic steroids age – includes “in and out competition drugs”. The third age – protein chemistry and molecular biology age – includes the newly discovered in genetic engineering used for the treatment of diseases too. Now, in the “gene doping age”, the new frontier of doping is the use of cells, genes, genetic elements, or the modulation of gene expression with the aim to increase the performance and not easy to detect (Botrè, 2008; Mazzeo & Volpe, 2016). This last period includes the blood doping. Indeed, the blood transfusion and administration can boost the capacity to transport the oxygen to the muscles.

Already in the early 1900s it was realized that the use of substances to increase physical performance, not only falsified the results of competitive sport but it was also very dangerous for the health (Mazzeo, 2016). For this reason, in 1928 the International Association of Athletics Federations became the first International Sport Federation (IF) to ban the use of stimulating substances. Only after the death of a cyclist at the Olympic Games in Rome in 1960 urged the relevant authorities to introduce the first anti-doping test (Mazzeo et al., 2018a).

After eight years, during the Olympic Games of Mexico City, there was a pilot project with the aim to analyze the efficacy of anti-doping tests and thanks to their success, the first official anti-doping screening started in 1972 during the Summer Olympic Games of Munich (Botrè, 2008). At beginning, the tests were sporadic and not completely reliable. But in 1999, thanks to the creation of the World Anti-Doping Agency (WADA), it finally created an organization with the sole purpose to fight this “cancer” of sport and consequently the situation of tests is changed (Dvorak et al., 2014; Valkenburg et al., 2014). One of most important WADA function was to harmonize the Olympic anti-doping code and develop a single and complete code applicable and acceptable for all the stakeholders. The world anti-doping code developed by WADA introduced several international standards (ISs) with the main goal to harmonize the anti-doping disciplines from each country (Mazzeo et al., 2016). The Agency has compiled a list of banned substances and practices that is constantly updated. Now, WADA, for example, has identified more than two hundred banned substances currently divided into 10 classes (including the class S0) and three methods (Table 1).

Table 1. Wada 2018 Prohibited List

Substances and methods prohibited (in and out competition)
S1 Anabolic agents
S2 Peptide hormones, growth factors, related substances and mimetics
S3 Beta- 2 agonists
S4 Hormone and metabolic modulators
S5 Diuretics and masking agents
M1 Manipulation of blood and blood components
M2 Chemical and physical manipulation
M3 Gene doping
Substances and methods prohibited in competition
<i>In addition to the categories S1 to S5 and M1 to M3,</i>
S6 Stimulants
S7 Narcotics
S8 Cannabinoids
S9 Glucocorticosteroids
Substances prohibited in particular sport
P1 Alcohol
P2 Beta-blockers

Athletes are generally in optimal physical condition. However, some athletes may have long-or short term conditions, such as asthma and sports injuries, that require medi-

cal intervention. Drug treatment for any of these conditions requires vigilance in relation to athletes (Table 2).

Table 2. Medical Condition for which athletes may require drug treatment and drugs that are in WADA Prohibited List regulations

Common Medical condition	Drug classes commonly used
Asthma	Beta-2 agonists Glucocorticosteroids
Diabetes Mellitus (Typel)	Insulin
Hypertension	Diuretics Beta-blockers
Viral cough and cold	Decongestant stimulants
Musculo-skeletal damage and inflammation	Narcotic analgesics Glucocorticosteroids

The list presented below includes the main substances or classes of substances that cause well documented side effects on the human organism. Moreover, these substances are more and more used by athletes not only in competitive sports, but also in fitness and recreational sports. It is important to ask why athletes dope (Stella et al., 2005). One thing is certain the substances that give pleasant sensations or help the subject in his activity will bring him to repeat the consumption. But, not all people develop drug dependence. It depends on several factors: the socio-environmental context of the subject and what effects have the substance in the body. The knowledge about certain Performance-enhancing effects of substance used by athletes is still very fragmentary and we have omitted them from our compilation. Moreo-

ver, besides the substances listed here, there are many other pharmacologically active compounds or medical drugs that also have specific side effects (Mazzeo, 2016). The motivation for drug abuse, the choice of substance and the prototype of use are sensitive to historical, sociocultural and psychological variables. The most common use in relation to sport activities are: restorative drugs or substances; additive drugs or substances; recreational drugs or substances (Morente-Sánchez & Zabala, 2013). Numerous research studies have suggested that attitudes toward doping and actual doping abuse are principally influenced by sports motivation; i.e., the subjective reasons underlying why athletes participate in sports affect the decision to use drugs. Athlete's Doping Objectives are different and diverse for sport (Table 3).

Table 3. Athlete's Doping Objectives. The substances prescribed for treating specific medical conditions are used in manners that are contrary to conventional clinical practice

Objectives

Aid workout/injury recovery
Alter intensity and aggression
Sharpen focus and concentration
Combat exhaustion and fatigue
Reduce weight/body fat
Relieve aches and pains
Increase muscle mass/oxygenation
Increase strength and endurance

Moreover, many substances have various gratifications' effects, such as stimulants, anabolic, narcotics and cannabinoids. Stimulants are used to increase the concentration, alertness and safety. They also increase the aggressiveness and the sense of competitiveness (Stella et al., 2005). To anabolic are recognized for the following effects: euphoria, sense of wellbeing, glee, increased motivation and self-esteem. Moreover, the athlete doesn't get bored during the training (Mazzeo, 2018). Cannabinoids, such as cannabis, hashish and marijuana, cause changes in mood and perception, euphoria, happiness, relaxation and deep sleep and reducing anxiety. They are considered drugs to use social-recreational increased sociability and sense of wellbeing (Stella et al., 2005).

The last doping's method is the use of genes. Gene therapy may be defined as the transfer of genetic material to human cells for the treatment or prevention of a disease or disorders (Doessing & Kjaer, 2005). Its principle is based on the delivery to a cell, of a therapeutic gene which may compensate an absent or abnormal gene (Mazzeo & Volpe, 2016). Gene therapy is currently an experimental therapy

and its use is strictly regulated (Beerens et al., 2003).

Unfortunately these new important discoveries for the human health have been used in distorted way by the athletes. In fact, the athletes may be able to use gene therapy to re-engineer their bodies for better performances (Oliveira, T.F. Collares, Smith, T.V. Collares, & Seixas, 2011). Gene doping is defined, for the first time in the 2003, in the IOC List of Prohibited Substances and Methods, as the "Gene or cell doping is defined as the non-therapeutic use of genes, genetic elements and /or cells that have the capacity to enhance athletic performance" (World Anti- Doping Agency, 2010; Zhang, Chen, Meng, & Chen 2008). Now, in the 2013 WADA Prohibited List, gene doping, is "the transfer of polymers or nucleic acid analogues" and "the use of normal or genetically modified cells" (World Anti- Doping Agency, 2013).

Doessing and Kjaer (2005) also suggest a role for GH as an anabolic agent in connective tissue in human skeletal muscle and tendon. Recombinant GH, is already being used as a doping agent in sports. Insulin-like growth factor 1 is a protein that stimulates cellular proliferation, somatic growth and differentiation (Doessing & Kjaer, 2005).

The Biological Passport is a tool for indirect detection of the presence of a doping substance in biological samples of an athlete (Mazzeo & Volpe 2016). With it, in fact, the changes of certain bio-markers of doping are recorded and monitored. If the data, combined with the personal data localization in a given period, exceeded a certain range, the athlete would assume the banned substances (WADA, 2015). The Anti-Doping Administration and Management System (ADAMS) is an on-line database system where are recorded all data: laboratory results, therapeutic use exemptions (TUEs) and information on anti-doping rule violations. It allows the sharing of information amongst the organizations and promotes efficiency, transparency and effectiveness in all anti-doping activities (Møller et al., 2014).

Moreover, the use of some performance-enhancing drugs, for some banned drugs do have potentially serious adverse side effects if used in long periods and high doses. Many studies have been carried out on the health effects of anabolic steroid use, erythropoietin (EPO) and others.

The importance of the right to the health is also underlined by the fact that it cannot be undermined by individuals and by public authorities or by other private entities. This right does not mean only to take care of illness but it also means ensuring better living and working conditions. Today's approach to anti-doping is mostly centered on the judicial process, despite pursuing a further goal in the detection, reduction, solving and/or prevention of doping (WADA, 2009).

Epidemiological data

The 2017 Report summarizes the results of all the samples WADA-accredited laboratories analyzed and reported into WADA's Anti-Doping Administration and Management System (ADAMS) in 2017. The 2017 Report – which includes this Executive Summary and sub-reports by Laboratory, Sport, Testing Authority (TA) and Athlete Biological Passport (ABP) Blood Analysis – includes in- and out-of-competition urine samples; blood and ABP blood data; and, the resulting Adverse Analytical Findings (AAFs) and Atypical Findings (ATFs).

Report Highlights

- A 7.1% increase in the overall number of samples analyzed: 300,565 in 2016 to 322,050 in 2017.
- A decrease in the number of AAFs: 1.60% in 2016 (4,822 AAFs from 300,565 samples) to 1.43% in 2017 (4,596 AAFs from 322,050 samples). This is primarily due to the significant decrease in the reported cases of meldonium.
- About 80% of WADA-accredited laboratories saw an increase in the total number of samples.
- A relative increase in the overall number of (non-ABP) blood samples analyzed: 7.75% in 2016 (23,298 of 300,565) to 8.62% in 2017 (27,759 of 322,050).
- An increase of 3% in the number of ABP samples tested: 28,173 in 2016 to 29,130 in 2017.

In Italy, the REPORTING SYSTEM - DOPING ANTIDOPING 2017, published by the Ministry of Health, carries out the control activity by collecting data through an integrated information system and processes them in collaboration with Istituto Superiore di Sanità.

In 2017, 287 sporting events were scheduled: 89.5% (257 events) were regularly held, while 30 demonstrations were not completed (10.5%). The controls concerned the events of the National Sports Federations, the Associate Sports Disciplines and the Sports Promotion Agencies.

1,211 athletes were subjected to doping control, 821 males (67.8%) and 390 females (32.2%). The average age of the population under doping control is 27.7 years (28.6 males and 25.7 females).

Of 1,211 athletes tested, 30 tested positive for doping (2.5%) with a substantial gender difference (4 females and 26 males). The gender difference emerges (even if not statistically significant) also as regards the average age of athletes positive results: 35 years for men and 31.8 for women.

The highest percentage of active substances detected in doping controls belongs to:

- anabolic agents (48.3%)
- stimulants (17.2%)
- corticosteroids (8.6%)
- diuretics and masking agents (8.6%).

The most controlled events concerned events related to cycling (17.9%), calcium (17.1%) and light athletics (13.6%).

Crossfit and Powerlifting, disciplines related to gyms world, had the highest positive rate, respectively 16.7% and 12.5%, although with a very low number of checks, while in cycling the rate is 5, 5%, even less than canoeing and rugby.

The surveillance on sports competitions is more stringent, but amateur doping escapes the controls more easily and it is very difficult to study the gyms.

Amateur doping is completely underestimated because it takes place in gyms, closed environments where there is connivance between those who take the substances and those who advise them. It is possible to record the cases of people who arrive at the hospital admitting the use of doping substances but it is obviously the tip of an iceberg, because many are silent and even with the toxicological examinations it is not possible to identify what assumed. Complex pathways have proposed to make the most of the clinical performance in chronic disability disease (Catalano et al., 2017). Therefore it is very difficult to do prevention in gyms. So many guys have no idea of the risks they run. One should start from the schools, from the little boys, to try to explain and understand the dangers of doping.

Conclusion

Athletes used pharmaceuticals to improve performance, commonly known as doping. By doping, athletes violate the World Anti-Doping Agency's (WADA's) regulation forbidding use of pharmaceutical products in competitive sports. Unfortunately, today, despite the technological advancement that characterizes the field of scientific research, the analytical methods are not sufficiently reliable for the search of the entire group of substances included in the anti-doping lists (Mazzeo, 2016). As new detection methods for illicit substances are developed, new doping methods appear.

Professional athletes must serve as role models and spokesmen for drug-free sport and lifestyle (Gomez, 2005). Doping is not limited to professional sports. Increasingly, public health officials are concerned that amateur and recreational athletes are also doping.

In addition, it is impossible to anticipate the moves of the opponent and this, therefore, is not easy to understand what new substances will be taken and what new methods will be adopted.

Close collaboration among the laboratories themselves would enable them to keep up to date and exchange new techniques. Closer ties with the pharmaceutical industry and those involved in basic research are also vital if they are able to anticipate new tendencies and forms of doping by means of a sort of scientific "vigil". The instrumentation and measurements industry would be also able to give them the benefit of recent progress in their domain.

Continuing, updates educational programs developed for these at-risk populations by national Olympic organizations and athletic federations are important first steps to curb and to control these dangerous behaviours. Still today, and increasingly strongly, the educational role of preventive medicine is very important (Mazzeo et al., 2018; D'elia, Mazzeo, & Raiola, 2018).

Prevention is one of the weapons more powerful than medicine; a valid preventive campaign can promote health, reducing prevalence, incidence and severity of diseases and limiting expenses at the same time.

The repression implemented by expansion and strengthening of anti-doping tests can be used as a valid deterrent; nevertheless, education compliance with the rules and, above all, information on damages health should play a priority role, as awareness and self-congratulation allow to achieve results superior to coercion and repressive methods.

All this presupposes an accurate knowledge of the subject, about the epidemiological, pharmacological and medical aspects. All professional figures involved are important; however, the role of medicine preventive appears decisive. Coaches and officials also need to be educated about their role (passive or active) in advocating drug-free sport.

Therefore, it is crucial the training of teachers of physical education should consider the problem and the use of educational tools to solve the problem adequately.

Moreover, additional research in this field will help athletes and physically active subjects to identify the medication and their side effects.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Evaluation of Knowledge and Competence of Kazakhstani Athletes about Nutrition

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Abstract

Knowledge and competences are important for every person, especially they are important for physically active people. Although the knowledge and competence of athletes about nutrition is investigated, this subject is still a relatively new area in the science of nutrition of Kazakhstan athletes. Knowledge and competence is characterized as the ability of an individual to obtain, process and understand basic information on nutrition. The purpose of the work is to determine the level of knowledge, sources and the method of their acquisition by the investigated athletes. 199 students from Al-Farabi Kazakh National University and Abay Kazakh National Pedagogical University were enrolled in 1-4 courses in physical education and sports and 60 athletes of high sportsmanship - 15 volleyball players of Burevestnik teams, 15 judo wrestlers of the Kazakhstan national team, 15 wrestlers of the club team and 15 triathletes of the Kazakhstan national team were engaged in the study of the level of knowledge, method of acquisition of information on nutrition. The questionnaire prepared by Steptoe et al., (1995) was applied during the survey of students, directly interviewing each respondent. Kazakhstani athletes get basic information on nutrition from trainers and family members, and too few are accounted for by doctors and nutritionists. Public information systems are relatively ineffective. A survey of students showed that 26.2% of women and 43.3% of men receive information on nutrition from their trainer and teacher. They do not receive enough information on nutrition from media, radio and television. However, 26.2% of women and 18.5% of men receive such information via the Internet. When regulating body weight, women are mainly guided by their opinions, while men prefer coach recommendations.

Key words: athletes, nutrition, knowledge, information methods

Introduction

Knowledge and competences are important for every person, especially they are important for physically active people (Heaney, O'Connor, Michael, Gifford, & Naughton, 2011; Carbone & Zoellner 2012). Although the knowledge and competence of athletes about nutrition is investigated, this subject is still a relatively new area in the science of nutrition. The questionnaires on determining nutritional knowledge are designed (Trakman, Forsyth, Hoyer, & Belski, 2018), however, the criteria for assessing knowledge and

competences of nutrition are still not sufficiently defined. Today there is no doubt that nutrition determines human health. Studies show that a healthy and balanced diet depends on knowledge about nutrition. Therefore, evaluating knowledge and nutritional competence, it should be noted that there is no single tool that would allow to reliably evaluate all of this (Silk et al., 2008). Knowledge and competence about nutrition is characterized as the ability of an individual to obtain, process and understand basic information on nutrition (Zoellner, Connell, Bouds, Crook, & Yadrick, 2009).



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The following works were found on this subject Kodinsky, Harvey-Berino, Berlin, Johnson, and Reynolds (2007), Kresic et al. (2009), Vitzthum et al. (2013), which presents data on the level of knowledge about nutrition of students in Croatia, Germany, Poland and the USA; Kelly, Mazzeo, and Bean (2012), Bojanic, Vasiljevic, Petkovic, and Muratovic (2015), exploring the knowledge of athletes about nutrition, believe that they can allow you to better plan the training process, reduce fatigue and allow the athlete to recover faster after exercise. According to the results of his research, Bojanic et al. (2015), the authors conclude that the knowledge of professional athletes of the Balkan countries in the field of sports nutrition is at a satisfactory level. Of the 787 athletes surveyed, only 65.5% noted a positive level of their knowledge about sports nutrition. The authors Jansen van Rensburg, Sparks, Fletcher, & Jansen van Rensburg (2018) who surveyed 2,550 amateur cyclists participating in long runs, concluded that athletes did not have enough knowledge about food additives consumed, carbohydrate consumption, as well as hydration strategies before and after prolonged physical exertion. Australian scientists Spronk, Heaney, Susan, Prvan, and O'Connor (2015), studied by survey the relationship between the general knowledge in the field of nutrition and nutrition quality of 101 athletes of high sportsmanship from four public sports institutions in Australia, among which were 37 men and 64 women, mostly the team sports representatives. The results of their research showed that women's knowledge about sports nutrition was rated higher than men. There was no significant influence of the age of the investigated, level of education and sportsmanship. However, athletes who participated in previous dietary consultations had higher knowledge about nutrition (61.6% versus 56.6%; $p=0.034$). The authors concluded that counting the importance of nutrition for health and optimal athletic performance, intervention is recommended to improve knowledge about nutrition, especially for young male athletes. Results of American scientists Holden, Forester, Smith, Keshock, and Williford (2018), just as clearly indicate that athletes - students need additional support, training and education related to the knowledge of sports nutrition, had made an attempt to compare knowledge about nutrition of athletes of various sports. The result of this study indicates that athletes with increased stamina have a higher level of knowledge about nutrition in comparison with the representatives of other sports (Blennerhassett, Mc Naughton, Cronin, & Sparks 2019).

Andrews, Wojcik, Boyd, and Bowers (2016), set the task to study the knowledge of sports nutrition of 123 athlete students, among whom were 47 women and 76 men, representatives of team sports, athletics, depending on gender, sports skills. The initial level of their knowledge about sports nutrition was 56.9%, which was deemed not to be a sufficient level. There were no differences in sex, skill. After some consultations with a nutritionist, their level of knowledge in the field of sports nutrition increased to 75%. Torres-McGehee et al. (2012), who studied the knowledge about nutrition of athletes, developing speed-strength qualities, found that the main source of knowledge about nutrition is trainers and information resources Ubeda et al. (2010), believes that the assessment of diet and eating habits, is of great importance for the maintenance of body weight of elite combat athletes. According to the authors, the consumption of some food

groups by Spanish combat athletes does not always correspond to the recommendations, since their body weight is much higher than their competitive weight. Some authors (Lamarche et al., 2014), evaluating the knowledge about nutrition of trainers who train young athletes, found that the Internet was the most popular source of information on nutrition. Less than 30% of the interviewed trainers were able to correctly answer some general nutrition questions about carbohydrates and lipids. There is still relatively little research on knowledge and competence about nutrition of Kazakhstan athletes (Yerzhanova, Sabyrbek, Dilmakhanbetov, Madiyeva, & Milasius, 2018).

Knowledge and competence about nutrition of physically active individuals and athletes of Kazakhstan, their knowledge about nutrition is a relevant, not yet sufficiently studied problem. The purpose of the work is to determine the level of knowledge and the way of its acquisition by investigated sportsmen about habits and diet.

Methods

One hundred ninety-nine (199) students from Al-Farabi Kazakh National University and Abay Kazakh National Pedagogical University were enrolled in 1-4 courses in physical education and sports were engaged in the study of the level of knowledge, method of acquisition of information on nutrition. Among them were 42 women (W), whose average age was 19.1 ± 1.3 years, their average height was 166.1 ± 7.5 cm, body weight 57.5 ± 8.8 kg. Their body mass index (BMI) averaged 20.8 ± 2.3 . Also, 157 men (M) participated in the questionnaire, whose average age was 20.2 ± 2.3 years, their average height was 177.3 ± 8.6 cm, and their body weight was 68.8 ± 10.6 kg. Their BMI averaged 21.8 ± 2.4 .

The questionnaire prepared by Steptoe, Pollard, and Wardle (1995) was applied during the survey of students, directly interviewing each respondent. The questionnaire consisted of questions about socio-demographic data, (gender, age), physical development indicators (height, body weight, BMI), the level of physical activity studied during the week (the number of workouts and their duration), questions about the mode and eating habits, methods of obtaining knowledge about nutrition.

Sixty (60) athletes of high sportsmanship, among which were 15 volleyball players of Burevestnik teams, 15 judo wrestlers of the Kazakhstan national team, 15 wrestlers of the club team and 15 triathletes of the Kazakhstan national team were engaged in the study of the knowledge of information on nutrition in 2019. The age of volleyball players was 19-22 years old, their growth averaged 188.0 ± 8.38 cm, body weight - on average 78.11 ± 7.68 kg, BMI averaged 22.1. The age of judoists was 20-28 years old, their average height was 174.3 ± 8.3 cm, body weight - on average 78.0 ± 18.9 kg, BMI averaged 25.74. The age of the club team judo wrestlers was from 17 to 21, their average height was 171.9 ± 6.0 cm, body weight - 71.0 ± 16.1 kg, BMI - an average of 24.07. The triathletes studied were 21-30 years old, their average height was 180.0 ± 7.2 cm, their body weight averaged 65.5 ± 7.1 kg, and the body mass index (BMI) averaged 20.2. The duration of filling up the questionnaire was not limited and averaged at about 30-45 minutes. The survey was carried out during the training camps at the venue.

Statistical analysis of the research data was carried out using the "Statistical Package for Social Sciences" program

(SPSS, version 16). To analyze the results of the study, traditional methods of mathematical statistics were used - the arithmetic mean data (X) and their standard deviations (S) were calculated. To analyze the reliability of categorical data, the χ^2 (chi-square) criterion was applied. The difference when $p < 0.05$ was considered reliable.

Results

The conducted questionnaire showed that, first of all, the information on nutrition the investigated students enrolled

in the specialty of physical culture and sports receive from a coach, teacher. Thus, 26.2% of women ($\chi^2=21.000$, $df=6$, $p=0.002$) and 43.3% of men ($\chi^2=193.930$, $df=7$, $p=0.000$) indicated that knowledge about nutrition was obtained from their trainer. 23.8% of women and 24.8% of men receive such information from their parents. Relatively few investigated students used information from the media and friends about their nutrition (Table 1). The second most important source of information for women is the Internet that 26.2% of women use.

Table 1. Percentage distribution of respondents in response to the question "I get information on nutrition"

Nº	Criteria	Women (n=42)	Men (n=157)
1	Radio	2.4 %	5.1 %
2	TV shows	11.9 %	1.3 %
3	Parents	23.8 %	24.8 %
4	Teacher, trainer	26.2 %	43.3 %
5	Magazines, newspapers	2.4 %	1.9 %
6	Friends	7.1 %	5.1 %
7	Internet	26.2 %	18.5 %

For the students in the field of physical culture the main criteria for regulating body composition and food rationing is the help of the trainer in drawing up a nutrition program. This answer was chosen by 40.8% of the investigated men

($\chi^2=28.350$; $df=3$; $p=0.000$), while 38.1% of women preferred self-training of the diet for weight control ($\chi^2=8.476$; $df=3$; $p=0.37$). However, this sample was not statistically significant (Figure 1).

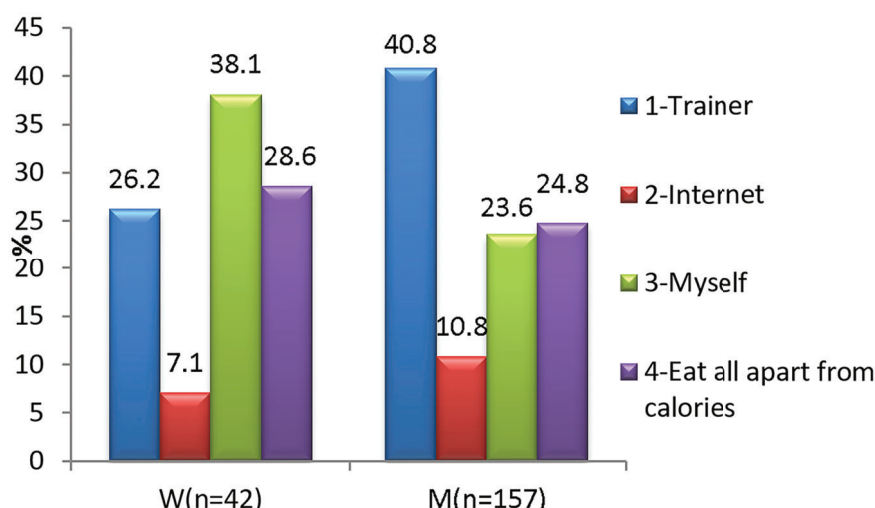


Figure 1. Percentage distribution of respondents in response to the question "I am guided in regulating body composition and compiling diet"

Upon assessing the answers of athletes of high sportsmanship to the question "Where do you get knowledge about nutrition?" the source of information on nutrition was determined. According to our survey, 36.6% of respondents

receive information on nutrition from their trainer, 20.0% from family members, 16.7% from other sources, less often from their nutritionist (10.0%) and doctors (8.3%) (Table 2).

Table 2. Percentage distribution of athletes by source of information on nutrition

Nº	Information sources	Volleyball players n=15	Judokas of the national team n=15	Judokas of the club team n=15	Triathletes n=15	\bar{X}
1	Radio and TV	13.3	0	9	6.7	5.0
2	Doctors	13.3	13.3	0	6.7	8.3
3	Reading popular literature	6.7	20.0	0	13.3	1.7
4	Nutritionist	6.7	20.0	0	13.3	10.0
5	Trainer	40.0	20.0	53.4	33.3	36.6
6	Friends	6.7	0	0	0	1.7
7	Family members	13.3	26.7	33.3	6.7	20.0
8	Other sources	0	20.0	13.3	33.3	16.7

It should be noted that the level of knowledge essentially determines a healthier, appropriate nutrition.

Discussion

Knowledge about nutrition is an intermediary factor in choosing food that is able to enhance sportsmanship. Although athletes gain knowledge about nutrition from many information sources, however, according to many authors, the most important sources of knowledge about nutrition are trainers, relatives, friends, and radio and TV shows.

One of the factors that do not contribute to compliance with the rules of balanced nutrition of athletes is insufficient awareness of nutrition (M. Jessri, M. Jessri, RashidKhani, & Zinn, 2010). Lack of awareness of nutrition may determine improper eating habits thereby retarding adaptation changes to physical exertion and hindering the achievement of high athletic performance. On the other hand, as some researchers note, the data presented does not always correspond to truth, which means that athletes do not always receive the correct information on nutrition (Mitchell, 2004; Gacek, 2007). Consequently, although the flow of scientific information on nutrition is quite large, athletes do not have enough information on it, they are not aware of the basic concepts of nutrition, so while training it is necessary to prepare and implement special educational programs containing basic knowledge about nutrition (Zawila, Steib, & Hoogenboom, 2003; Froiland, Koszewski, Hingst, & Kopecky, 2004; Nowacka, Leszczyńska, Kopeć, & Hojka, 2016).

According to our research, the main source of information about nutrition is the trainer, from which the knowledge about nutrition is obtained by average 36.7% of the Kazakhstan athletes of high sportsmanship investigated by us. 26.2% of female students and 43.3% of male students enrolled in the program of physical culture and sports receive the most information from the trainer and teacher. On the other hand, knowledge about nutrition can determine sociodemographic factors: gender, age, specificity of the sport (Dunn, Turner, & Denny, 2007; Rash, Malinauskas, Duffrin, Barber-Heidal, & Overton, 2008; Nazni & Vimala, 2010), who studied the level of knowledge, determined that it depends from the education of the athlete. However, there is evidence that many athletes are not enough aware of good nutrition and proper diet. Rosenbloom, Jonnalagadda, and Skinner (2002), Zawila et al. (2003), Dunn et al. (2007), Rash et al. (2008) note that the main problem facing the youth of colleges and universities in America today is the easy availability of fast food or easily cooked food. Current research shows that as athletes become more knowledgeable, the quality of food consumption improves (Kunkel, Bell, & Luccia, 2001). The scientific literature notes that qualified knowledge about nutrition can improve nutritional status. Zawila et al. (2003) points out that athletes obtain information on nutrition from public audiovisual media, the Internet, popular literature, friends, and family members. Birch and Fisher (1998) pays special attention to the role of parents in the nutrition of athletes, especially young ones, determining what, when and how much they should eat excluding their self-control. Our studies have shown that nutrition programs prepared by the trainer play the main role for men (43.8%), while women (38.1%) prefer to compile these programs by themselves. Juzwiak and Ancona-Lopez (2004) note that specific dietary tips on nutrition for Brazilian athletes were recommended

by 93 and 46% of the investigated trainers before and after the competition respectively. In this regard, the trainer must have not only a training methodology, but also a sufficient amount of physiological knowledge. On the other hand, as the results of some researchers show, the level of knowledge of trainers about nutrition is not sufficient (Jazayeri & Amani, 2004; Torres-Mc Gehee et al., 2012), and information sources (TV, radio programs, popular literature, friends, family members) do not always provide athletes with the qualified information on nutrition (Jessri et al., 2010; Nazni & Vimala, 2010).

Kazakhstani athletes get basic information about nutrition from trainers and family members, and too few are accounted for by doctors and nutritionists. Public information systems are relatively ineffective. A survey of students showed that 26.2% of women and 43.3% of men receive information on nutrition from a trainer and teacher. As well as sportsmen of high sportsmanship, students indicate that they receive the most information from their trainer or teacher - 26.2% and 43.3% of respondents, respectively. They do not receive enough information about nutrition from media, radio and television. However, 26.2% of women and 18.5% of men receive such information via the Internet.

Data of our research allow to assume that Kazakhstani athletes lack motivation to comply with the requirements of good nutrition, therefore, regardless of the available knowledge about nutrition, their eating habits do not always meet the requirements of healthy nutrition.

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Conflict of Interest

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ORIGINAL SCIENTIFIC PAPER

The Influence of the System of Physical Education of Higher Educational School on the Level of Psychophysiological Qualities of Young People

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Abstract

In terms of functioning of physical education system in higher educational establishments, a four-year educational pedagogical experiment with the application of the directional technology of acquiring professional-applied motor skills was implemented. According to the results of approbation of experimental technology, a reliable improvement in the state of psychophysiological qualities was recorded in the study group: evaluation of the process of main nervous processes excitation - by 125.32 Ms ($p < 0.001$), the forces of the excitation process, internal inhibition and mobility of the main nervous processes - by 145.99 Ms ($p < 0.001$), "an adequate indicator of the relative change in the strength of the excitation process, internal inhibition and mobility of the main nervous processes" - by 20.66 Ms ($p < 0.001$).

Key words: young, latent period, psychophysiological state

Introduction

Physical education has always been one of the essential components of the process of preparing young people for promising employment and adapting them to the social environment. The current system of physical education of a higher educational school now creates certain preconditions for ensuring the success of further professional activities and indirectly manifests itself therein, mainly through factors such as: will, state of health, physical and other personal qualities of the individual. However, a functioning system does not effectively provide the initial psychophysiological readiness of student youth for professional activity. This is confirmed by the following results of the research.

In the course of studying in higher educational institutions in the body of students young people psychophysiological processes take place. This has been accompanied by psychological and physical activity and are determined by a number of

elements and factors of the educational process, each of which has a tendency to achieve the useful final studying result. That is why the question of the dynamics of assessing the psychophysiological qualities of the youth organism is in the plane of our interests (Ivanova, 1992; Lyzogub, 1999; Ostapenko, 2014).

The focused professional-applied discipline of the discipline "Physical education and sports" promotes the adaptation of the functional capabilities of the youth organism to further professional activity (Klymovych, Olkhovyi, & Romanchuk, 2016; Klymovych & Olkhovyi, 2016). However, due to the influence of a number of factors of the external and internal environments, professional-oriented direction contributes to the positive dynamics of the process of adaptation to further work, and on the other hand – requires additional efforts from the future specialists and a sufficient level of physical fitness for exercise (Korolchuk, 2002; Korchagin, Kurbakova, & Olkhovyi, 2017; Ostapenko, 2014).



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The analysis of recent researches and publications has revealed that the greatest activation (in percentage of) psychophysiological processes of young organism to the new conditions of the educational environment and directly student life begins with the first courses of study, due to the influence on the organism of long and short-term various situations (Klymovych et al., 2016). The consequences of the influence of certain stages of the educational process in higher educational institutions on the body of young people in term of functioning of the current system of present physical education have been studied in detail (Ostapenko, 2014). However, the dynamics of indicators that characterizes the level of psycho-physiological processes occurring in the body of those studying in higher education institutions before the transfer of the educational system and the conditions of promising professional activity by means of physical training during the entire study period is not fully characterized.

The purpose is to experimentally examine the influence of the system of physical education of a higher educational school on the level of psychophysiological qualities of youth.

Methods

To determine how the impact of the directed technology on the acquisition of professional-applied motor skills by graduates of higher educational institutions of on the state of psychophysiological qualities of boys has influenced, we conducted a pedagogical experiment carried out under the conditions of the normal functioning of the educational process of higher educational institutions and had the character of the formative experimental work. The research was conducted throughout the period of training and fully coincided with the hours of the curriculum of youth training, which did not cause the need for organizational restructuring of the educational process. However, in the pilot sample, these classes were conducted in accordance with the content of the experimental curriculum developed with the use of experimental methodological influence in the form of directed technology for the acquisition of professional-applied motor skills.

To obtain a rational advantage over the continuous diagnosis of the general population for a large number of parameters and more accurate information about the investigated contingent in a broader program, we applied a sample survey of individuals of the general population based on its staffing. The volume of the research sample (n) was limited to 20% of the total population. So, from the general population of those who entered higher education, two similar educational groups ($n=47$) were selected, one of which was the control ($n=24$), and the other - an experimental ($n=23$) sample population.

Taking into account that the conditions of the educational environment in which higher education is acquired influences the future specialist as a set of synergistic and antagonistic actions, and the organism responds to these actions as a whole, determining the level of professional ability of the cadets in the studied groups was carried out in a complex manner, with the obligatory inclusion evaluation of brain functions and servicing systems and organs (Korchagin et al., 2017; Lyzogub, 1999).

The professional activity of modern youth is accompanied by such an element as the adoption of managerial decisions on one or another situational manifestation or circumstances during the performance of functions for professional appointment (Makarenko, 1984). This professional component, as a

form of higher nervous activity manifestations, is realized as a result of interaction in the cerebral cortex of two nervous processes - excitation and inhibition. The dynamics of these specific properties of the main nervous processes determined by force, motion and balance (psychophysiological qualities of student youth) was investigated using the applied methods of assessing the state of the nervous system - by the amount of time of the latent period of a simple sensorimotor reaction (LPSSMR), a complex sensorimotor reaction with a choice LPCSMRWc) and the time of decision-making (the difference between a complex and simple sensory-motor reaction) (Korolchuk, 2002; Olkhovyi, 2015).

The evaluation of the qualities of the main nervous processes using sensorimotor reactions was carried out as follows. The strength of the excitation process was estimated by the amount of time LPSSMR: its reduction indicates an increase in the strength of the excitation process. The estimation of internal inhibition was carried out taking into account the relative frequency of mistakes on the braking signal, the increase of this index indicates the weakening of the internal inhibition force. In order to evaluate the motility of the nervous processes, the indicators of LPCSMR were compared.

A simple sensorimotor reaction is one of the informative methods for characterizing the strength of the nervous processes. To record the speed of a simple sensorimotor reaction, a computer program "Latent Reaction" (Klymovych & Olkhovyi, 2016) was used. The explorer is given a light signal, which he must respond to by pressing the left mouse button with the maximum speed. The signal was activated automatically, at intervals of up to 3-4 seconds. LPSSMR recorded the program automatically, the result of each subject was recorded as a separate file, fixed the number of errors. After 2 training attempts, the results of a series of 10 signals are recorded and the average arithmetic index of LPSSMR is calculated.

The complex sensor-motor reaction with the choice of light stimuli allowed to investigate the strength of the processes of excitation and internal inhibition, as well as the motor of the main nervous processes. The research program uses the same program as for LPSSMR research, but different light signals (flashes of red and green light bulbs) are fed in a certain sequence. The switching off of red and green signals is carried out by the right and left mouse buttons. The next flash occurs after 2-3 seconds after the corresponding reaction. When determined by LPCSMRWc, the red light bulb being surveyed reacts by pressing the left button, and on the flash of green - the right one.

If the the researched object does the opposite, the bulb will not go out, and this will indicate an error. The computer automatically registers the response time to an accuracy of 0.001 s and the number of errors. In the process of research LPCSMRWc surveyed is provided 25 light signals, of which 15 red and 10 green. Increasing LPCSMRWc or increasing the relative error rate after processing the signal value of the stimulus indicates a decrease in the mobility of nervous processes.

By establishing the difference between LPSSMR and LPCSMRWc an adequate indicator of the relative change in strength and excitement and internal inhibition of the nerve process was determined (Korolchuk, 2002; Olkhovyi, 2015). This by-side indicator has become an integral part of the research of the ability and promptness of graduates' decision-making, which will facilitate their professional activity in the future in relation to one or another situational manifestation or circum-

stances during the performance of functions for professional appointment.

Results

The homogeneity of the studied samples was confirmed by the absence of significant differences in the average indices of the assessment of psycho-physiological qualities based on the results of the comparative analysis of the results of the entrance control in the representatives of the control and experimental

population groups that were involved in the implementation of the formative pedagogical experiment (Table 1), namely:

Level of excitability of the central nervous system (LPSSMR) - at 2.98 Ms at $p>0.05$;

The strength of the process of excitation, internal inhibition and mobility of the main non-core processes (LPCSMRwC) - at 0.14 Ms at $p>0.05$;

The difference between LPSSMR and LPCSMRwC (Time of decision-making) - at 3.12 Ms at $p>0.05$.

Table 1. Dynamics of assessment of psychophysiological qualities of young people CG (n=24) and EG (n=23) during the experiment

Indexes (unit measurement)	Group	Period researches	\bar{X}	m	S	Changes %	BE - AE t	CG - EG	
								BE t	AE t
LPSSMR (Ms)	CG	BE *	440.95	16.01	78.44				
		AE *	419.8	21.37	104.7	4.8	1.49		
	EG	BE	443.93	21.83	104.7			0.11	4.4
		AE	318.61	8.47	40.64	28.23	4.99		
LPCSMRwC (Ms)	CG	BE	491.11	16.9	82.8				
		AE	459.27	22.54	110.4	6.49	2.19		
	EG	BE	490.97	20.17	96.71			0.01	4.67
		AE	344.98	9.47	45.42	29.74	6.4		
Time for decision (Ms)	CG	BE	50.15	2.45	12.0				
		AE	39.47	1.87	9.16	21.3	1.49		
	EG	BE	47.03	2.45	11.78			0.9	5.62
		AE	26.37	1.38	6.65	43.03	7.35		

Legend: BE - before the experiment, AE - after the experiment

Discussion

Based on the results of our research, we recorded an improvement (Table 1.) of the level of qualities of the main nervous processes in the boys of the control group (n=24) who were trained in generally acceptable physical education programs, namely:

Level of excitability of the central nervous system (LPSSMR) - at 20.39 Ms, at $p>0.05$;

The strength of the process of excitation, internal inhibition and mobility of the main non-core processes (LPCSMRwC) -

at 31.84 Ms, with $p<0.05$;

The difference between LPSSMR and LPCSMRwC (Time of decision-making) - at 3.12 Ms at $p>0.05$.

A comparative analysis of the initial level of evaluation of the process of excitation of the main nervous processes in the representatives of the studied samples recorded its significant advantage (Table 1.) for those who studied under the experimental technology:

Level of excitability of the central nervous system (LPSSMR) - at 101.19 Ms, at $p>0.001$ (Figure 1.)

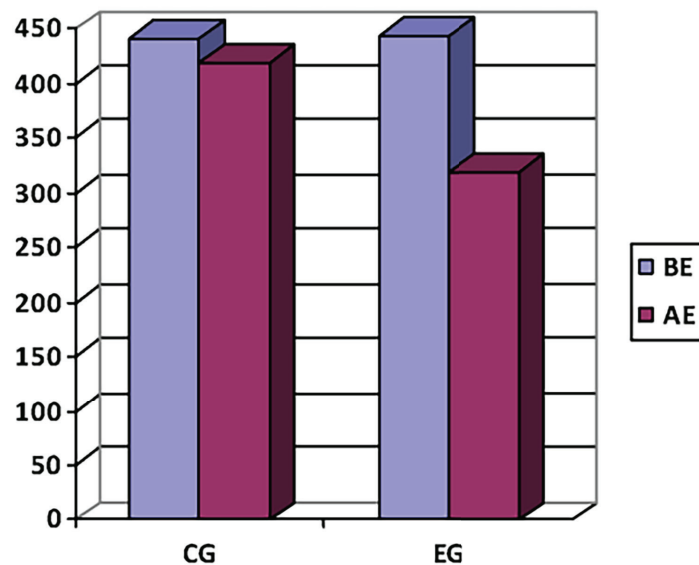


Figure 1. Level of excitability of the central nervous system (LPSSMR)

The strength of the process of excitation, internal inhibition and mobility of the main non-core processes (LPCSMRwC)

– at 114.29 Ms, with $p < 0.001$ (Figure 2.).

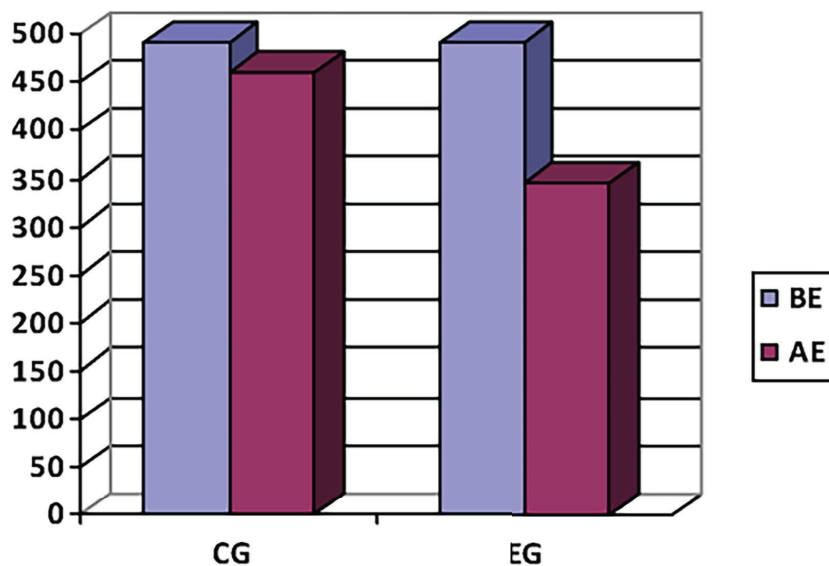


Figure 2. LPCSMRwC (Ms)

The difference between LPSSMR and LPCSMRwC (Time

of decision-making) - at 13.1 Ms at $p > 0.05$. (Figure 3.).

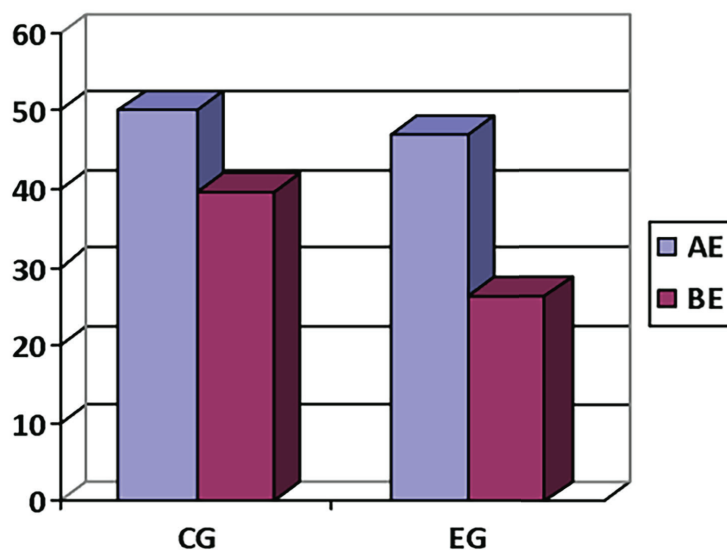


Figure 3. Time for decision (Ms)

The main result of the research carried out was the fact that we have established the presence of indirect reliable positive effect of the experimental technology of acquiring professional-applied motor skills on the stability of psychophysiological qualities (Table 1.) of the surveyed. Thus, at the end of the experiment, the estimation level of the process of excitation of the main nervous processes with the help of LPSSMR at the representatives of the EG (n-23) indicates an improvement of this indicator by 125.32 Ms, at $p < 0.001$. The strength of the excitation, internal inhibition and mobility of the main nervous processes in the EG (Table 1.) also experienced significant positive changes at 145.99 Ms, with $p < 0.001$. In this case, "an adequate indicator of the relative change in the strength of the process of excitation, internal inhibition and mobility of the main nervous processes (Klymovych, 2016). Time of decision-making (Table 1.) - significantly different from the input

data for boys EG at 20.66 Ms, at $p < 0.001$.

Above statistical analysis revealed a reliable advantage of indicators level of the stability of the psycho-physiological qualities of the representatives of the experimental sample to the influence of factors of the educational process. What formed a more favorable reaction of their organism to the professional factors of further professional activity and the acquisition of professional-applied motor skills.

The obtained statistics confirmed our assumption that the experimental application of the technology of graduates' acquiring of professional-applied motor skills indirectly has a positive effect on the reliable dynamics of psychophysiological qualities of boys (17-22 years) based on the results of studies at a higher educational school.

In the long run, we continue to investigate the effectiveness of the functioning of the system of physical education in the

higher education school based on the results of the application of the directed technology for the acquisition of vocational and applied motor skills by boys.

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Conflict of Interest

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ORIGINAL SCIENTIFIC PAPER

Effects of the Basic Period in Swimming Training with the Age Group

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Abstract

Development of aerobic capacity and endurance is important part of basic period in swimming training for age groups. The focus of this study was monitoring the progress of a group of 17 male swimmers, aged between 12 to 14 from HAPK Mladost, Zagreb. They were tested throughout basic period over 3 consecutive years (2016-2018). For this purpose, the training effects were measured by three tests: speed (25 m freestyle), speed endurance (6x50 m freestyle) and endurance (1500 m freestyle). Initial testing was performed after 2 weeks of adaptation while final testing was completed in the 12th week of each of basic period through all three years. Descriptive statistics were used to analyze the effects of the basic period. T-test showed statistically significant positive outcomes in all test results during 3 years of basic training (12 weeks per year). As a conclusion progress of the speed test was found increased with each year while progress of the remaining two tests decreased with each additional year. Swimmers that were measured in this research have won first place at National championship. As a result, the existing training plan for the age group was concluded to be used further. This research provided guidelines for further planning of swimming training.

Key words: swimming, endurance, speed, age group

Introduction

According to Theory of block periodization (Issurin, 2008) the goal of basic period in swimming training is development of basic endurance. The purpose of this study was to monitor the progress of a group of male swimmers in the basic period during 3 years (2016-2018). Basic period lasted 12 weeks. Total load and zones of intensity were defined in annual plans. The training effects were measured by speed, speed endurance and endurance tests. Initial testing was done after 2nd week, while final testing was completed in week 12. Zones of intensity for particular age (12-14) were supposed to stimulate development of endurance in basic period. This approach is compatible with World Health Organization (2010) recommendations that emphasize the importance of developing the aerobic endurance in age group. According to Olbrecht (2000), Armstrong and Barker (2011), possible progress in the increasing in $\dot{V}O_{2\max}$ in one swimming se-

ason is 15-20%. The other authors (Behringer, Heede, Matthews, & Mester, 2011; Bompa & Buzzichelli, 2015) find greater impact in the development strength in that age. Speed and speed endurance had to be maintained at initial level in the same period. During specific and competition period, endurance had to be maintained while speed and speed endurance had to be developed (Leko, Karaula, & Šiljeg, 2017).

Methods

Participants

The sample consisted of 17 male swimmers, aged between 12 and 14 during 3 years. All of them are participating of training programs at "HAPK Mladost" swimming club. All participants were in good health, and they conducted swimming program during basic period of 3 years. Swimming program was carried out six times per week, where length of training session was 2 hours. The testing was undertaken at 25 m swimming



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pool in Zagreb. Measurements were done in accordance with ethical principles and all of the tests were conducted by the same person. The testing procedure was standardized for all swimmers.

Materials and Procedure

Swimmers were tested in specific motor skills. Three tests were used: speed (25 m freestyle), speed endurance (6x50 m freestyle, with start on every 60 s) and endurance (1500 m freestyle). The 25 m, 6x50 m and 1500 m tests were used in the assessment of swimming speed applying the freestyle technique. Swimmers swam in period of 3 days starting with 25 m freestyle, second day 6x50 m freestyle and third day 1500 m freestyle. During research over period of 12 weeks, mentioned parameters were followed during the basic cycle. At the beginning of the winter season and before measurement commenced, two weeks of adaptation were carried out. After these two weeks, initial testing was done at the beginning of the basic cycle. The final test was conducted during the last days of week 12. The task was performed in the water and at the starter's signal by pushing

from the wall. The result was measured by Omega electronic with one hundredth of a second accuracy.

Statistical analysis

The basic descriptive indicators for certain tests were calculated (means, minimum, maximum and standard deviations). In the t-test, statistically significant differences were determined between the initial and final results ($p < 0.05$), in all three tests. For all the analyses, Statistic for Windows 13.4, statistical software package was used to compute and report the data. Descriptive statistics were used to analyze the effects of the basic period. The normality of distribution for each variable was tested. T-test was used for each of the tests within 3 years.

Results

Based on the results of the descriptive statistics it can be concluded that in all three observed years, the training program caused changes in the swim speed test, speed endurance test and endurance test during 12 week of basic period. Positive effects grew in each of the three observed years (Table 1).

Table 1. Descriptive statistic for variable 25 m freestyle, 6x50 m freestyle i 1500 m freestyle in initial (INI) and final (FIN) tests in 2016, 2017 and 2018 years (N=17)

Variable	Descriptive Statistics		
	Minimum	Maximum	M±SD
2016 25 m INI	15.58	19.14	16.78±1.01
2017 25 m INI	14.43	17.43	15.68±0.90
2018 25 m INI	14.14	17.05	15.39±0.90
2016 25 m FIN	14.84	18.81	16.46±1.07
2017 25 m FIN	14.02	17.14	15.31±0.85
2018 25 m FIN	13.80	16.30	14.85±0.75
2016 6x50 m INI	34.22	44.12	38.86±2.80
2017 6x50 m INI	33.09	39.45	35.71±2.30
2018 6x50 m INI	31.65	37.89	34.54±2.16
2016 6x50 m FIN	32.87	40.41	36.34±2.40
2017 6x50 m FIN	31.09	37.40	33.77±1.98
2018 6x50 m FIN	30.36	36.77	33.21±1.86
2016 1500 m INI	1236.30	1527.62	1400.47±94.09
2017 1500 m INI	1167.18	1466.43	1280.58±90.48
2018 1500 m INI	1128.55	1396.11	1254.08±82.48
2016 1500 m FIN	1185.81	1479.11	1310.79±90.54
2017 1500 m FIN	1115.11	1330.71	1213.76±76.14
2018 1500 m FIN	1100.18	1359.02	1210.7370.61

Reference to Table 1 it is apparent that dispersion measures for the tests are decreasing. However, it can be noted that

dispersion of results increases at the beginning of the season while dispersion decreases in the final measurement.

Table 2. T-test for Variables 25 m freestyle, $p < 0.05$

Variable	M±SD	N	Diff.	Std.Dv. Diff.	t	df	p	Conf. -95.00%	Conf. +95.00%
2016 25 m INI	16.75±1.00	24	0.35	0.49	3.43	23	0.00	0.13	0.55
2016 25 m FIN	16.40±1.09								
2017 25 m INI	15.68±0.90	17	0.38	0.34	4.45	16	0.00	0.19	0.55
2017 25 m FIN	15.30±0.85								
2018 25 m INI	15.38±0.90	17	0.53	0.33	6.66	16	0.00	0.36	0.70
2018 25 m FIN	14.85±0.75								

Based on the results of the t-test it can be concluded that in all three observed years, the training program caused sta-

tistically significant changes in all swim speed test through 12 weeks (Table 2, 3 and 4).

Table 3. T-test for Variables 6x50 m freestyle, $p < 0.05$

Variable	M \pm SD	N	Diff.	Std.Dv. Diff.	t	df	p	Conf. -95.00%	Conf. +95.00%
2016 6x50 m INI	39.22 \pm 2.88	24	2.44	1.18	10.06	23	0.00	1.93	2.94
2016 6x50 m FIN	36.78 \pm 2.54								
2017 6x50 m INI	35.70 \pm 2.30	17	1.93	0.69	11.48	16	0.00	1.57	2.29
2017 6x50 m FIN	33.77 \pm 1.98								
2018 6x50 m INI	34.54 \pm 2.16	17	1.324	0.77	7.06	16	0.00	0.93	1.72
2018 6x50 m FIN	33.21 \pm 1.86								

Better results are obvious in final tests in all three years. Unlike the speed test (25 m freestyle) and speed endurance te-

sts (6x50 m freestyle), progress of endurance test in the results (1500 m freestyle) is decreasing over the three observed years.

Table 4. T-test for Variables 1500 m freestyle, $p < 0.05$

Variable	Mean	SD	N	Diff.	Std.Dv. Diff.	t	df	p	Conf. -95.00%	Conf. +95.00%
2016 1500 m INI	1408.18	96.37	24	78.82	41.91	9.21	23	0.00	61.12	96.52
2016 1500 m FIN	1329.35	96.62								
2017 1500 m INI	1280.58	90.47	17	66.82	38.79	7.10	16	0.00	46.87	86.76
2017 1500 m FIN	1213.75	76.13								
2018 1500 m INI	1254.07	82.48	17	43.35	40.44	4.41	16	0.00	22.55	64.14
2018 1500 m FIN	1210.72	70.61								

Discussion

Based on recent researches, some authors have argued that simultaneous training of different motor or functional abilities can cause limitation of development or even decline in some abilities (Issurin, 2008; Maglischo, 2003). For this reason, the training program applied in this research primarily wanted to develop the aerobic endurance and swim strength (WHO, 2010). Speed and speed endurance were represented with a very small percentage during basic training program in overall. Such approach relied on the findings of Maglischo (2003), which warned the mutually negative effects of endurance and speed. The author explained that if you train endurance the results in speed will be worse and vice versa. Analyzing the results of initial and final tests and all observed variables over a three-year period, it can be concluded that swimmers had better swimming time in the initial results of 2017 compared to the final state of the previous 2016. However, in 2018 initial swimmers' status observed through all three observed variables were worse compared to the final results of 2017. This particularly refers to the level of aerobic ability where the swimmers in the 1500-meter freestyle test had an initial result in 2018 worse by 40.32 seconds compared to the final result in 2017. At the same time, the result of a speed endurance was worse for 0.77 seconds. As an age group category of 12-14 years old, where aerobic capacity development is a priority, it is apparent that in the period from January 2018 to August 2018 work on aerobic capacity development was insufficient and did not produce stabilization or development of aerobic abilities. Endurance test (1500 m) showed statistically significant progress in basic period 2016-2018 (1,29.6-1,06.8-43.3 respectively). Statistically significant progress was also recorded in speed test (25 m) (0.32-0.37-0.53 respectively) and speed endurance test (6x50 m) (2.52-1.9-1.3 respectively) in 3 observed years in basic period of training cycle. This data differs from some of the previous claims (Maglischo, 2003), which noted the conflict between endurance development and speed in the same period. During the observed period all tests showed

progress, but the progress of the speed test increased with each year while progress of the remaining two tests decreased with each additional year. In a future it may be possible to increase the volume of training in aerobic zones. That will cause greater impact on endurance and limiting progress in speed and speed endurance. Swimmers that were measured in this research have won first place on National championship. So, the existing training plan for the age group should be used further. This research has provided guidelines for further planning of swimming training. In the last year of research, swimmers are at an age when they enter a puberty (14 years). So the increase in swimming speed can be attributed to rapid growth and strength (Behringer et al., 2011; Bomba & Buzzichelli, 2015). In the first two years of research, when swimmers had 12 and 13 years, this cannot be an argument. The advantage of this research, considering training of group of swimmers 12-14 age, is that excluding anaerobic zones in training process is unnecessary. In future studies, the authors suggest to follow up on group of swimmers age 12-14 regarding their anthropometrical characteristics and further on to analyze strength test results. Practical implication of this research is to redefine intensity zones in training of swimmers age 12-14 in basic period by including more of anaerobic intensity zones, especially the sprint zone. The results showed improvement in all tests (speed, speed endurance and endurance) throughout 12-week period of basic preparation in age group. Same tests were performed every year at the same periods. Results measured progressively improved. The highest improvement was in speed test although training program was set for improving of basic endurance. One of conclusions of the research showing no conflict between development of basic endurance and speed for group of swimmers 12-14 age.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Patterns of Physical Activity of Libyan Undergraduate Students at the University of Tripoli Using International Physical Activity Questionnaire (IPAQ)

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Abstract

This study aims to evaluate Physical Activity (PA) among undergraduate students. Physical activity is associated with many physical and psychological health benefits, both in the prevention of ill, health and the management of existing health conditions and a strong relationship between being physically active and good health. The researchers used the descriptive approach to study 515 undergraduate students from the University of Tripoli in Libya. The International Physical Activity Questionnaire (IPAQ) short version was used to identify the physical activity levels among the participants. Higher prevalence of physical activity was found in moderate intensity which reached 18.49 minutes per day during the average of 3.69 days, while the High intensity PA category was only 9.38 minutes per day during the average of 1.54 days per week, participants were reached 28.02 minutes as an average time of walking with the average of 4.05 days of the week. The results of the study, indicated that all the students of the sample achieved moderate PA rates (18.49 minutes per day), which was higher than the rate of high intensity physical activity that was only (9.38minutes per day). Thus these results indicate that the sample did not reach the WHO recommendations toward physical activity and health even when combining the high moderate and high physical activity levels that achieved during the week.

Key words: *physically active, IPAQ, walking, moderate, high*

Introduction

Physical activity is defined as any physical movement performed by the skeletal muscles that requires the expenditure a quantity of energy that exceeds the energy spent in rest (Caspersen, Powell, & Christenson, 1985). Defined this definition and was subsequently widely adopted by research and at an international level as a Definition of physical activity (World Health Organization, 2004). Suggests that all activities of daily life such as walking and climbing, as well as domestic chores, gardening, or sports activities, are summarized as “physical activity”. The individual for the purpose of employment, recreation, treatment or prevention, “Physical activity is associated with many health benefits, both physical and psychological, in the prevention of ill health or in dealing with an unhealthy situation (Johnson, Tilgren, & Hagstromer, 2009).

This relationship between physical activity and health appears to be somewhat correlated with the amount of physical activity that a person is doing. The high intensity of physical activity is more important to reduce the risk of cardiovascular disease (Geffken, Cushman, Sakkinen, & Tracy, 2001). As well as to treat various other diseases, Such as osteoporosis (Warburton et al., 2006). Physical activity is therefore an essential element for the 18-65 age group (Haskell et al., 2013).

WHO reports that high levels of physical inactivity are observed worldwide, both in high-income countries, middle-income and low-income countries, and the increasing obesity rates in the Middle East Including Arab countries, are at high risk, and this is reflected in the incidence of related diseases, with the degree of overweight and obesity from 25% to 82% in the Middle East (Musaiger, 2004).



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To reduce the risk of non-communicable diseases and increase the physical activity level the World Health Organization recommended that adults aged between 18-64 should performing at least 150 minutes moderate physical activity per week or 75 minutes high intensity physical activity weekly (World Health Organization, 2013; Strong et al., 2005) conducted an evidence based study on effect of physical activities for school-age youth.

Students' behavior during work indicates an increase in physical inactivity. The students come to the university to ride a car and then moves from one study room to another, in the same building, or sitting in one of the halls. In addition, every college in the university has a car park that deprives the student one of the steps to walk they were going to do in the absence of this garage, therefore we have seen that it is important to stand on rates of physical activity at the university students because of these rates of importance to the public health of the students (Tremblay, Colley, Saunders, Healy, & Owen, 2010).

This study contributes to the identification of types of physical activity practiced by the undergraduate students in the university.

Methods

The researcher used the descriptive approach to achieve the study objectives. Five hundred and fifteen (515) undergraduate male students were selected from six faculties of University of Tripoli for measuring their physical activity patterns aged between 18 to 25 years. The sample selected was only male students due to several social and cultural factors, as well as there was a lack of female staff members to assist the researcher to collect female physical activity data. The participants were distributed on Faculty of Economics and Political Science, Faculty of Languages,

Faculty of Literature, Faculty of Science, Faculty of Engineering, faculty of Pharmacy. Thirty-five respondents did not return their questionnaires and their data were not included in the analysis.

The International Physical Activity Questionnaire (IPAQ, 2000) short version was used to identify the physical activity levels among the participants. The IPAQ was distributed during (2016-2017) semester. The IPAQ publically available at www.ipaq.ki.se and it does not need a permission to use it. This questionnaire focusing on the time spent doing High Intensity physical activity and the time spent performing Moderate Intensity physical activity during the day, and also IPAQ collecting the data about the spent for Walking more than 10 minutes during the day, and also the number of days for doing each category of previous physical activity patterns.

The researchers verified the validity and reliability of the questionnaire by applying it two times with thirty students from the research society where the lowest score was 0.703 and the highest score was 0.885. In general, there is statistical significance in all parts of the questionnaire.

The IPAQ measurement tool is based on 4 general items including 7 questions to identify the time spent in a high-intensity, moderate-intensity effort, the time spent walking during the past seven days, the time spent sitting during the past seven days.

Moderate activity in IPAQ is defined as those that result in a moderate increase in respiratory rate, heart rate and sweating for at least 10 minutes, and severe physical activity

According to IPAQ, the activity accompanied by a strong increase in heart rate and a significant increase in sweating during the exercise of this intensity of activity for ten minutes.

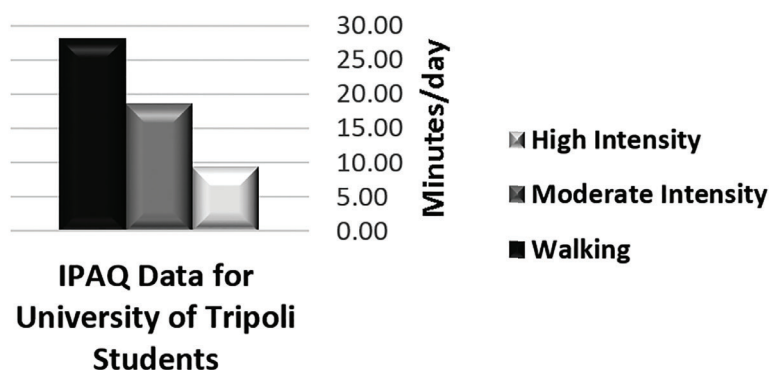


Figure 1. Physical Activity per Minute

Results

Higher prevalence of actives was found in moderate intensity PA which is reached 18.49 minutes per day (Figure 1) which is equivalent to 66.33% of physical activity (with the exception of walking) during the average of 3.69 days per week

(Figure 2), while the high intensity pa category was only 9.38 minutes per day which equivalent to 33.67% of physical activity during the average of 1.54 days per week, participants were reached 28.02 minutes as an average time of walking with the average of 4.05 days of the week.

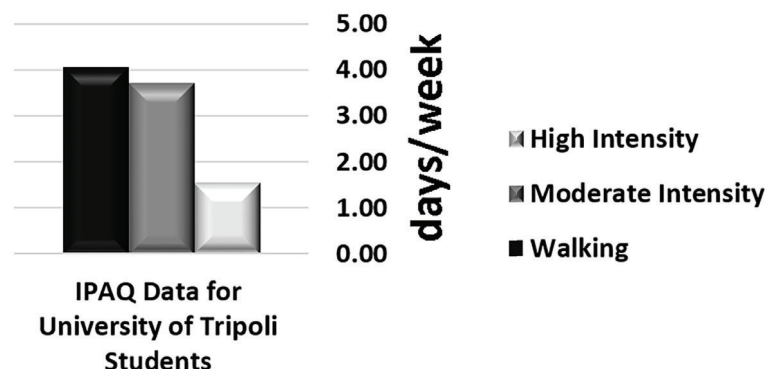


Figure 2. Physical Activity per Day

Discussion

This study aims to identify the patterns of physical activity with the students at University of Tripoli, through the use of the international survey of physical activity, as well as to identify the walking rate achieved during the week.

In Arabic world, the IPAQ instrument has been tested several researchers (Al-Hazzaa, 2006). The IPAQ subjected to a validity and reliability study conceded in 14 centers in 12 countries in the year 2000 (Craig et al., 2003).

The International Physical Activity Questionnaire (IPAQ) was built in 1998, many tests were conducted to achieve a high level of honesty and consistency. After conducting several studies, on this scale, the results showed that it has an acceptable degree of validity to be used in many places and in different languages. The results of these tests and studies also showed the possibility of using this tool in national projects and surveys that seek to identify the rates of physical activity in the population (IPAQ, 2014).

IPAQ Short version is a tool primarily designed to observe physical activity among adults in the age group (15-69 years) and provides detailed information for the purposes of evaluation. The short Arabic version of this questionnaire was used in a group of Arab countries (Awadalla et al., 2014). The researchers were informed of studies using the Arabic version in (Saudi Arabia, Egypt, and Sudan).

In May 2004, the World Health Assembly (WHA) issued Resolution 7517 on the Global Strategy on Dietary System, Physical Activity and Health. The Assembly recommended that Member States develop a national plan of action and policies to promote physical activity rates (World Health organization, 2010). In 2008, the European Union's Physical Activity Guidelines, which proposed a wide range of measures and measures for Member States to promote higher levels of physical activity, were published. These guidelines recommended that the EU and its member states achieve at least 60 minutes of moderate daily physical activity for children and young people, As well as a minimum of 30 minutes of physical activity.

Most early studies as well as current work focus on physical activity and its role in health and fitness (Kim et al., 2013) showed the benefits of regular physical activity for a healthy life.

The results of the study, as shown in Figure 1 and Figure 2, indicated that all the students of the sample of the selected faculties achieved moderate PA rates (18.49 minutes per day), which was higher than the rate of high intensity physical activity that was only (9.38minutes per day). These findings are compatible with the findings of (El-Gilany, Badawi, El-Khawaga, & Awadalla, 2011; Awadalla et al., 2014).As these studies found that moderate rates of physical activity was higher than the high intensity level, thus these results indicate that the sample did not reach the (WHO) recommendations toward physical activity and health even when combining the high moderate and high physical activity levels that achieved during the week. It was not clear the contributing factor for such below WHO guidelines but it could be attributed to increasing in sedentary life style, impact of urban design for land use and transport reduced physical activity. In addition, the subject's could not meet the WHO standard due to school stress and schedule that may have prevented them from physical activities.

Interestingly the results indicated that the sample spent 28.02 minutes for walking which was not compatible with their physical activity rates. The walking could be affected by readily available transport system in most study area. The result also

could serve as pro-active steps to reverse the decline in physical activity levels in recent decades brought about by numerous factors such as easily access to daily necessities of movement. Similarly, study conducted to determine rate of physical activity amongst university students in one of the European report is mention that participation in leisure sport and physical activity has remained relatively low in Romania, but still levels of obesity among Romanians aged 18 and older are among the lowest of all their EU counterparts (Eurostat, 2011). Despite increase awareness of the benefits of physical activities and its association with lower health risks and relationship between sedentary behaviors and higher health risks have been consistently identified but many students attributed lack of physical activities due to time constrain as revealed by study conducted among university student in the UK, this also agreed with this study which identified below WHO guideline on physical activity. Also revealed that cost is also institutional barriers for physical activity. Hence, suggested that universities must implement strategies to reduce cost, increase accessibility and improve students' time management capacity to include physical activity in their schedules. In another study among university student in Portugal, the level of student's physical activity was accessed if meets the public health recommendations for physical activity and went further to accessed effect of gender on daily physical activity (Clemente, Nikolaidis, Martins, & Mendes, 2016). Conversely, to this study, the results reveal that the amount of physical activity that Portuguese university students perform complies with the recommendation of moderate-to-vigorous PA for most of the week (5 days) (Clemente et al., 2016).Furthermore, Reported the gender based data of physical inactivity and the values revealed inactivity patterns in 41% of the men and 65% of the women students. In this study the general student's physical activity was focused but previous compared between genders, like the case of (Bauman et al., 2009; Baptista et al., 2012). In both studies, it is revealed that male students walked statistically more steps (23.92%) and spent more time in light (7.74%), moderate (26.61%) and vigorous (243.64%) activities than female students.

The study found that the sample could not reach the World Health Organization recommendation levels of physical activity.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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SHORT REPORT

Pre-Season Bilateral Strength Asymmetries of Professional Soccer Players and Relationship with Non-Contact Injury of Lower Limb in the Season

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Abstract

The aim of this study was to determine the relationship between bilateral pre-season strength asymmetries and the injury of the lower limb in the season. Examined group consisted of 227 soccer players playing in the highest league competition in the Czech Republic (age 25.44 ± 8.7 , body height $= 182.1 \pm 6.6$ cm, body weight $= 77.5 \pm 6.9$ kg). We measured the isokinetic strength of the flexors and extensors of the knee by using the Cybex dynamometer Humac Norm at 60 m.s⁻¹ angular speed and then we compared the bilateral asymmetries between the dominant and non-dominant lower limb in knee flexors and extensors. We retrospectively compare the injury to pre-seasonal bilateral strength imbalances between flexors and extensors of the knee. The results show that 65.9% of players who suffered non-contact leg injuries in the season had imbalances in knee extensors between preferred and non-preferred lower limb $\geq 10\%$ difference before the season and the percentage of injured players with bilateral asymmetry of knee flexors was 67.9%. These results predict that abnormal muscle asymmetry between the lower extremities may be one of the causes of injury in the area of lower extremities.

Key words: imbalance, muscle strength, non-contact injury, professional athletes, soccer

Introduction

The most soccer injuries are connected to the lower extremities, which is not unexpected, because soccer is described by high intensity and intermittent switches of direction at high loads (Wong & Hong, 2005). Most reports signified that soccer players are commonly within the extreme rates of strength asymmetry (Tourny-Chollet, Leroy, & Beuret-Blanquart, 2000; Weber, Silva, Radaelli, Paiva, & Pinto, 2010). According to Iga, George, Lees, and Reilly (2009), soccer players practically at no time use the both lower limbs by the identical prominence, this inclination is associated to the hemispheric authority of the brain on the reverse area, which may be the reason of an anomalous deficit in professional soccer players. Soccer players may suffer imbalanced

changes between the right and left leg as a effect of specific technical movements achieved in the game, and such asymmetrical pattern may cause functional or even structural disproportionateness (Schiltz et al., 2009). The authority of one segment of the body over the other constructs a better capability of the leading feature and can build the imbalance of strength of the several muscles that hang on the performances essential for sport.

Some soccer players have presented diversities in strength and flexibility between dominant and non-dominant legs (Rahnama, Lees, & Bambaecichi, 2005) and even biomechanical asymmetry between them (Dörge, Andersen, Sørensen, & Simonsen, 2002). Ekstrand, Hagglund, and Walden (2011) and Dick, Putukian, Agel, Evans, and Marshall (2007)



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found that nearly a third of all injuries in soccer are muscular injuries of hamstrings, adductors, quadriceps and calf muscles. Several reports have revealed a correlation between the strength of quadriceps and hamstrings and the increased risk of lower limb injuries (Croisier, Ganteaume, Binet, Genty, & Ferret, 2008; Cameron, Adams & Maher, 2003; Myer et al., 2009; Soderman, Alfredson, Pietila, & Werner, 2001). However, other studies present a minor association of weak thigh muscles and the risk of injury (Zvijac, Toriscelli, Merrick, & Kiebzak, 2013; A.H. Engebretsen, Myklebust, Holme, L. Engebretsen, & Bahr, 2010). Freckleton and Pizzari (2013) conducted several meta-analysis prospective studies in which they analyzed the knee muscle's isokinetic knee strength as a risk factor for hamstring injuries, indicating that the high quadriceps strength compared to hamstring was a significant risk factor for injuries to the back of the thigh muscles. One of the primary functions of ACL is to oblige the front translation of the tibia with respect to the femur. Activating hamstring muscles supports ACL in this function. ACL stretching is substantially reduced when hamstring and quadriceps are activated, compared with activation of only the muscular group quadriceps (Hewett, Ford, Hoogenboom, & Myer, 2010; Georgoulis et al., 2010). These and other conclusions (Boden, Sheehan, Torg, & Hewett, 2010; Withrow, Huston, Wojtys, & Ashton-Miller, 2008) suggest that imbalances in the strength of hamstrings may increase the risk of ACL injury.

The aim of this study was to determine the relationship

between bilateral pre-season strength asymmetries and the injury of the lower limb in the season.

Methods

The strength characteristics were observed in 227 healthy soccer players playing in the highest league competition in the Czech Republic. Tests of strength (knee flexors and extensors) were performed before the 2017/2018 season. Isokinetic strength parameters were monitored by using isokinetic dynamometer (Cybex Humac Norm®, USA), where we determined the maximum strength (PT) of extensors and flexors of the knee of the dominant and non-dominant limb at concentric contraction at an angular velocity of 60.s⁻¹. We retrospectively compare the non-contact injury in season to pre-seasonal bilateral strength differences between flexors and extensors of the knee.

Results

The bilateral asymmetries ($\geq 10\%$) of the knee extensors (Q:Q ratio) has 29.05% of examined athletes. The percentage of players who suffered non-contact injuries in the lower limbs is 33.61%, of which 31.43% of injured players are in pre-seasonal imbalances above critical level, and 34.50% of injured players has 10% difference between preferred and non-preferred lower limb, indicating that up 65.50% of injured soccer players has pre-seasonal asymmetries ($\geq 10\%$) (Figure 1).

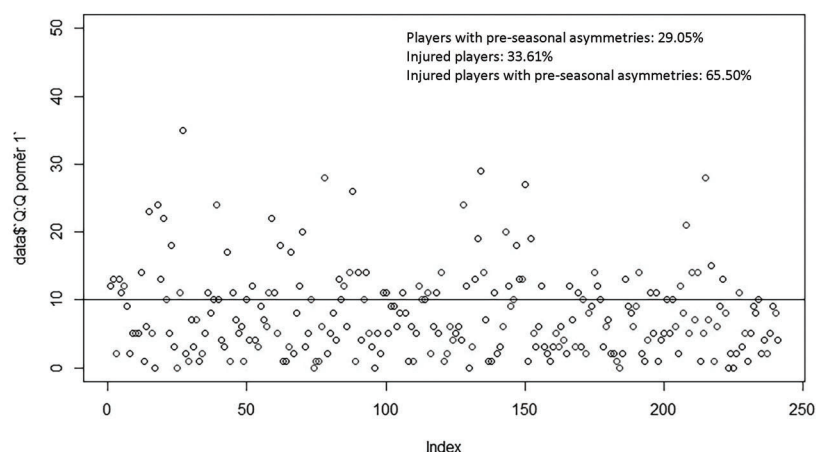


Figure1. Relationship between Q:Q ratio and injury

The ratio of players who were asymmetry in the knee flexors (H:H ratio) before season is 36.51%. The percentage

of injured soccer athletes with pre-seasonal bilateral asymmetries is 67.91% (Figure 2).

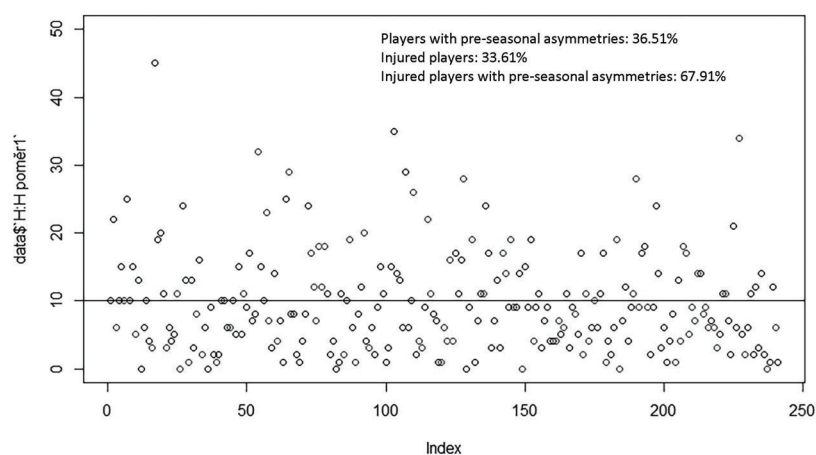


Figure2. Relationship between H:H ratio and injury

Discussion

The most injuries was occurred in the knee area. During the season, 21 non-contact knee injuries and 15 ACL ruptures were reported, with an average match deficit of 223 days. We monitored 20 non-contact knee flexor injuries, mainly due to stretching of the rear femoral muscles, and recovery was significantly shorter, on average for 14 days. The ankle bore occurred 17 times, and the other injuries accounted for only 8 injuries of different types. The Q:Q ratio represents the proportion of knee extensors between the dominant and non-dominant lower limb. In the our examined soccer players, with an angular velocity of 60°s⁻¹, the average bilateral relationship is 7.84±6.31%, large individual excursions being observed. The percentage of players with bilateral asymmetries (≥10%) of the knee extensors (Q:Q ratio) was 29.05%. The percentage of players who suffered non-contact injuries in the lower limbs is 33.61%, of which 31.43% of injured players are in pre-seasonal imbalances above critical level, and 34.50% of injured players are at 10%, indicating that 65.50% of injured athletes has pre-seasonal asymmetries (≥10%).

The ratio between the knee flexors between the preferred and the non-preferred lower limb represents the H:H ratio. Average values of H:H ratio (9.52±9.55%) are higher than Q:Q ratio in examined group. The ratio of players who were asymmetry in the knee flexors (H:H ratio) before season is 36.51%. The percentage of injured soccer athletes with pre-seasonal bilateral asymmetries is 67.91%. Tourny-Chollet et al. (2000) in their study concluded that the knee flexors on the dominant leg tend to be stronger than on the non-dominant flexor. The results of recent research show that most players show abnormal strength deficits (more than 10%) at all angular speeds (Rahnama et al., 2005; Daneshjoo, Rahnama, Mokhtar, & Yusof, 2013). Brito et al. (2010) examined the isokinetic knee ratio in sub-elite soccer players, and their results showed that ratios on the non-dominant leg showed higher levels than dominant leg ratios, especially in flexors of knee. Other studies agree on similar conclusions. In the analysis of the young soccer players, no meaningful correlations in the asymmetry of the knee extensors have been proved (Lehnert, Urban, Procházka, & Psotta, 2011; Silva, Nassis, & Rebelo, 2015; Forbes et al., 2009). These results are confirmed by further research by professional players (Teixeira, Carvalho, Moreira, Carneiro, & Santos, 2015; Zabka, Valente, & Pacheco, 2011; Zakas, 2006; Daneshjoo et al., 2013; Rahnama, Lees, & Bambaecichi 2005; Eniseler, Şahan, Vurgun, & Mavi, 2012). On the other hand, significant differences in imbalance were found in knee flexors (Bonetti, 2017). Fousekis, Tsepis, and Vagenas (2011) measured the actual risk factors of pre-season injuries to 100 professional football players, finding that players with muscular asymmetries of hamstrings are at greater risk of knee injury or hamstrings. ACL and hamstring are more susceptible to injury than the knee extensions due to hamstrings being used to protect against the anterior tibia transition to the femur, which occurs during violent impacts and sudden changes in the direction. The lower strength ratio between the flexors and extensors of knee extends the ACL pressure during these activities. Several studies have revealed a correlation between the strength of quadriceps and hamstrings and the increased risk of lower limb injuries (Croisier et al., 2008; Myer et al., 2009; Soderman, Alfredson, Pietila & Werner, 2001). However, other

studies present a minor association of weak thigh muscles and the risk of injury (Zvijac, Toriscelli, Merrick & Kiebzak, 2013; Engebretsen, Myklebust, Holme, Engebretsen & Bahr, 2010). These inconsistent findings can be caused by variety of research protocols (different angular speed, concentric or eccentric contraction), scores (maximum torque, HQ ratio, asymmetry measurement), research population (women, various sports) limbs, special injuries, (hamstrings, ACL rupture).

For players with a higher level of bilateral asymmetry (≥10%) in pre-seasonal testing, we presented that more than 60% of the injured players have right-left imbalances of 10% in flexors and extensors of knee. We observe a high percentage of players with imbalances between the dominant and non-dominant lower limbs, with more players displaying imbalances in flexors of knee, which may cause the lower limb injuries to predominantly the rupture of the ACL and other parts of the knee. The orientation of further research on this topic would be recommended by the widening of possible modifiable injury predictors such as shortened muscle length optimum, muscle flexibility of athletes, hip imbalances or non-modifiable factor such as muscle fiber types. Furthermore, it is possible to orient research only for certain types of injury (ACL or hamstring injuries) and its relation to imbalance, either in the area of the spine or in the lumbo-sacral region.

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There are no acknowledgements.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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SHORT REPORT

The Effects of Roller Massage, Massage, and Ice Bath on Lactate Removal and Delayed Onset Muscle Soreness

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Abstract

The purpose of the study was to investigate the effects of rolling massage, massage, and ice bath on lactate removal and delayed onset muscle soreness. Thirty students of Faculty of Sport Sciences of third semester were randomly selected and assigned to three groups, roller massage, massage, and ice bath group. All groups were doing Running-based Anaerobic Sprint Test (RAST) after 10 minute warm up. Eight minutes after RAST, all students were examined their blood lactate using blood lactate analyzer. The roller massage group was treated using foam roller for 5 minutes, the massage group was massaged for 5 minutes, the ice bath group were put in 10 degree cold water for 5 minutes, then their blood lactate were reexamined. The normality test of roller massage is .022, and homogeneity test $p=.133$, so the data was analyzed using nonparametric Kruskal Wallis. Contrary to results of other studies, lactate removal tends to be the most effective in ice bath treatment (17.40) compared with massage treatment (16.65), and roller massage (12.45), and reduction in Delayed Onset Muscle Soreness (DOMS) tends to be most effective in ice bath treatment (12.25) compared with massage treatment (13.95), and roller massage (20.30) even though non significant ($p=.399$). Vasoconstriction effect of ice bath made a faster lactate removal, physique trait also might have an effect. Cooling effect of ice bath has an effective analgetic effect.

Key words: *massage, roller massage, ice bath, blood lactate, Delayed Onset Muscle Soreness (DOMS)*

Introduction

High intensity exercise could cause muscle injury and connective tissue damage. Injury and inflammation causes pain that manifests one to three days post anaerobic activity, known as delayed onset muscle soreness (DOMS) (Harlinda, 2014). Anaerobic work produces lactate, and accelerated lactate clearance as well as fast reduction of DOMS is needed to support sport performance in a series of anaerobic activities

Popular methods being used to get fast recovery are active recovery, massage, contrast hot and cold water treatment, ice bath, and recently roller massage. Ice bath is more effective within 10-15°C and 5-15 minute duration (Versey, Halson, & Dawson, 2013). Dupuy, Douzi, Theurot, Bosquet and Dugué (2018) analyzed systematically through meta-analysis

about recovery technique to treat athletes after high intensive exercise and concluded that massage is the most effective method to decrease inflammation, DOMS, and fatigue. Ingram, Dawson, Goodman, Wallman and Beilby (2009) proved that cold water immersion is better than contrast water treatment in reducing DOMS and coming back to baseline during repeated sprint. There is not much proof that cold water immersion facilitates lactate metabolism, but cold water immersion decreases muscle damage and increases parasympathetic nerve function (Ihsan, Watson, & Abbiss, 2016).

The purpose of this study was to find out the effectiveness of massage versus cold water immersion in reducing lactate and DOMS after doing RAST in tropical region, and whether physique trait influences result.



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Methods

The design of this study was randomized pretest posttest group design. Thirty of second year students of Faculty of Sport Science, Surabaya State University were randomly selected and randomly assigned to three groups consisted of 10 students, the roller massage group, the massage group, and the Ice Bath group. After 10 minute warming up, all three groups were doing Running-based Anaerobic Sprint Test (RAST). After RAST, all participants took 8 minute rest before blood sample was taken to determine their lactate level using lactate analyzer Accutrend, then the roller massage group was doing massage using foam roller for 5 minutes, the massage group was massaged for 5 minutes, and the Ice Bath group entered a container of 10°C cold water for 5 minutes. After that, all three groups were taken their blood samples for the

second time to determine their lactate level after roller massage, massage, and Ice Bath treatments. Twenty four hours later, all participants reported the Delayed Onset Muscle Soreness (DOMS) according to their perception using 1 to 6 Scale.

This study was approved in advance by Ethical Board of the Surabaya State University with certificate number: 462 IO/18. Each participant voluntarily provided written informed consent before participating.

Results

Table 1 shows that In normality test, ice bath has $p=.200$, massage $p=.200$ and roller $p=.022$. It means that sample is not normally distributed, so that non-parametric statistics should be used to analyze the data

Table 1. Tests of Normality

method		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Δ (pretest-posttest) lactate	Ice Bath	.170	10	.200 *	.958	10	.763
	Roller	.284	10	.022 *	.830	10	.034
	Massage	.211	10	.200 *	.889	10	.167
Posttest only DOMS	Ice Bath	.329	10	.003	.655	10	.000
	Roller	.329	10	.003	.655	10	.000
	Massage	.302	10	.010	.781	10	.008

Legend: df - number of degree of freedom, sig. - significance of two-tailed testing of arithmetic mean difference, Δ - pretest-posttest, DOMS - delayed onset muscle soreness

Table 2 based on mean, homogeneity test shows $p=.009$, meaning that sample is not homogenous, and again non-pa-

rametric statistics should be used to analyze the data.

Table 2. Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Δ (pretest-posttest) lactate	Based on Mean	5.665	2	27	.009
	Based on Median	1.881	2	27	.172
	Based on Median and with adjusted df	1.881	2	21.828	.176
	Based on trimmed mean	5.237	2	27	.012
Posttest only DOMS	Based on Mean	1.969	2	27	.159
	Based on Median	1.703	2	27	.201
	Based on Median and with adjusted df	1.703	2	17.677	.211
	Based on trimmed mean	1.961	2	27	.160

Legend: df1 - number of degree of freedom 1, df2 - number of degree of freedom 2, sig. - significance of two-tailed testing of arithmetic mean difference, Δ - pretest-posttest, DOMS - delayed onset muscle soreness

Table 3 Kruskal-Wallis test shows that the highest lactate removal is given by Ice Bath (17.40) followed by Massage (16.65) and Roller massage (12.45). It means the most effective way to reduce lactate is Ice Bath, even though it is not signifi-

cant (asymptotic $p=.399$). The lowest perception of muscle soreness happens after sample treated by Ice Bath (12.25), followed by massage (13.95) and roller massage (20.30) even though statistically non significant

Table 3. Kruskal-Wallis

Method	Method	N	Mean Rank
Δ (petest-posttest) Lactate	Ice Bath	10	17.40
	Roller	10	12.45
	Massage	10	16.65
	Total	30	
Posttest only DOMS	Ice Bath	10	12.25
	Roller	10	20.30
	Massage	10	13.95
	Total	30	

Legend: N - number of cases, Δ - pretest-posttest, DOMS - delayed onset muscle soreness

Table 4 shows that 2 tailed statistics are non-significant (p lactate=.734, p DOMS=.675), so the results of this study

can not be inferred to population.

Table 4. Test Statistics

	Δ lactate	DOMS
Mann-Whitney U	45.500	45.000
Wilcoxon W	100.500	100.000
Z	-.340	-.419
Asymp. Sig. (2-tailed)	.734	.675
Exact Sig. [2*(1-tailed Sig.)]	.739 ^b	.739 ^b

Legend: Δ – pretest-posttest, DOMS – delayed onset muscle soreness, asymp. Sig - significance of two-tailed testing of arithmetic mean difference

Discussion

High intensity exercise causes muscle damage, oedema, hyperthermia, dehydration and used up glycogen reserve (Ihsan et al., 2016). The benefit of massage locally is to decrease pain, peripheral vasodilation, increase vein and lymphatic drainage, and activate local metabolism. Mechanical energy could stimulate new capillary development (Shirinsky et al., 1989), mechanical signal could increase fibroblast proliferation, which is important to stimulate recovery in injury area (Curtis & Seehar, 1978). Jain, Berg and Tandon (1990) showed that mechanical stimulation on fibroblast cause cell development, protein synthesis and increased intercellular cyclic adenosine monophosphate (cAMP) 24 hours after stimulation. Mechanical stimulation will activate fibroblast and collagen synthesis and extracellular matrix in injury area. Fibroblast activation followed by collagen synthesis is an important in recover process almost in any tissue (Jain et al., 1990). In a controlled study, Butterfield, Zhao, Agarwal, Haq and Best (2008) found that 30 minute massage on rabbit anterior tibialis which was doing eccentric contraction would decrease tissue necrosis compared with those not being massaged. Butterfield et al. (2008) showed that massage was effective in decreasing cell infiltration, inflammation or oedema so as to facilitate recovery process. Waters-Banker, Dupont-Versteegden, Kitzman and Butterfield (2014) added that massage could have an immunomodulatory therapeutic modality, it makes changes through immunity response. Through transduction mechanism, massage was able to change the phenotype of macrophage M1 which has proinflammatory character to macrophage M2 which has anti-inflammatory character through differentiation of T helper cell Th1 to become Th2. Th2 cells instead can promote macrophage differentiation, creating an abundance of M2 anti-inflammatory phenotype and signifying the repair and regeneration phase. Cell or tissue damage will increase along with intensity and exercise duration since the cell will continuously send mechanical signal that become chemical response (Butterfield, 2010). Timing of the massage treatment will influence its immunomodulatory effects. Massage would be more effective if given immediately after injury (Waters-Banker et al., 2014).

Pain inhibition involves endogenous morphine, as opioid receptors like μ and κ receptors in Peri Aqueductal Grey matter are activated (Mansour, Fox, Akil, & Watson, 1995). Oxytocinergic mechanism is also activated (Uvnas-Moberg, Bruzelius, Alster, & Lundberg, 1993). Strong massage pressure will stimulate a faster recovery than light or moderate pressure (Gehlsen, Ganion & Hellfist, 1999).

There are some theories of Delayed Onset Muscle Soreness (DOMS), namely; lactic acid, muscle spasm, connective

tissue damage, muscle damage, and inflammation. Integration of these theories is likely to explain DOMS (Cheung, Hume, & Maxwell, 2003). The primary cause of DOMS is eccentric contraction that makes micro injury with the most serious condition. Several strategies to recover from DOMS or to reduce the seriousness of DOMS are massage, stretching, anti inflammatory drugs or cryo therapy. Fridén, Sfikianos and Hargens (1986) concluded that if muscle was used for unusual activities, there was disturbance on myofibril and cell structural framework followed by increased lysosome activity.

Some studies explain that cold water immersion can make faster recovery, but it is considered that the most effective one is cold water immersion with temperature 10-15°C in 5-15 minutes (Versey et al., 2013). Many studies indicate that cold water immersion facilitates recovery by decreasing hyperthermia and fatigue, there is not much proof that cold water immersion facilitates lactate metabolism, but cold water immersion decreases muscle damage and increases parasympathetic nerve function (Ihsan et al., 2016).

Physiological changes during cold water immersion that increases recovery time include intracellular-intravascular fluid shift, reduction in muscle edema and fatigue, increased blood flow with possible nutrient and waste transportation (Wilcock, Cronin, & Hing, 2006). Differences in physique traits, depth of the water, duration of the immersion and temperature, kinds of exercise, will influence the results (Stephens, Halson, Miller, Slater, & Askew, 2017). Dupuy et al. (2018) analyzed systematically through meta-analysis about recovery technique to treat athletes after high intensive exercise and concluded that massage is the most effective method to decrease inflammation, DOMS and fatigue. Ingram et al. (2009) proved that cold water immersion is better than contrast water treatment in reducing DOMS and coming back to baseline during repeated sprint.

Contrary to studies concluded by Ihsan et al. (2016) and Dupuy et al. (2018), this study conducted in School of Sport Sciences, Surabaya State University proves that cold water immersion (CWI) 10°C for 5 minutes after doing Running-based Anaerobic Sprint Test causes lactate as well as DOMS reduction better than massage treatment. Lactate reduction through CWI vs massage (10.95 vs 10.05, $p=.739$) and DOMS reduction is greater in ice bath treatment than massage (10 vs 11), even though they are not significant ($p=.739$). This is contrary to what was concluded by Ihsan et al. (2016) saying that there was not enough evidence that ice bath treatment facilitated lactate metabolism, and also conclusion made Dupuy et al. (2018) saying that massage was the best recovery technique from fatigue and DOMS. Physique trait of people living in tropical area might cause greater vasoconstriction than people living with

four seasons and removed lactate faster. Physique trait could make difference in reaction to cold, and might make cold water immersion more effective than massage in reducing lactate and DOMS. Obviously, Ice Bath is a very effective treatment of any anaerobic activity, especially if eccentric contraction is involved.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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Revised September 2018

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Original Scientific Paper

Talent Identification Criteria

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Word count: 2,946

Abstract word count: 236

Number of Tables: 3

Number of Figures: 0

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- Krstrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine and Science in Sports and Exercise*, 35(4), 697-705. doi: 10.1249/01.MSS.0000058441.94520.32

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- Williams, R. (2016). Krishna's Neglected Responsibilities: Religious devotion and social critique in eighteenth-century North India [Electronic version]. *Modern Asian Studies*, 50(5), 1403-1440. doi:10.1017/S0026749X14000444

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- Chantavanich, S. (2003, October). Recent research on human trafficking. *Kyoto Review of Southeast Asia*, 4. Retrieved November 15, 2005, from <http://kyotoreview.cseas.kyoto-u.ac.jp/issue/issue3/index.html>

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- Pasadilla, G. O., & Milo, M. (2005, June 27). *Effect of liberalization on banking competition*. Paper presented at the conference on Policies to Strengthen Productivity in the Philippines, Manila, Philippines. Retrieved August 23, 2006, from <http://siteresources.worldbank.org/INTPHILIPPINES/Resources/Pasadilla.pdf>

Encyclopedia entry (print, with author):

- Pittau, J. (1983). Meiji constitution. In *Kodansha encyclopedia of Japan* (Vol. 2, pp. 1-3). Tokyo: Kodansha.

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- Ethnology. (2005, July). In *The Columbia encyclopedia* (6th ed.). New York: Columbia University Press. Retrieved November 21, 2005, from <http://www.bartleby.com/65/et/ethnolog.html>

Thesis and dissertation:

- Pyun, D. Y. (2006). *The proposed model of attitude toward advertising through sport*. Unpublished Doctoral Dissertation. Tallahassee, FL: The Florida State University.

Book:

- Borg, G. (1998). *Borg's perceived exertion and pain scales*: Human kinetics.

Chapter of a book:

- Kellmann, M. (2012). Chapter 31-Overtraining and recovery: Chapter taken from *Routledge Handbook of Applied Sport Psychology* ISBN: 978-0-203-85104-3 *Routledge Online Studies on the Olympic and Paralympic Games* (Vol. 1, pp. 292-302).

Reference to an internet source:

- Agency. (2007). Water for Health: Hydration Best Practice Toolkit for Hospitals and Healthcare. Retrieved 10/29, 2013, from www.rcn.org.uk/newsevents/hydration

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Table heading should be written above the table, in Title Case, and without a full stop at the end of the heading. Do not use suffix letters (e.g., Table 1a, 1b, 1c); instead, combine the related tables. *See example:*

- ✓ **Table 1.** Repeated Sprint Time Following Ingestion of Carbohydrate-Electrolyte Beverage

2.5.2. Table sub-heading

All text appearing in tables should be written beginning only with first letter of the first word in all capitals, i.e., all words for variable names, column headings etc. in tables should start with the first letter in all capitals. Avoid any formatting (e.g., bold, italic, underline) in tables.

2.5.3. Table footnotes

Table footnotes should be written below the table.

General notes explain, qualify or provide information about the table as a whole. Put explanations of abbreviations, symbols, etc. here. General notes are designated by the word *Note* (italicized) followed by a period.

- ✓ *Note.* CI: confidence interval; Con: control group; CE: carbohydrate-electrolyte group.

Specific notes explain, qualify or provide information about a particular column, row, or individual entry. To indicate specific notes, use superscript lowercase letters (e.g. ^{a,b,c}), and order the superscripts from left to right, top to bottom. Each table's first footnote must be the superscript ^a.

- ✓ ^aOne participant was diagnosed with heat illness and n = 19.^bn = 20.

Probability notes provide the reader with the results of the tests for statistical significance. Probability notes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || etc.

- ✓ *P<0.05, †p<0.01.

2.5.4. Table citation

In the text, tables should be cited as full words. *See example:*

- ✓ Table 1 (first letter in all capitals and no full stop)
- ✓ ...as shown in Tables 1 and 3. (citing more tables at once)
- ✓ ...result has shown (Tables 1-3) that... (citing more tables at once)
- ✓in our results (Tables 1, 2 and 5)... (citing more tables at once)

2.6. Figures

On the last separate page of the main manuscript file, authors should place the legends of all the figures submitted separately.

All graphic materials should be of sufficient quality for print with a minimum resolution of 600 dpi. SM prefers TIFF, EPS and PNG formats.

If a figure has been published previously, acknowledge the original source and submit a written permission from the copyright holder to reproduce the material. Permission is required irrespective of authorship or publisher except for documents in the public domain. If photographs of people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph whenever possible permission for publication should be obtained.

Figures and figure legends should be completely intelligible without reference to the text.

The price of printing in color is 50 EUR per page as printed in an issue of SM.

2.6.1. Figure legends

Figures should not contain footnotes. All information, including explanations of abbreviations must be present in figure legends. Figure legends should be written below the figure, in sentence case. *See example:*

- ✓ **Figure 1.** Changes in accuracy of instep football kick measured before and after fatigued. SR – resting state, SF – state of fatigue, * $p > 0.01$, † $p > 0.05$.

2.6.2. Figure citation

All graphic materials should be referred to as Figures in the text. Figures are cited in the text as full words. *See example:*

- ✓ Figure 1
 - × figure 1
 - × Figure 1.
 - ✓ ...exhibit greater variance than the year before (Figure 2). Therefore...
 - ✓ ...as shown in Figures 1 and 3. (citing more figures at once)
 - ✓ ...result has shown (Figures 1-3) that... (citing more figures at once)
 - ✓ ...in our results (Figures 1, 2 and 5)... (citing more figures at once)

2.6.3. Sub-figures

If there is a figure divided in several sub-figures, each sub-figure should be marked with a small letter, starting with a, b, c etc. The letter should be marked for each subfigure in a logical and consistent way. *See example:*

- ✓ Figure 1a
- ✓ ...in Figures 1a and b we can...
- ✓ ...data represent (Figures 1a-d)...

2.7. Scientific Terminology

All units of measures should conform to the International System of Units (SI).

Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples.

Decimal places in English language are separated with a full stop and not with a comma. Thousands are separated with a comma.

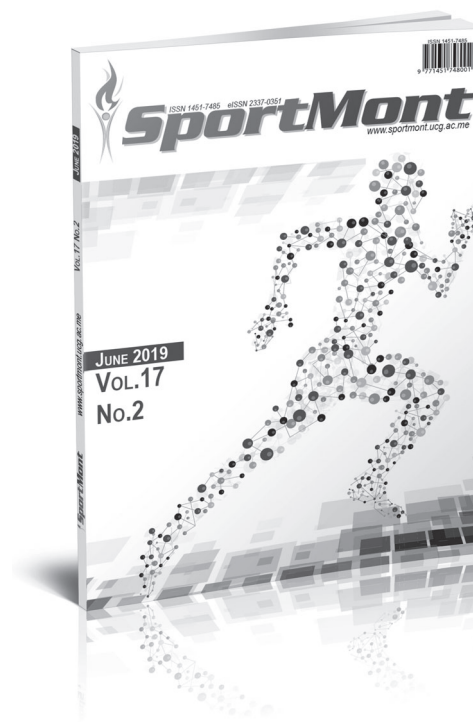
Percentage	Degrees	All other units of measure	Ratios	Decimal numbers
✓ 10%	✓ 10°	✓ 10 kg	✓ 12:2	✓ 0.056
× 10 %	× 10 °	× 10kg	× 12 : 2	× .056
Signs should be placed immediately preceding the relevant number.				
✓ 45±3.4	✓ p<0.01	✓ males >30 years of age		
× 45 ± 3.4	× p < 0.01	× males > 30 years of age		

2.8. Latin Names

Latin names of species, families etc. should be written in italics (even in titles). If you mention Latin names in your abstract they should be written in non-italic since the rest of the text in abstract is in italic. The first time the name of a species appears in the text both genus and species must be present; later on in the text it is possible to use genus abbreviations. See example:

✓ First time appearing: *musculus biceps brachii*

Abbreviated: *m. biceps brachii*



ISSN 1451-7485

Sport Mont (SM) is a print (ISSN 1451-7485) and electronic scientific journal (eISSN 2337-0351) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

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- Worldwide media coverage.

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SM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

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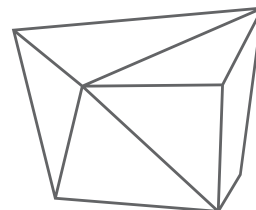
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Summer issue – June 2019
Autumn issue – October 2019



Univerzitet Crne Gore

UNIVERZITET CRNE GORE
ARHITEKTONSKI FAKULTET

UNIVERSITY OF MONTENEGRO
FACULTY OF ARCHITECTURE



The goal of establishment of our institution is the education highly qualified professional cadre based on the best knowledge of the theory and practice in the world, and its application to the development and implementation of plans and projects in the space - as a basic condition for the quality valorization, programming, management and protection of natural and inherited built environment. In this way conceptual-

ized school forms internationally experts in all areas of creativity - in the field of urban planning, architecture, construction and design - which includes the ability to create useful objects, architectural forms of all categories, urban and vacant space at different levels. Such qualified cadre are the spiritus movens of development of culture and technology in the modern world.

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The University of Montenegro is the leading higher education and research institution in Montenegro. It is a public institution, established by the state, operating as a unique legal entity represented by the Rector. It is an integrated university organized on the model of the most European universities. Organizational units are competent for provision of study programmes, scientific-research and artistic work, use of allocated funds and membership in professional associations.

Since its foundation, the University of Montenegro has continuously been conducting reforms in the area of education and research, while since 2003 in line with the trends in EHEA. After adoption of the Bologna Declaration, University of Montenegro organized systematic preparation of documents aligned with it. Already in 2003, the experimental teaching programme started and today, all studies are organised in line with the Bologna principles. During the last two years systematic reforms of the University's study programmes have been conducted in order to harmonize domestic higher education system with European standards and market needs to highest extent.

The University of Montenegro has unique academic, business and development objectives. It comprises 19 faculties and two research institutes. The seat of the UoM is in Podgorica, the capital city, while university units are located in eight Montenegrin towns. The University support services and centers (advisory services, accounting department, international cooperation, career orientation) are located in the Rectorate.

Academic community of University of Montenegro is aware of the importance of its functioning for further development of the state and wider region. It has been so far, and will be in the future, the leader in processes of social and cultural changes, along with the economic development.

In the aspect of attaining its mission, University of Montenegro is oriented towards the priority social needs of the time in which it accomplishes its mission; open for all the students and staff exclusively based on their knowledge and abilities; dedicated to preservation of multicultural and multi-ethnic society in Montenegro; entrepreneurial in stimulating social and economic application of supreme achievements within the scope of its activities.

In 2015/16 there were a total of 1.192 employees at UoM, 845 of which were engaged in teaching. In the same year there were 20.236 students registered at all three cycles of studies.

Internationalization is high on the agenda of UoM priorities, thus it has participated in a number of international projects – over 50 projects funded under the Tempus programme, over 15 Erasmus Mundus Action 2 projects for student mobility, a number of projects under FP7 funding scheme or IPA supported projects, Erasmus + capacity building and International credit mobility projects and other.

For more information about University of Montenegro, please visit our website www.ucg.ac.me or send e-mail to pr.centar@ac.me.





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**Faculty for sport
and physical education
NIKŠIĆ**



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Znanje i zdravlje!



*Montenegrin Journal
of Sports Science and Medicine*



MONTENEGRIN JOURNAL OF SPORTS SCIENCE AND MEDICINE



ISSN 1800-8755

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Montenegrin Journal of Sports Science and Medicine (MJSSM) is a print (ISSN 1800-8755) and electronic scientific journal (eISSN 1800-8763) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

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- Fast publication time;
- Peer review by expert, practicing researchers;
- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
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MJSSM is published biannually, in September and March of each year. MJSSM publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

MJSSM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the MJSSM website: <http://www.mjssm.me/?sekcija=page&p=51>. Contributors are urged to read MJSSM's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to office@mjssm.me or contact following Editors:

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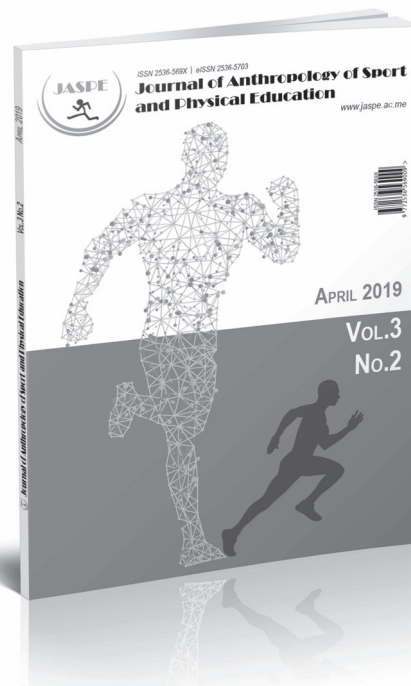
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Autumn issue – September 2019



Journal of Anthropology of Sport and Physical Education



ISSN 2536-569X

Journal of Anthropology of Sport and Physical Education (JASPE) is a print (ISSN 2536-569X) and electronic scientific journal (eISSN 2536-5703) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

- Open-access and freely accessible online;
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- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
- Worldwide media coverage.

JASPE is published four times a year, in January, April, July and October of each year. JASPE publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Anthropology of Sport and Physical Education, as well as it can function as an open discussion forum on significant issues of current interest.

JASPE covers all aspects of anthropology of sport and physical education from five major fields of anthropology: cultural, global, biological, linguistic and medical.

Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the JASPE website: <http://www.jaspe.ac.me/?sekcija=page&p=51>. Contributors are urged to read JASPE's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to jaspe@ucg.ac.me or contact JASPE's Editor:

Bojan MASANOVIC, *Editor-in Chief* – bojanma@ucg.ac.me

Publication date:
Winter issue – January 2019
Spring issue – April 2019
Summer issue – July 2019
Autumn issue – October 2019



Univerzitet Crne Gore

UNIVERZITET CRNE GORE PRAVNI FAKULTET – PODGORICA

UNIVERZITET
CRNE GORE



PRAVNI
FAKULTET
PODGORICA



Faculty of Law was founded on October 27th, 1972 in Podgorica as a scientific and artistic educational institution, in which educational and research work was organized in the area of law and similar social studies. While making into law the establishment of this institution, Assembly of Socialist Republic of Montenegro highlighted that "The establishment of this institution of high education is necessary for meeting overall demands of the society of the Republic". Faculty of Law is one of the founding fathers of the University of Montenegro.

During the forty-five years of its existence Faculty of Law grew to a modern, contemporary, scientific and artistic educational institution. Forty-five generations studied at the faculty. About 17.000 students enrolled at the faculty and 4285 students graduated from the faculty. About 15 percent of the students studied abroad. Part of the best students continued postgraduate and doctoral studies at prominent university centers. Most of the former students stayed in Montenegro due to family ties. 88 professors and associates worked at the faculty, out of whom there were 26 guest professors. Today most of the professors and cadre at the faculty are former students.

Faculty organizes graduate and postgraduate studies. There

are teaching and cadre resources for organizing specialist and doctoral studies in all the areas of law.

As a university branch Faculty of Law realizes a big number of its planned aims and tasks and finds solutions for many important questions of cadre organization, technical and material problems. With the help of the University of Montenegro, faculty largely develops the international cooperation net.

Faculty follows world trends and achievements in the area of high education with the aim to coordinate its work with European and world demands. This year faculty made the first steps in realization of Bologna declaration. There is enough cadre for all the necessary teaching at the faculty.

The faculty was founded because of expression of need to reach the necessary standard for socio-economic, political, cultural and social development of Montenegro. During its overall existence faculty shared the fate with Montenegrin society. It will continue to do so by making steps towards implementing new practises and creating new relations, with the help of implementation of modern European trends.

The faculty is a complex organization and managing institution nowadays.

Faculty of Economics *University of Montenegro*

The Faculty of Economics celebrated its 57th anniversary this year, and it is the oldest higher education institution in the country. Since its establishment, 8,630 students graduated at our Faculty.

Today, Faculty of Economics is a largely interdisciplinary institution, characterized by expressed dynamism in its work. Employees at the Faculty are dedicated to constant improvements and enhancements, all in accordance with the needs brought by the changes.

We provide our students with the best theoretical and practical knowledge, enabling them to develop critical spirit in approaching economic phenomena and solving concrete problems in daily work. From September 2017, at the Faculty, the new generation will start a 3 + 2 + 3 study, which will improve the quality of studying.



Development of Faculty of Economics in the coming period will follow the vision of development of the University of Montenegro, pursuing full achievement of its mission

Comprehensive literature, contemporary authors and works have always been imperative in creation of new academic directions at Faculty of Economics, which will form the basis of our future.

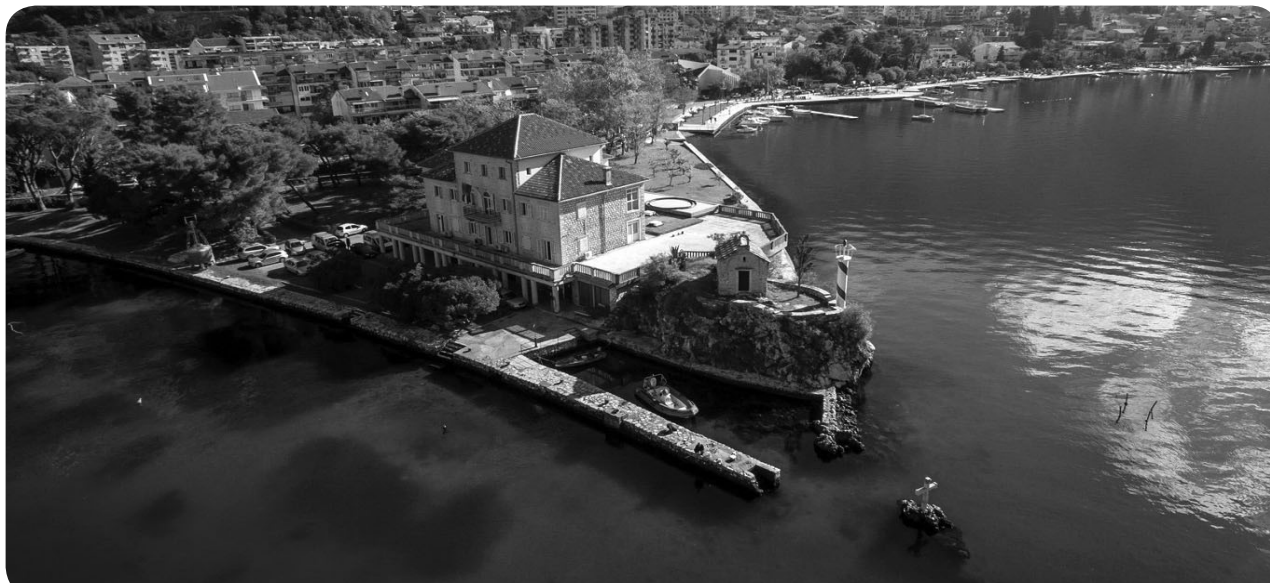
Faculty and its employees are dedicated to developing interest in strengthening the entrepreneurial initiative, creative and interdisciplinary approach among young people, using modern teaching and research methods. In this regard, the Faculty has modern textbooks and adequate IT technology, which supports the objectives set.





Univerzitet Crne Gore

UNIVERZITET CRNE GORE INSTITUT ZA BIOLOGIJU MORA



University of Montenegro – Institute for marine biology is located in Kotor, Montenegro. Since its establishment in 1961, the Institute performed comprehensive research of the marine and coastal area, which has its wide impact to the environmental protection, pollution-prevention and practical application. Core competencies of the Institute are focused on research in the fields of marine conservation, ichthyology and marine fisheries, marine chemistry, aquaculture, plankton research, neuro and eco-physiology. The main research area is investigating and protection of Adriatic sea with special interest of South Adriatic area. Institute for marine biology have a wide range of international cooperation with Marine research institutions and Universities all over Mediterranean area through a numerous EU funded scientific projects.

All over the year Institute is looking to hire a young students from the field of general biology, marine biology, marine chemistry, molecular biology or similar disciplines on voluntary basis to work with us. We need opportunity for international internship or MSc or PhD thesis that could be performed on Institute in our 5 different labs: Fisheries and ichthyology, Aquaculture, Marine chemistry, Plankton and sea water quality and Benthos and marine conservation.

Every year Institute organize several summer schools and workshop for interested students, MSc and PhD candidates. From 01-05 July 2019 we will organize Summer school "Blue Growth: emerging technologies, trends and opportunities" in frame of InnoBlueGrowth Project who is financed by Interreg Med programme. Through the specific theme courses, workshops and working labs offered – covering different areas of the blue economy – the Summer School aims at encouraging young people involvement in blue economy sectors by offering high-quality technical knowledge and fostering their entrepreneurial spirit. The Summer School will facilitate fruitful exchanges and a stronger understanding among a variety of actors coming from different Mediterranean countries with diverse profiles, including representatives from the academia, the public and private sectors, but also potential funders and investors. These activities will count on specific team building activities for participants as well to reinforce interpersonal skills and foster cohesion among blue academia and sectors.

If You are interested apply on the following link: <https://www.ucg.ac.me/objava/blog/1221/objava/45392-ljetnja-skola-plavi-rast-nove-tehnologije-trendovi-i-mogucnosti>

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UNIVERSITY OF MONTENEGRO FACULTY OF MECHANICAL ENGINEERING Podgorica



www.ucg.ac.me/mf

Mechanical engineering studies in Montenegro started during the school year 1970/71. On April 15th, within the Technical Faculty, the Department of Mechanical Engineering was formed. The Department of Mechanical Engineering of the Technical Faculty was transformed in 1978 into the Faculty of Mechanical Engineering, within the University "Veljko Vlahović". Since 1992 the Faculty of Mechanical Engineering is an autonomous University unit of the University of Montenegro. It is situated in Podgorica.

The University of Montenegro is the only state university in the country, and the Faculty of Mechanical Engineering is the only faculty in Montenegro from the field of mechanical engineering.

Activities of the Faculty of Mechanical Engineering can be divided into three fields: teaching, scientific-research work and professional work.

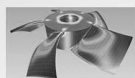
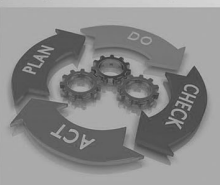
Two study programmes were accredited within the Faculty of Mechanical Engineering:

- Academic study programme MECHANICAL ENGINEERING
- Academic study programme ROAD TRAFFIC

The study programmes are realised according to the Bologna system of studies in accordance to the formula 3+2+3.

On the study program Mechanical Engineering it is possible to study next modules:

- Mechanical Engineering – Production
- Applied Mechanics and Construction
- Energetics
- Energy Efficiency
- Mechatronics
- Quality



At the Faculty of Mechanical Engineering, as organisational units, there are centres and laboratories through which scientific-re- search and professional work is done:

- Centre for Energetics
- Centre for Vehicles
- Centre for Quality
- Centre for Construction Mechanics
- Centre for Traffic and Mechanical Engineering Expertise
- Centre for transport machines and metal constructions
- 3D Centre
- Didactic Centre – Centre for Automation and Mechanomics training
- European Information and Innovation Centre
- Cooperation Training Centre
- Laboratory for Metal Testing
- Laboratory for Turbulent Flow Studies
- Laboratory for Vehicle Testing
- Laboratory for Attesting of Devices on the Technical Examination Line



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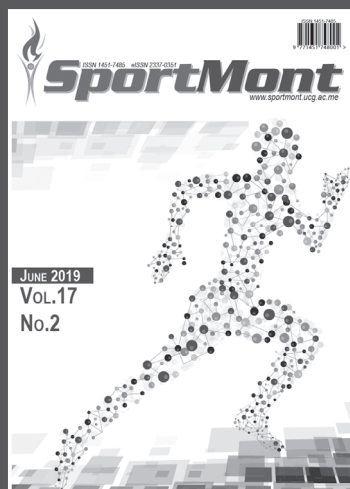
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Managing Editor: **Jovan Gardasevic**, Montenegro

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17th Annual Scientific Conference of Montenegrin Sports Academy "Sport, Physical Activity and Health: Contemporary Perspectives"

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Dubrovnik - Croatia