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TABLE OF CONTENTS

Stevo Popovic, Radenko M. Matic, Dusko Bjelica and Nebojsa Maksimovic
(Original Scientific Paper)
Estimation of Different Research Expectations of First-Year Students from the Sport Science Programmes and Their Teachers from Various Stages of Their Proficiency 3-7

Ihor Vypasniak, Sergii Popel, Bohdan Mytskan, Zınovii Ostapiak and Iryna Ivanyshyn
(Original Scientific Paper)
Reactive Changes of Buccal Epitheliocytes and Erythrocytes in Students with Different Somatic Health and Cardiorespiratory Endurance Levels 9-14

Andrey Rusanov, Irina Roy, Olga Rusanova, Nataliia Yevpak and Liudmyla Podosinova
(Original Scientific Paper)
The Effects of the Comprehensive Rehabilitation Method on Quadriceps Activation: Outcomes in Patients with an Injury to the Anterior Cruciate Ligament 15-18

Bojan Masanovic, Fitim Arifi and Jovan Gardasevic
(Original Scientific Paper)
Standing Height Estimation from Sitting Height Measurements in Adolescents in the Central Region of Kosovo 19-23

Mohammad Fayiz AbuMoh'd
(Original Scientific Paper)
Influence of an Isotonic Sports Drink during Exercise and Recovery on Subsequent Endurance Capacity and Aldosterone Response in the Heat in Well-Trained Endurance Athletes 25-31

Suncica Rogic, Nikola Misnic, Milena Radonjic and Vladimir Djurisic
(Original Scientific Paper)
Testing Sponsorship Recall and Recognition after the Games of the Small States of Europe – Montenegro 2019 33-39

Boris Banjevic
(Original Scientific Paper)
Morphological Characteristics and Functional Capabilities of Ground Forces Soldiers and Soldiers of the Navy of Montenegro 41-47

Armend Kastrati, Nazrije Gashi and Georgi Georgiev
(Original Scientific Paper)
The Influence of Social Support from Parents on the Level of Physical Activity in Adolescents 49-53

Jovan Gardasevic, Srdja Martinovic, Ivan Vasiljevic, Marija Bubanja, Pavle Malovic and Erol Vrevic
(Original Scientific Paper)
Analysis of Trends in Anthropometric Characteristics of Montenegrin Young Men from Niksic from 1957 to 1969 55-59

Ivan Derun and Hanna Mysaka
(Original Scientific Paper)
Intellectual Capital Efficiency Management in Professional Football Clubs' Performance: Problems of Assessment 61-66

Svetlana Otaraly, Aibek Alikey, Zhanna Sabyrbek, Alya Zhumanova, Irina Martynenko and Sniegina Poteliuniene
(Original Scientific Paper)
Evaluation of Kazakhstan Students' Views on Health, Lifestyle, and Physical Activity.....67-72

Serhii Romanchuk, Artur Oderov, Volodymyr Klymovych, Andrii Arabskyi, Orest Lesko, Serhii Fedak, Antonina Dunets-Lesko, Yurii Bobko, Oleh Olkhovyi and Tetiana Liudovyk
(Original Scientific Paper)
Priority Indicators of Sports Activity of Jumps in Water at the Stage of Advanced Sports Training.....73-78

Volodymyr Klymovych, Artur Oderov, Serhii Romanchuk, Mukola Korchagin, Vitalii Zolochevskyi, Serhii Fedak, Igor Gura, Oleh Nebozhuk, Viktor Lashta, Viktor Romanchuk and Orest Lesko
(Original Scientific Paper)
Correlation of Physical Fitness and Professional Military Training of Servicemen.....79-82

Mohammad Fayiz AbuMoh'd and Mohammad Abubaker
(Original Scientific Paper)
Effect of β-Alanine Supplementation on Repeated Sprint Ability and Responses of Blood Lactate and Bicarbonate in Male Soccer Players.....83-88

Samsul Arifin, Heri Retnawati and Himawan Putranta
(Original Scientific Paper)
Indonesian Air Force Physical Tester Reliability in Assessing One-Minute Push-Up, Pull-Up, and Sit-Up Tests.....89-93

Yeter Aytül Dağlı Ekmekçi, Nilsen Kundakcı and Rıdvan Ekmekçi
(Original Scientific Paper)
Performance Evaluation of Basketball Referees with an Integrated MCDM Approach.....95-102

Marta Bon and Primoz Pori
(Original Scientific Paper)
Various Aspects of the Scientific Development of Beach Handball over Three Decades - from "Keep It Simple" to the Olympic Games.....103-106

Meltem Ince Yenilmez and Onur Burak Celik
(Review Paper)
The Difference between Male and Female Sport Participation in Turkey: "Determination Always Finds a Way".....107-112

Alexander Bolotin and Vladislav Bakayev
(Short Report)
Comparative Analysis of Peripheral Blood Circulation Parameters in Long-Distance Swimmers at Middle Altitude and Under the Conditions of a Hypoxic Gas Environment.....113-115

Pablo Monteagudo, Ana Cordellat, Ainoa Roldán, Caterina Pesce and Cristina Blasco-Lafarga
(Short Report)
Assessing Health-Related Quality of Life in Older Adults: EuroQol Five-Dimensional Questionnaire vs the Short Form Health Survey.....117-120

Guidelines for the Authors.....121-131

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SportMont

ORIGINAL SCIENTIFIC PAPER

Estimation of Different Research Expectations of First-Year Students from the Sport Science Programmes and Their Teachers from Various Stages of Their Proficiency

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Abstract

The goal of this study was twofold: the first goal was focused on identifying how the expectations of both first-year students from the Sport Science programmes and their teachers differ regarding student research, while the second goal was focused on identifying how teachers' expectations differ based on stages of their proficiency, from novice to expert. A survey of 194 first-year undergraduate students (31% female/69% male) and 38 professors from the University of Novi Sad, Serbia was conducted. Data collection involved two standardized surveys: Student Expectations of the Research Process and Faculty Expectations of Student Research, which were modified to satisfy the requirements of sport science students and teachers. The gulf between student and teacher research expectations was found to be considerable, while the gulf among the different stages of teachers' proficiency was recognized in the area of the responsibility for first-year students learning the skills necessary to succeed at carrying out university-level research. In conclusion, it is noteworthy that a gulf between student and teacher research expectations was found and needed to be further analysed in the following stage of our research, while the gap between the different stages of teachers' proficiency is not considerable.

Keywords: *research, expectations, proficiency, Serbia*

Introduction

The teaching process at universities is a multifaceted issue of great concern. Not only students and teachers, but parents, the local community, and regional and national government bodies, as well as the non-governmental sector, are equally interested. All of the above subjects have the same goal, which is to improve the academic success of students in the most efficient way for students to acquire the adequate knowledge and skills needed in their future careers. However, not all participants view the process of achieving the intended result in the same way. Most agree that there is a significant impact of mental and cognitive ability on academic achievement and that a high level of intelligence does not promise a successful final result; it is also well-accepted that learning styles greatly affect academic development. However, there is a significant gap in access among participants from the various social categories mentioned, as well as an intergenerational gap, especially with regard to students who need to develop both theoretical and practical knowledge and competences in parallel, for which it is very important to include the innovation component. Due to its complexity, the process has generated learning strategies that differ significantly in efficiency and practicality, and which are very important to closely monitor and explore, to minimize the gap, especially between students and teachers, and teachers

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with different levels of proficiency.

Because the different research expectations of students and their teachers were found to be considerable in the previous literature (Abazaoglu, Yatagan, & Arifoglu, 2016; Begeny, Krouse, Brown, & Mann, 2011; Blazar, 2015; Borghi, Mainardes, & Silva, 2016; Peterson et al., 2011), and students' expectations differ from their experiences (Ayllon, Alsina, & Colomer, 2019; Bardach, Yanagida, Schober, & Luftenegger, 2019) but not substantially, and teachers likely have very different research expectations of first-year and senior students (Brinkworth, McCann, Matthews, & Nordstrom, 2009; Croninger, Rice, Rathbun, & Nishio, 2007; Jacobs & Harvey, 2010; Phillips, 2010; Timmermans, de Boer, & van der Werf, 2016), the first goal of this study was focused on identifying how first-year students' from the sport science programmes at the Faculty of Sport and Physical Education at the University of Novi Sad and teachers' expectations of student research differ. The relationship between their expectations has not been fully investigated taking into consideration all the relevant dimensions (Hidalgo-Cabrillana, & Lopez-Mayan, 2018), while some specific characteristics might be found in the area of sport science, due to its unique teaching and research processes (M. Spittle, & S. Spittle, 2016; Sutliff, Patterson, & Brown, 1999; Trouilloud, Sarrazin, Bressoux, & Bois, 2006; Zhang, Solmon, & Gu, 2012).

In contrast, the second goal of the present study focuses on identifying how teachers' expectations differ based on stages of their proficiency, from novice, advanced beginner, competent, proficient to expert; this goal was pursued primarily because there are few studies focused on this issue (Benner, 1984; Grochow, 2008; Tian, Wei, & Li, 2019) and because the stages of proficiency might influence the teachers' expectations, mostly for the reason that the teachers who prefer the old fashion teaching approach (probably older and "more experienced" teachers) are less focused on students' research expectations and their needs.

Method

First, in this section, it is important to explain why the proposal was undertaken at the Faculty of Sport and Physical Education at the University of Novi Sad. This university unit has very well-rated Sport Science programmes (from 201 to 300 Sport Science Schools and Departments within Shanghai Ranking's Global Ranking 2018) and a wide range of teachers, from novice to very experienced (recognized experts in the field), as well as numerous students that could promise the representative sample. For this reason, a survey of 194 first-year undergraduate students (31% female/69% male) and 38 professors (8.3% novice, 38.9% advanced beginners, 13.9% competents, 13.9% proficient, and 25.0% expert) from University of Novi Sad, Serbia was conducted.

Data collection involved two standardized surveys: Student Expectations of the Research Process (Raven, 2012) and Faculty Expectations of Student Research (Raven, 2012), which were modified by my host and me to satisfy sport science students and teachers requirements. Both surveys were standardized in the previous investigations, while this study has used the variations that might be recognized as specific to the area of Sport Science. The first is the student survey, and it is administered only to first-year classes. It is designed to explore data on students' research experiences and their expectations regarding adequate research. This survey is selected for two reasons: 1) the first-year classes contain recent high school graduates, making it possible to learn more about student research expectations when beginning university: 2) teachers must identify a specific group of students to base their responses on when completing the faculty survey. Hence, the questionnaire contains especially specific questions about research experiences and sources they had used. Additionally, the questions are related to general activities that could influence research behaviours, such as the use of technology and the time spent reading, which are essential elements of the whole process. In contrast, the second survey is the faculty survey, and it was constructed to complement and compare with data gathered from the student survey.

Descriptive statistics (frequencies) were used to identify how first-year students' from the sport science programmes at the Faculty of Sport and Physical Education at the University of Novi Sad and teachers' expectations of student research differ, and to identify how teachers' expectations differ based on stages of their proficiency.

Results and Discussion

From the results perspective of this study, it is necessary to highlight that the gender balance was not proportional among the students (31% female/69% male), and this might be a limiting factor in this research (Figure 1). However, sport science programmes are much more popular among male students in Serbia. Hopefully, this fact would launch promotional activities in the direction of attracting more female students to this field.

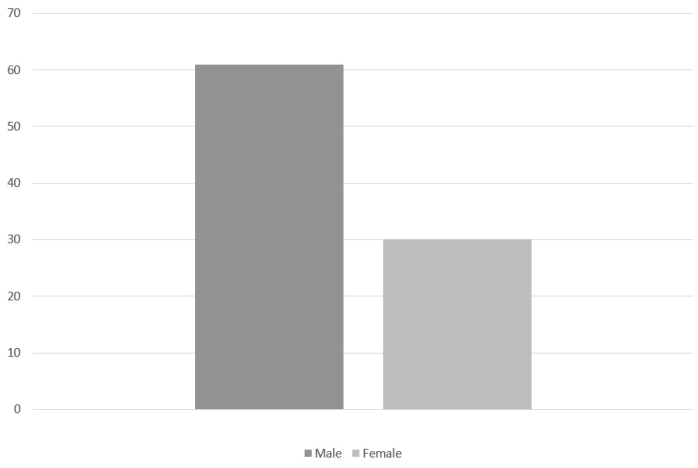

FIGURE 1. Gender balance among the students

Interestingly, 4.6% of students do not have a mobile phone at all, while 28.4% of students do not have a laptop; therefore, a significant percentage of them cannot use online resources in the research process. However, the majority of the students feel very prepared (47.4%) or somewhat prepared (25.8%) to do university-level research and rated their academic research skills as excellent (23.2%) and very good (51.5%); in the opinion of the authors of the present paper, these figures are quite high, and it must be concluded the students are quite self-confident. Nevertheless, the gulf between student and teacher research expectations was found to be considerable (Figure 2), mostly because the majority of the teachers believe students are not prepared at all (22.2%), or they are not very prepared (63.9%) to do university-level research; they rated the first-year students' academic research skills as average (47.2%), not very good (36.1%), or terrible (11.1%). These results correspond to the results from previous studies (Raven, 2012), and confirm that western and eastern European populations have the same gulf between student and teacher research expectations.

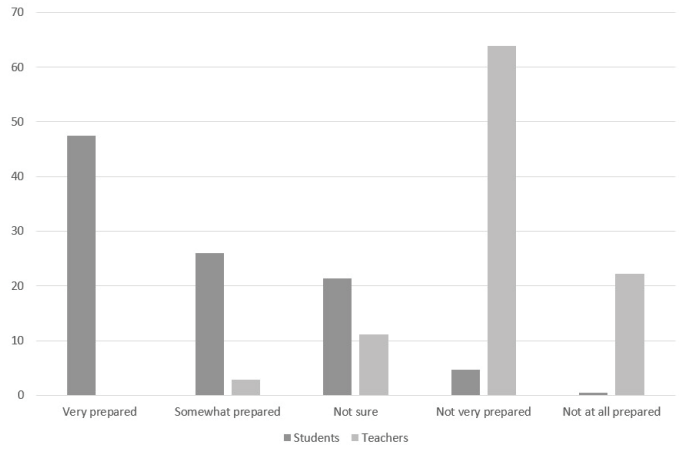

FIGURE 2. Students' preparedness to do university-level research

When we asked the students: "Who do you think is responsible for providing the skills necessary to succeed in carrying out university-level research?", over half of the students (53.1%) selected the teachers, while 38.1% of them recognized themselves to be the most responsible. In contrast, the teachers expected that they are more responsible (69.4%), but a significant number of teachers (38.1%) believe the students are the most responsible in this process (Figure 3). Although teachers have a somewhat traditional approach, it is good to know that Serbian students have more self-confidence in their abilities and the opportunities offered by contemporary education and ICT. This part of our study does not correspond to previous studies (Raven, 2012), and it indicates that there are significant differences in how teachers view things in Serbia and, for example, Canada, where teachers have much more confidence in the independent work of students, which is highly commendable.

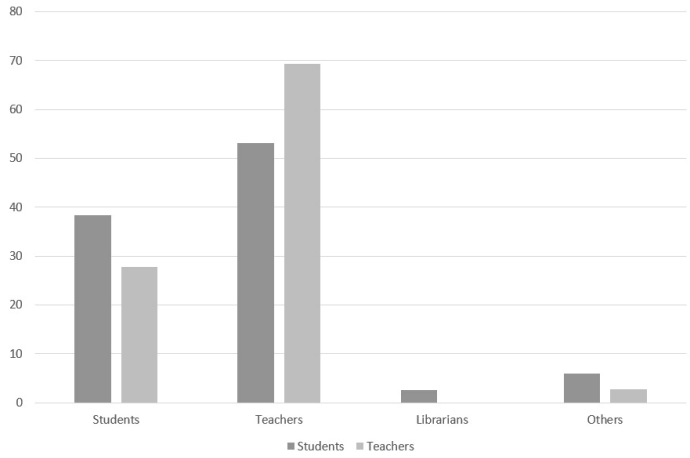

FIGURE 3. Responsibility for students learning how to do research?

Furthermore, it is also noteworthy that 43.3% of students indicated that they spend over 20 hours a week reading books, magazines, journals and/or newspapers for school, work and/or pleasure (reading could be in print or online, but should not include general web browsing, e-mail, or gaming). In contrast, just 18% of student spent more than 20 hours per week online (e.g., general web browsing, Facebook, e-mail, gaming, etc.), which is a fascinating finding as this social group is much more focused on reading in a traditional way, in comparison to online reading and, in the current technology-saturated society, we could isolate the factor that influenced sports science students to behave this

way. Also, that results showing that the traditional way of reading is a more frequent option then online reading at the beginning of the study is based on the fact that new students see books as a basic and the most valuable source of scientific information. Later, when they are at a higher level of study, they have more information about reliable scientific online resources from different sources (teachers, older colleagues, social networks, web sites of the university or faculty, etc.). Likewise, they often need more time to accept and understand the significance of online versions of scientific journals, magazines, and similar sources. Also, it should be kept in mind that academics do not have adequate habits and behaviours for buying the online version of scientific literature and that type of market in Serbia not sufficiently developed.

A gulf between student and teachers research expectations was also found with regard to the amount time required for the research component when they are assigned to prepare a 10-page paper, as well as recognizing the percentage of the research material that students expect to find using the Google search engine. Specifically, over half of the teachers believe the students will take the least amount of time in working on the research component when they are assigned to prepare a 10-page paper, while the students expect to work on it at least two hours more than the teachers do. Furthermore, the students give preference to the material they find on Google to a much greater percentage than expected by the teachers.

A gap between student and teachers research expectations was also recognized in the areas as rating students' overall internet searching skills (Figure 4). Over half of the teachers rated this student skill as average, while most of the students rated it as excellent (34%) and good (53.1%). Taking into account all of the preceding, it is clear that the expectations of students and teachers vary and that descriptive results are not sufficient for more serious conclusions, so more advanced analysis is necessary.

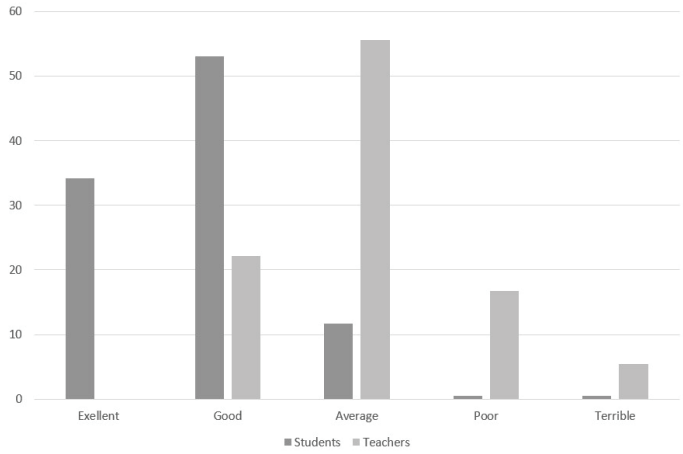

FIGURE 4. Rating of students' general Internet searching skills

In contrast, the second goal was focused on identifying how teachers' expectations differ based on stages of their proficiency, from novice, advanced beginner, competent, proficient, to expert. Regarding the preparedness of first-year students to do university-level research, we did not recognize significantly varied expectations among the different stages of teachers' proficiency, just small differences, and most of them agree the students are not very prepared or not prepared at all. They also agree regarding the following questions: "What percentage of first-year students do you think know what a research database is?", "What percentage of first-year students do you think know what citation and plagiarism are?", and "How would you rate first-year students' academic research skills?"; they did not have very positive expectations. The gap among the different stages of teachers' proficiency is recognized in the area of responsibility for first-year students learning the skills necessary to succeed at carrying out university-level research.

Interestingly, most experts gave priority to the students, while others (novice, advanced beginner, competent, and proficient) give priority to the teachers. Further, while most of the questions did not indicate any differences, it is very important to highlight that novices did not expect first-year students to go to their teachers if they need help with their assignments and recognized that only colleagues and family would be contacted. In contrast, members of all other stages of the teachers' proficiency gave priority to professors, while the competent gave priority to the colleagues.

Conclusion

In conclusion, it is interesting to highlight that a gap between student and teacher research expectations was found and needs to be further analysed in the following stage of our research, while the gap between the different stages of teachers' proficiency is not considerable. Therefore, further research activities need to be focused on investigating how to bridge the estimated gaps in the areas in which different expectations were recognized and providing some instruction and support services. Recently, the student's association of the Faculty of Sport and Physical Education in Novi Sad launched a new scientific study group of students with intentions for decreasing the gap between students and teacher's views on research expectations. This section started at the beginning of 2020 with the main aim to bring the cutting edge to all interested students (all years of studies) who have the ambition to pursue science in the fields of sports, physical education, and sports medicine. Therefore, this research can be a good starting point for future research and evaluation of the effects of this and similar next steps, which can contribute to reducing the established gap.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Reactive Changes of Buccal Epitheliocytes and Erythrocytes in Students with Different Somatic Health and Cardiorespiratory Endurance Levels

Ihor Vypasniak[1], Sergii Popel[1], Bohdan Mytskan[1], Zınovii Ostapiak[1] and Iryna Ivanyshyn[1]

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Abstract

This paper aims to identify the specific features in buccal epitheliocytes' and peripheral blood erythrocytes' structural changes for students with different somatic health and cardiorespiratory endurance levels. Forty male students aged 17 were enrolled in this study, divided into three groups: 15 students with above-average and average somatic health levels, 15 students with below-average somatic health level, and a control group consisting of 10 healthy students. Cardio-respiratory endurance was determined using a 12-minute shuttle run test. Histological specimens were stained with azure and eosin and examined with a Leika DME light microscope. To obtain cell images, an Olympus Camedia C-480 ZOOM digital video camera was used. Determination of nucleus and cytoplasm structural perimeters on cytological medicine was performed using BioVision 4.0 software. Students with different somatic health levels were found to have regular reactive changes in the morphometric parameters of the buccal epitheliocytes and peripheral blood erythrocytes after cardiorespiratory endurance testing. As the proportion of discocytes decreases, and the contents of spherocytes and stomatocytes increases, a significant enrichment of microrelief and an increase of peripheral blood erythrocytes atypical forms occur, which indicates the low membrane resistance to the maximal aerobic physical activity in students with low somatic health. The revealed morphometric changes of buccal epitheliocytes and peripheral blood erythrocytes during physical activity are conditioned by the somatic health level, which affects the deformation degree of erythrocytes, limits the production of new, functionally active cells, and leads to a delay in the differentiation processes of cells within an increasing number of cells with raised core sizes, which closely correlates with the number of levels achieved during 12-minute shuttle run test.

Keywords: *epitheliocytes, erythrocytes, morphometry, core-cytoplasmic ratio, somatic health, cardio-respiratory endurance*

Introduction

Scientific literature indicates significant changes in the homeostasis of the human body at its maximum physical activity (Apanasenko, Volhina, & Bushuiev, 2000; Leshchak & Popel, 2012; Belykh, Eskov, & Fudin, 2015). In this case, the first impact element at the level of the whole body is the immune system, and at the outset in its nonspecific parts, such as local immunity (Dranik, 2006). The works of various authors show the particular sensitivity of this element of the body's immune response to physical activity, not only in athletes (Zemska & Piatnychuk, 2017; Nedospasov, 2013) but also in people who do not engage in sports (Levytskyi, 2007; Leshchak & Popel, 2012) or are in a state of psycho-emotional or immobilizing stress (Duma, Popel', & Polyanskaya, 2016; Moshkin & Gerlinskaya, 2016; Popel & Mytskan, 2016; Gan & Popel, 2017), or have different organ diseases, and similar

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(Arutyunov, Pleskanovskaya, & Naumov, 2009; Rabinovich, Ostrovskij, & Abramova, 2013; Faichak, Popel, & Sluchyk, 2011).

In this regard, the oral cavity mucous membrane is of particular importance, because in many works it has been proven to be particularly sensitive in very different body conditions both in physiological (Arutyunov et al., 2009; Gasyuk, 2009) and in pathological states (Hande & Chaudhary, 2010; Popel, Mytskan, & Lapkovskyi, 2017; Prasad, Ramesh, & Balamurali, 2010).

The adhesion of bacterial flora and the penetration of other reagents under the oral cavity mucous membrane is impaired by a multilayered non-keratinized and partially keratinized epithelium (Dranik, 2006). Therefore, its functional state is of great importance in the development of recovery processes or the stabilization and maintenance of body homeostasis due to the combined involvement of activation mechanisms of nonspecific and cellular immunity. This is ensured by the fact that buccal epitheliocytes, except for their mechanical barrier function and participation in phagocytosis, can be antigen-presenting cells capable of secreting various biologically active substances, such as proinflammatory cytokines, chemokines, growth factors, and others (Gasyuk, 2009; Levytskyi, 2007; Rabinovich et al., 2013; Gan & Popel, 2017).

It should be noted that mucous membranes' epitheliocytes synthesize an additional secretory component "s", which attaches to immunoglobulin molecule A (IgA) produced by tissue lymphocytes that migrate from the bloodstream through haemocapillaries' walls in different parts of the oral cavity mucosa. As the IgA molecule passes through the epithelial cells, the sIgA complex is formed. Therefore, this complex of epithelial and plasma cells neutralizes bacterial toxins, localizes viruses, and stimulates phagocytosis, thus providing local resistance of the body at the oral cavity level (Dranik, 2006; Wandeur et al., 2011).

Considering that at maximal physical loading (PLmax) in different organs and tissues microcirculation disorders are observed (Baskevych et al., 2017; Popel & Mytskan, 2016; Popel et al., 2017), it is quite natural that they, first of all, concern rheological property disorders of peripheral blood erythrocytes (PBE). As such changes promote hypoxia and increasing of protein and lipid peroxidation (Faichak et al., 2011), we can suggest their influence on changes in cells' energy metabolism, which also results in functional changes of the buccal epitheliocytes (Hande & Chaudhary, 2010). Thus, according to some studies (Duma et al., 2016; Leshchak & Popel, 2012; Popel & Mytskan, 2016; Popel et al., 2017), one of the informative indicators of the state of cellular metabolism is morphological changes of PBE and buccal epitheliocytes, which are widely used in the diagnostics of various pathological conditions of the human body. Using the method of exfoliative cytology, the determining of the perimeter, core area and cytoplasm and their correlation in epitheliocytes, as well as their shape changes, can be evaluated comprehensively, which increases the level of the informativeness of these changes (Zemska & Piatnychuk, 2017; Levytskyi, 2007; Faichak et al., 2011).

It is known that morphometric changes in buccal epitheliocytes can occur not only under the influence of PLmax but also be an indicator of somatic health (SH) (Levytskyi, 2007). Therefore, the possibility of the interaction and cooperation of buccal epitheliocytes with immunocompetent cells and their ability to perform barrier function depends on their morphofunctional state, which may be changed under the influence exo- and endogenous factors, in particular, PLmax, SH level, and PBE state (Arutyunov et al., 2009; Zemska & Piatnychuk, 2017; Leshchak & Popel, 2012; Faichak et al., 2011; Popel et al., 2017).

The main goals of this research were to identify the specific features in buccal epitheliocytes' and peripheral blood erythrocytes' structural changes for students with different somatic health and cardiorespiratory endurance levels.

Methods

Participants and data collection

To achieve this goal, an assessment of the morphometric parameters of buccal epitheliocytes was conducted in forty 17-year-old male students of the Physical Education and Sports Faculty of Vasyl Stefanyk Precarpathian National University. At the time of the study, all the students (according to medical examination) had the following somatic health (SH) status verified on the basis of international criteria and diagnostic standards: above average (AA) (25.0%), average (A) (37.5%), and below average (BA) (37.5%). Students with high and low levels of SH were not identified. Based on these results, two groups were formed; the first group had 15 students with above-average and average cardiac somatic health levels; the second group had 15 students with below-average somatic health level; the control group (CG) had 10 healthy students of the same age. Cardio-respiratory endurance was determined using the 12-minute shuttle run test.

Students with inflammatory oral cavity phenomena, endocrine disorders (diabetes mellitus), and gastrointestinal tract diseases were not involved, because such conditions affect the morphofunctional buccal epitheliocyte state and, as a rule, these individuals receive pharmacotherapy, which also has some effect on the cytological picture of cavity mucous membrane and cavity peripheral blood state (Arutyunov et al., 2009; Gasyuk, 2009; Wandeur et al., 2011; Prasad et al., 2010).

Instruments and analysis

Peripheral blood erythrocyte morphological studies (PBE) were performed with a JEOL-25M-T220A (Japan) scanning electron microscope according to the conventional method.

After rinsing the oral cavity with saline, with a light pressure, we scraped the cheek epithelium inner surface in the area of molars with the end of a sterile dental trowel and transferred the obtained material to a slide with a smear, drying for 2-3 minutes outdoors.

Histological specimens were stained with azure and eosin and examined with a Leika DME light microscope. To the cell images, an Olympus Camedia C-480 ZOOM digital video camera (Olympus Corp., Japan) with 400-1200 magnification there was used.

Determination of core (Pc) and cytoplasm (Pcp) structural perimeters on cytological medicine was performed using a BioVision 4.0 software. The frequency of cells with anomalies was determined in terms of 1000 cells.

Correlation analysis of the core-cytoplasmic ratio (Sc/Scp) and (Pc/Pcp) was performed to identify the possible relationship of a single indicator changes with PLmax duration (determined by the level of performing the 12 min shuttle run).

Processing of the statistical study results was performed using the standard Statistica 5 for Windows software. For data processing, the correspondence analysis of obtained data to

the normal law of random variables distribution was carried out. The results are presented as mean values and standard deviation (M±SD). Averages were compared using Student's t-test. Statistical data analysis was performed at a given probability (0.95), and the obtained results were considered statistically significant at $p<0.05$. To determine the perimeters and core area ratio dependence to the cytoplasm perimeter and the area (Pc/Pcp and Sc/Scp) of buccal epitheliocytes after performing the 12-minute shuttle run test), a multiple linear regression analysis was performed using a stepwise method (Venkataswamy-Reddy, 2019).

Results

Morphometric analysis of students' buccal epitheliocytes after performing the 12-minute shuttle run test revealed a significant perimeter and core area increase and a decrease of relevant cytoplasmic parameters of these cells. At the same time, the core-cytoplasmic ratio increase was established (Table 1).

Table 1. Changes in Morphometric Epitheliocytes Parameters in Students after Performing the 12-Minute Shuttle Run Test (M±m)

Indicators	1-st group (n=15) M±SD	2-nd group (n=15) M±SD	Control group (n=10) M±SD
Pcp (μm)	188.4±2.44*	179.8±3.20*	192.4±3.26
Pc (μm)	32.6±0.27*	35.2±0.36*	30.4±0.42
Pcp/Pc	0.17±0.003*	0.21±0.005*	0.15±0.001
Sc (μm2)	61.4±2.52	71.4±1.28*	53.8±1.22
Scp (μm2)	2032.5±60.11*	1918.7±68.53*	2156.3±73.41
Scp/Sc	0.03±0.001*	0.05±0.001*	0.02±0.001

Legend: Pcp–cytoplasm perimeter; Pc–core perimeter; Sc–core area; Scp–cytoplasm area; *-p<0.05

To determine core perimeters and area ratio dependence to cytoplasm perimeter and area (Pc/Pcp and Sc/Scp) of buccal epitheliocytes after the 12 min shuttle run test, a multiple linear regression analysis was performed (Figure 1).

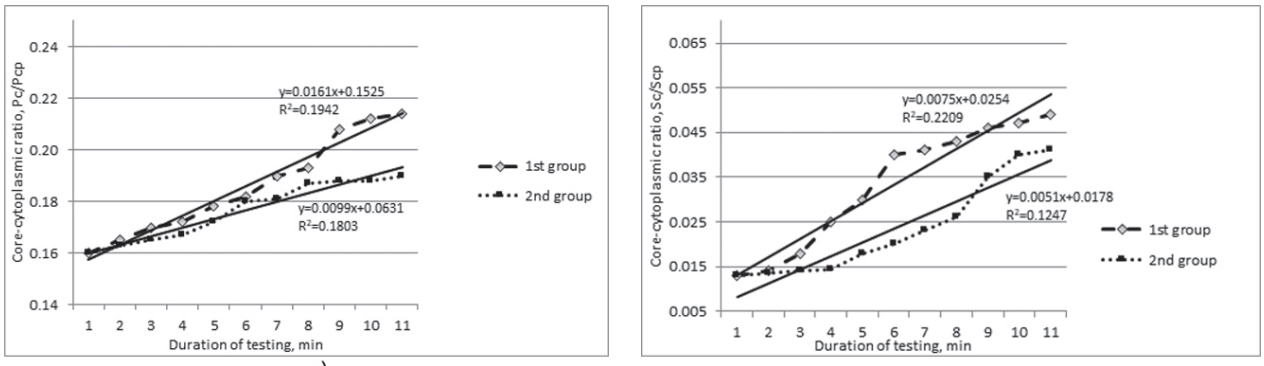

FIGURE 1. Specific features of the correlation between changes of core and cell perimeter ratio (a) and core and cytoplasm area (b) in students with different somatic health levels

Because of the results of the conducted studies, a correlation analysis of obtained relative indicators was also performed to identify possible correlations (Figure 2).

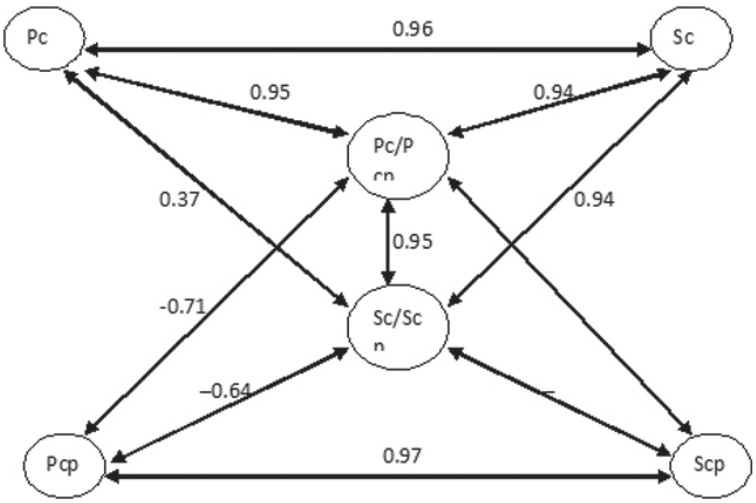

FIGURE 2. Correlation between indicators of morphometric epitheliocytes for students with above-average and average somatic health levels

In the first group, there was a strong positive correlation between such morphometric indicators as Pc and Sc (rs=0.96; p<0.05), Pcp and Scp (rs=0.97; p<0.05) as well as Sc/Scp to Pc/Pcp (rs=0.95; p<0.05).

An average inverse correlation was observed between Pcp and Pc/Pcp indices (rs=-0.71; p<0.05), Pcp and Sc/Scp (rs=-0.64; p<0.05), Sc and Pc/Pcp (rs=0.34; p<0.05), and Scp to Sc/Scp (rs=-0.63; p<0.05). During statistical data processing, the presence of a weak positive correlation between Pc and Pc/Pcp (rs=0.33; p<0.05), Pc and Sc/Scp (rs=0.37; p<0.05) was determined. Sc and Pc (rs=0.34; p<0.05), and Sc and Sc/Scp (rs=0.42; p<0.05) (Figure 2).

The manifestation of the first reactivity signs of PBE in students of the 1st and 2nd groups was marked by the spherocytes proportional increase, and the discocytes' proportion progressive decrease (Table 2). After performing the 12-minute shuttle run test, an increase in the proportion stomatocytes was observed, while the ovalocyte number had no significant changes.

Table 2. Relative content (%) of various shapes of erythrocytes in the peripheral blood of students with different somatic health levels before and after the 12-minute shuttle run test

Erythrocytes shapes	Groups				
	1st (n=15)		2nd (n=15)		Control group(n=10)
	before	after	before	after	
Discocytes	60.8	61.3	44.8	36.2*	65.4
Discospherocytes	22.8	28.3	29.3	31.5*	34.3
Spherocytes	3.3	3.7	7.3	12.9*	2.5
Stomatocytes	2.4	4.8	4.6	6.1*	2.4
Ovalocytes	2.1	2.3	2.7	3.9*	2.2

Legend: * - p<0.05

The students of the first group were dominated by discocytes (61.3%) and discospherocytes (28.3%). The atypical erythrocyte-form proportion was minimal: spherocytes – 3.7%, stomatocytes – 4.8% and ovalocytes – 2.3%.

In students of the 2nd group, significant deviations were observed, both from the control group indicators and 1st group students indicators (Table 2, Figure 3).

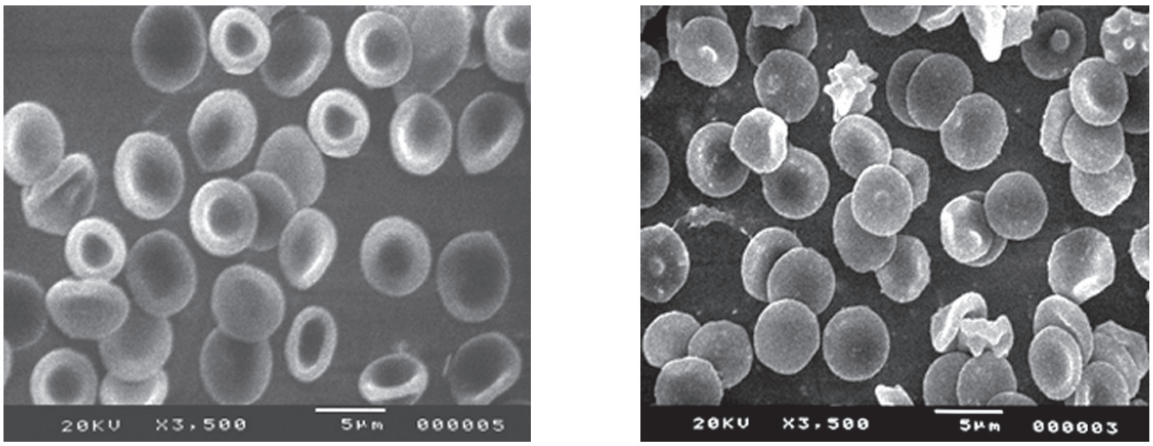

FIGURE 3. Erythrocyte geometry in students of the 1st (a) and the 2nd groups (b) after performing the 12-min shuttle test. Scanning electron microscopy (zoom: ×3500)

Discussion

A considerable amount of research is devoted to the study of the body's response to PL including blood and various organs' epithelial cover (Duma et al., 2016; Levytskyi, 2007; Leshchak & Popel, 2012; Popel & Mytskan, 2016). These results are essential for modelling the PL volume, taking into account the SH level. This is confirmed by the cytological study results of buccal epitheliocytes in smear-imprints of the oral cavity mucous membrane (OCMM) of persons with poor health. It is known that one of the main mechanisms of nonspecific body protection forms is the microflora composition of OCMM (Faichak et al., 2011). It not only regulates and maintains the necessary colonization resistance level but also affects the whole body's metabolism and adaptation processes course (Belykh et al., 2015; Gan & Popel, 2017). Together with local components (buccal epitheliocytes and leukocyte-lymphocytic cell pool of OCMM) of the immune system, the microflora maintains a sufficient enzymatic activity level that affects the secretion of various biologically-active substances that determine the nature of the reaction to different irritants, including PL (Popel et al., 2017). That is why in students with low SH level and cardio-respiratory endurance the number of cellular elements and autoflora components is statistically significantly increased, the adhesive epitheliocyte properties are disrupted, and the phagocytic properties of leukocyte-lymphocytic properties are reduced, which reveals local (nonspecific) protective properties. The fact that these parameters decrease under the PL influence confirms the need for a differentiated approach in training regime modelling to prevent and correct immunological disorders in students.

It is known that the stabilization of OCMM autoflora persistence indicators has a positive effect on microbial biocenosis as a whole (Rabinovich, 2013). Recent studies (Popel & Mytskan, 2016; Wandeur et al., 2011; Hande & Chaudhary, 2010; Prasad et al., 2010) show that the epithelium, including buccal, occupies a significant place in the cell-humoral homeostasis system. These cells react to intercellular communication molecules, change the gene expression and related phenotypic parameters (Wandeur et al., 2011). The specific OCMM reactions of students under PL influence showed a number of general changes in nonspecific protection indices, which show the possibility of local resistance data being used as an SH integral indicator and cardio-respiratory endurance.

Based on the works of Hans Selve (1977), the indirect indicator of stress development is the reactions in PBE by the type of poikilocytosis. In chronic stress, the number of buccal epithelium cells and PBE, changing in shape, does not go beyond norms limits (Bulgakova, 2006). According to current scientific studies in the red blood cells, the changes observed in PL are typical for stress reactions, which can be recorded in acute stress as an adaptation syndrome, and at PL maximum correspond to conditions observed in depleted adaptation potential (Vejn et al., 1981; Muruzyuk & Romanova, 2001).

It is known that a complex, multilevel stress-realization system functions in the body, but the stress hormones' effect on PBE has not been studied thoroughly (Volchegorskij et al., 1998). Our data on buccal epitheliocytes' cellular content and PBE indicate a change in autonomic tone and autonomic imbalance formation. A probable sign of autonomic balance formation is the increase in the number of differently shaped and sized cells. In this case, poikilocytosis and a possible decrease of the haemoglobin amount indicate that the body is adapting to new conditions. Therefore, changes in PBE should be considered in combination with other epitheliogram components.

According to Verkhoglyadova et al. (2005), poikilocytosis on the epithelial reaction background (anisocytosis and nuclear shift) usually indicates the progression of the fatigue processes, but they are not regarded as negative prognostic signs.

It is known that under adrenaline influence poikilocytosis occurs (Vejn et al., 1981; Hoffman et al., 2018), and at the depletion of sympathetic CNS section, the inhibitory process and leukopenia is observed. Therefore, we can suggest that a similar mechanism is the basis of buccal epithelium and PBE cellular responses, which we observed in students with low SH levels, which is probably due to the depletion of vascular and bone marrow cell reserves (Verkhoglyadova et al., 2005; Pseunok et al., 2000). Our previous studies have shown that under stress, there is a PBE redistribution between different organs, which is manifested by increased inversely altered PBE forms and the acceleration of their ageing (Faichak et al., 2011). The indication of this is the development of neutrophilic OCMM leukocytosis, which is mainly due to increased bone marrow neutrophils' flow into vascular beds, the recruitment of which is potentiated by glucocorticoids and catecholamines with increased concentration under PL.

It is observed that eosinophils' increase in OCMM is an ACTH-dependent process and is associated with these cells' release from the blood into connective tissue (Goldberg et al., 1997). Thus, in addition to nervous and endocrine components to modern ideas about induction mechanisms of stress response to PL, it is necessary to take into account the epithelial and haematological components. Therefore, they must be considered as a node in the formation of hormonal and metabolic body status and as a manifestation of haematological stress syndrome's generalized reaction to acute and chronic stress (Vasil'ev et al., 1992; Gorizontov et al., 2013; Raushenbakh et al., 2012).

The change in PBE composition after the PL series probably occurs due to the influence on the hypothalamus. In fact, during PL due to reverse connection, the specific, time-stable, functional system of neural interactions is formed (Vasilevskij et al., 2013), which is an adaptation process coordinator and regulator, and is capable of forming new adequate reaction forms to internal and external factors.

The changing PBE form is very important and proves the dependence of erythrocyte homeostasis disorders on central regulation level functioning. This dependence is exceptional because it directly relates to the occurrence, course and result of haematological and cytological disorders and yet with the occurrence, the course of whole body is disordered. These deviations are reactive by nature, since blood indicators are restored upon CRC activity normalization (By'kov et al., 2012).

It can be assumed that the triggering mechanism of PBE composition changes and buccal epitheliocytes is the protective mechanisms' general mobilization to counteract endo- and exogenous factors' effect on the body. It is known that under PL, the body's need for oxygen increases, and it is quite logical that its haemoglobin amount increasing, which significantly reduces the whole body adaptation and has a positive effect on SH.

Blood is the transport medium for leukocytes from their formation sites (bone marrow, spleen and lymph nodes) to penetration sites into OCMM. Leukocyte output is associated with increased epithelial tissue permeability of OCMM, as well as their redistribution in the bloodstream, indicating a decrease in the body's immune resistance, which can occur in both acute and chronic physical fatigue, especially in individuals with low SH level and cardio-respiratory endurance.

It is important to emphasize once again that changes in EPC do not go beyond the normal parameters, which is distinct from the sharp jump of indicators of blood cells during acute stress.

Korneva (2015), states the importance of using tests that can identify "risk groups" and diagnostics of SH correction effectiveness by physical training. One of which can be PBE morphological composition changes control and buccal epitheliocytes.

Additionally, this study confirmed that morphometric analysis of buccal epitheliocytes revealed a probable increase in perimeter and core area, as well as a decrease in the above-mentioned parameters in students after performing the 12-minute shuttle run test. The morphometric changes of buccal epitheliocytes and peripheral blood erythrocytes during the aerobic endurance test were determined due to the health level. In particular, it affects the erythrocyte deformity degree in students with below-average health levels, limits the production of young, functionally active cells, and delays buccal epithelial cells' differentiation processes with an increase the number of heightened core-size ageing cells. The increase in the erythrocyte numbers of different forms compared with the increase of core-cytoplasmic ratio index in buccal epithelial cells of all health groups of students has a positive correlation with the number of achieved levels during the 12-minute shuttle test.

Further complex studies of changes in buccal epithelial cells and peripheral blood erythrocytes in students of different sexes after performing aerobic exercises of different power are recommended.

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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 Effects of the Comprehensive Rehabilitation Method on Quadriceps Activation: Outcomes in Patients with an Injury to the Anterior Cruciate Ligament

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Abstract

Dynamics of the indices of interferential superficial electromyography of the quadriceps muscle in patients with an injury to the anterior cruciate ligament (ACL) of the knee joint were investigated in the process of physical rehabilitation. The study included 39 randomly selected individuals with a complete ACL tear who were qualified for surgical reconstruction. The age of the participants was 18–59 (average: 36.3±12.8) years. All participants underwent rehabilitation treatment in the Institute of Traumatology and Orthopaedics, National Academy of Medical Sciences of Ukraine, and had surgeries in the institute's clinics. In the functional rehabilitation period, in patients in the main group, who were engaged in the author's programme, there were no statistically significant differences in the mean amplitude of the quadriceps head intact and injured limbs ($p>0.05$). The values of the comparative factor of maximal contraction of the heads of the quadriceps muscle of the intact and injured limbs of the patients approached the norm. In patients in the control group, a statistically significant ($p<0.05$) difference in the mean values of the mean amplitude of the contraction of the heads of the quadriceps muscle of the injured and intact limbs was established: in relation to vastus medialis – 98.93±37.13 mV and 175.90±65.96 mV, in relation to the rectus femoris muscle – 113.59±62.67 mV and 169.99±52.23 mV.

Keywords: *physical rehabilitation, trauma, anterior cruciate ligament, knee joint, recovery treatment*

Introduction

A total of 20% of all sports-related knee injuries are ruptures of the anterior cruciate ligament (ACL), which is evidenced by more than 100,000 cases annually in the United States. ACL rupture often leads to knee joint instability during daily activities. To compensate for the knee instability, ACL-deficient (ACLD) patients adopt an asymmetrical gait pattern, consisting of altered knee joint movement, moment, and contact forces. However, muscle timing and the magnitude of activity are of great importance (Shanbehzadeh, Mohseni, Bandpei, & Ehsani, 2017).

Electromyography (EMG) is widely used in sports medicine for investigating potential alterations in the muscle activation patterns in pathologic conditions in order to facilitate the development of evidence-based training and rehabilitation programmes (Kvist, & Gillquist, 2001; Knoll, Kocsis, & Kiss, 2004; Shanbehzadeh, Mohseni, Bandpei, & Ehsani, 2017). Recently, increasing research results suggest that altered quadriceps and hamstrings activation in ACL injury may only exist in the presence of knee instability as part of an adaptation

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strategy to support joint stability, that is, inhibited quadriceps activity with concurrent increased activity of both quadriceps and hamstrings (Begalle, Distefano, Blackburn, & Padua, 2012; de Jong, Caspel, & Haeff, 2007). It has been reported that disproportionate activity of the quadriceps and hamstring muscles results in muscle imbalance and increased strain in the ACL (Begalle, Distefano, Blackburn, & Padua, 2012; Hewett, Zazulak, Myer, & Ford, 2005). Hence, many ACL injury prevention and rehabilitation programmes attempt to reinstate quadriceps-hamstrings activation balance (Pappas, Nightingale, & Simic, 2015; Khaiyat & Norris, 2018).

This study is aimed at investigation of the effects of the comprehensive rehabilitation method on quadriceps activation in patients with an injury to the anterior cruciate ligament.

Methods

Participants

The study included 39 randomly selected individuals with a complete ACL tear who were qualified for surgical reconstruction. The age of the participants was 18–59 (average: 36.3 ± 12.8) years. Among the exclusion criteria, there were partial ruptures of the ACL, combined injuries of the ACL and meniscus, and ACL and cartilage damage, identified by ultrasound and magnetic resonance imaging (MRI). In the process of the research, we systematized and consolidated data from 39 medical records of patients treated in the Institute of Traumatology and Orthopaedics, National Academy of Medical Sciences of Ukraine from 2016 to 2018 and were operated on in the hospitals of the Institute. The femoral end of the transplant was fixed with the help of the RigidFix or Cross-Pin systems, and the tibial end by using the Biointrafix or Biosure Sync systems. The patients, without temporary contraindications for arthroscopic operative intervention, were examined by using instrumental methods of research. The examination was performed within different periods of recovery treatment. Overall, 21 participants (the main group) underwent rehabilitation in accordance with the proposed programme after ACL reconstruction; in 18 patients (control group), the traditional programme of physical rehabilitation was implemented. The results registered at the preliminary stage of the research showed no statistically significant differences between the examined indicators and the age of the patients among the control group and the main group.

Procedure

To achieve the set target in this study, the following methods were used: theoretical analysis of data from the scientific and methodological literature; pedagogical; clinical (examination, anamnesis collection); instrumental methods of research (anthropometric measurements, goniometry, electromyography); and methods of mathematical data processing.

The algorithm of the complex diagnostics for acute ACL injuries, created at the institute, was applied to the patients having corresponding claims; the algorithm implied clinical, functional, X-ray, ultrasound, and MRI examination. In all the hospitalized patients, the following procedures were applied: definition of the patient's claims, anamnesis; clinical examination, palpation; examination of the injured joint function, evaluation of instability level, presence of block, synovitis, infiltration, muscular atrophy, X-ray, ultrasound, MRI (if possible) examination of the knee joint, and similar. The obtained data were recorded in the patients' medical history. During the clinical examination and anamnesis collection, all participants were asked about the reason for visiting the rehabilitation department; the intensity of pain syndrome (the Visual Analogue Scale of pain was applied); their claims on pain syndrome during active movements, passive movements, and at rest; instability of knee joint; quantitative measurements of instability were performed in accordance with the criteria of the American Association of Arthroscopy.

The research related to human use has complied with all the relevant national regulations and institutional policies; has followed the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or an equivalent committee.

Informed consent has been obtained from all individuals included in this study.

Statistical analysis

The following methods of mathematical statistics were applied: descriptive statistics, selective method, Shapiro-Wilk's normality test, Student's t-test, non-parametric Mann-Whitney test, and factor analysis. Methods of descriptive analysis were used, including tabular presentation of separate variables, calculation of mean arithmetic value (M), standard deviation (SD). The sample data for normality were tested with the normal distribution formula and the Shapiro-Wilks test. To determine the statistical significance of the differences between the samples of normal distribution, the Student's test was used. The level of $p \leq 0.05$ (the probability of error) was assumed statistically significant.

Results

Thus, the analysis of results in the research of the specific limb functional conditions among the examined patients with knee joint ACL injuries allowed outlining the main set of tasks that should be solved in the process of rehabilitation programme development. Having studied the specifics of the lower limb functional conditions among the participants, we described and developed a physical rehabilitation programme for patients after ACL reconstruction with arthroscopic operative interventions. The programme consisted of five periods: preoperative, early postoperative, late postoperative, functional periods, and a period of higher physical activity. The basis of the programme was the use of workout modules on the Gamma Platform, remedial gymnastics, and massage with elements of passive workout to increase the movement amplitude in the injured joint and post-isometric relaxation, mechanotherapy on a joint workout machine, and keeping to the orthopaedic routine. The specific feature of the developed programme of physical rehabilitation for patients with injured ACL, comparing with the traditional programme, was, mainly (except the early postoperative rehabilitation period) the use of the workout modules "Boat", "Ball swing", "Sorting balls", "Trampoline jumping", "Jump rope", and "Combined" on the Gamma Platform, which enhanced the elimination of loading asymmetry between intact and injured limbs and the faster recovery of the functional abilities of the operated joint.

To assess the effectiveness of the rehabilitation programme, two groups of patients were formed: the main group, who followed the presented authors' programme (n=21), and the control group (n=18), of patients who underwent the recovery treatment course including remedial gymnastics, classical

Table 1. Dynamics of indices of interferential superficial electromyography of maximal contraction of the rectus femoris muscle and of vastus medialis of the quadriceps muscle in patients of the main group (MG=21) and control group (CG=18) with damage to the anterior cruciate ligament of the knee during recoveri

The studied indicators	Limbs	The preoperative rehabilitation period		p	The early postoperative rehabilitation period		p	The late postoperative rehabilitation period		p	The functional rehabilitation period		p
		MG	CG		MG	CG		MG	CG		MG	CG	
		M±SD			M±SD			M±SD			M±SD		
Amplitude of vastus medialis (mV)	injured	114.81±27.97	107.59±18.64	p>0.05	69.23±14.18	67.03±13.73	p>0.05	230.83±36.89	108.50±39.44	p≤.05*	306.93±71.24	98.93±37.13	p≤.05*
	intact	143.54±47.21	137.71±31.95	p>0.05	160.53±24.11	160.56±25.09	p>0.05	253.93±59.03	164.42±24.82	p≤.05*	299.16±118.43	175.90±65.96	p≤.05*
p		p≤0.05*	p≤0.05*		p≤0.05*	p≤0.05*		p≤0.05*	p≤0.05*		p>0.05	p≤0.05*	
Median frequency of vastus medialis, (Hz)	injured	62.16±32.09	51.80±43.09	p>0.05	43.33±16.82	43.57±16.08	p>0.05	93.47±19.71	59.44±15.99	p≤.05*	117.57±30.08	51.41±29.72	p≤.05*
	intact	70.47±30.19	70.07±31.42	p>0.05	77.60±30.90	77.23±32.29	p>0.05	135.50±46.43	74.96±19.31	p≤.05*	123.13±40.57	106.10±32.66	p>0.05
p		p>0.05	p>0.05		p≤0.05*	p≤0.05*		p≤0.05*	p≤0.05*		p>0.05	p≤0.05*	
Amplitude of the rectus femoris muscle, (mV)	injured	115.42±24.38	109.68±36.15	p>0.05	90.36±22.63	92.11±24.60	p>0.05	187.81±61.13	117.70±26.01	p≤.05*	300.95±93.27	113.59±62.67	p≤.05*
	intact	157.09±33.05	148.85±44.60	p>0.05	196.81±54.79	200.62±60.58	p>0.05	217.21±69.18	142.47±34.79	p≤.05*	313.42±98.60	169.99±52.23	p≤.05*
p		p>0.05	p>0.05		p>0.05	p>0.05		p>0.05	p>0.05		p>0.05	p≤0.05*	
Median frequency of the rectus femoris muscle, (Hz)	injured	60.64±19.10	52.73±29.25	p>0.05	54.98±20.06	59.73±17.09	p>0.05	116.40±12.03	65.42±21.48	p>0.05	121.77±11.46	68.13±32.69	p>0.05
	intact	54.13±13.57	56.70±12.70	p>0.05	77.35±29.70	83.86±26.30	p>0.05	73.60±16.40	81.50±22.15	p>0.05	127.20±28.50	108.01±18.08	p>0.05
p		p>0.05	p>0.05		p>0.05	p>0.05		p>0.05	p>0.05		p>0.05	p≤0.05*	

Legend: * - p≤0.0

massage and physical therapy methods in accordance with the hospital programme. The study of the results, their comparison with the baseline data (registered during the preoperative period, 1–4 weeks before the surgical intervention) and their evaluation were performed before the discharge from the hospital, during the early postoperative period (up to 2 weeks after the surgical intervention), during the late postoperative period (3–16 weeks after the surgical intervention), and in the functional period (17–32 weeks after the surgical intervention) of the recovery treatment.

Following the results of superficial electromyography examination, the estimation of the bioelectrical activity of the rectus femoris muscle and among patients with ACL of knee joint injuries was provided (Table 1). The baseline average indices of superficial electromyography examination amplitude of the rectus femoris muscle (mV) of the injured limb were patients of the main group (MG) – 114.81±27.97 mV (M±SD) and the control group (CG) patients – 107.59±18.64 mV (M±SD), the amplitude of vastus medialis, (mV) of the injured limb – patients of MG – 115.42±24.38 mV (M±SD) and patients of CG – 109.68±36.15 mV (M±SD). The indicators for the studied parameters among the patients of the groups (CG and MG) did not present statistically significant differences ($p>0.05$).

In the late postoperative period in patients with MG and CG, the average indicators of interferential superficial electromyography of amplitudes of the rectus femoris muscle and of vastus medialis of the injured limb significantly improved and amounted to patients of MG – 230.83±36.89 mV (M±SD) and 187.81±61.13 mV (M±SD), CG – 108.50±39.44 mV (M±SD) and 117.70±26.01 mV (M±SD). The indicators for the studied parameters among the patients of the groups (CG and MG) did present statistically significant differences ($p<0.05$).

Thus, in the functional rehabilitation period, in patients with MG, who were engaged in the author's programme, there were no statistically significant differences in the mean amplitude of the quadriceps head intact and injured limbs with statistically significant difference ($p>0.05$).

In patients with CG, a statistically significant ($p<0.05$) difference in the mean values of the mean amplitude of the contraction of the heads of the quadriceps muscle of the injured and intact limbs was established: of vastus medialis: 98.93±37.13 mV (M±SD) and 175.90±65.96 mV (M±SD), of the rectus femoris muscle: 113.59±62.67 mV (M±SD) and 169.99±52.23 mV (M±SD).

Discussion

The research performed by Shanbehzadeh, Mohseni, Bandpei, and Ehsani (2017) proves the positive impact of the increased hamstring muscular activity, while simultaneously highlighting the important fact that at the acute stage and in ACLD patients that experience knee instability there is a decreased Q-ceps activation, which provides a better picture of the rehabilitation treatment process and suggests considering such finding when working on the rehabilitation strategy.

Another study, performed by Suter, Herzog, and Bray (2001) to assess muscle inhibition in patients with chronic anterior cruciate ligament (ACL) deficiency or ACL reconstruction, provided a picture of the application of a series of protocols when striving to increase the activity of the individual knee extensor muscles and decreasing muscle inhibition of the whole quadriceps group.

An additional critical study, by Drechsler and Oona (2007), provided an analysis of the process of neuromuscular changes in the quadriceps femoris muscle at one and three months after anterior cruciate ligament reconstruction (ACLR). The results of this study once again confirmed our thesis that muscle activation patterns may be altered not only following ACL injury and surgical repair but also may contribute to subsequent changes in muscle fibre properties during detraining and subsequent retraining.

The conducted studies of the effectiveness of the developed complex programme of physical rehabilitation confirm the data on its significant advantage in comparison with the traditional programme of the medical institution.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

Standing Height Estimation from Sitting Height Measurements in Adolescents in the Central Region of Kosovo

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Abstract

The purpose of this research is to determine a regression equation for the estimation of stature from sitting height measurements in the Central Region of Kosovo. This research was carried out on 193 subjects (100 male and 93 female). The anthropometric measurements were taken according to the ISAK protocol. The relationships between standing height and sitting height measurements were determined using simple correlation coefficients at a ninety-five per cent confidence interval. A comparison of the means of standing height and sitting height between genders was performed using a t-test. After that, a linear regression analysis was carried out to examine the extent to which sitting height can reliably predict standing height. The results revealed that Central Kosovan males are 180.32±5.88 cm tall and have a sitting height of 95.36±3.26 cm, while Central Kosovan females are 166.77±4.72 cm tall and have a sitting height of 89.84±2.92 cm. The results have shown that both genders make Central-Kosovans a tall group, taller that general Kosovan population. The results of this research study confirmed that sitting height reliably predicts stature in both genders of adolescents in the Central Region of Kosovo and revealed a very useful finding for physical anthropologists and experts from related fields.

Keywords: *assessment, measures, stature, sitting height, Kosovan*

Introduction

This study analyses the relationship between standing height and sitting height measurements in adolescents in the region of Central Kosovo, which is one of five Kosovan regions (Eastern, Western, Northern, Southern and Central). This region contains eight municipalities (Glogovac/Drenas, Gračanica, Kosovo Polje/FushëKosovë, Lipljan, Novo Brdo, Obilic, Podujevo. and Pristina), covers the area of 2,470 square kilometres and has a population of 477,312; the average density per square kilometre is 233 inhabitants (Arifi, Gardasevic, & Masanovic, 2018). The territory of Kosovo is small but has a highly varied terrain. Most of Kosovo's borders are dominated by mountains and high plains (Popovic, Gardasevic, Masanovic, Arifi, & Bjelica, 2017). The most noticeable topographical feature is the Albanian Alps, which are a continuation of the Dinaric Alps that run laterally through the west along the border with Albania and Montenegro (Gardasevic, Masanovic, & Arifi, 2018). It is widely known that body height and body proportions are distinct in populations living in the Dinarides (Grasgruber et al., 2019). People from this area were recognized as tall people by European anthropologists more than 100 years ago (Popovic, 2019; Masanovic, Gardasevic, & Arifi, 2018; Vukasevic, Mitrovic, & Masanovic, 2020). Based on that, one possible conclusion is that this fact might influence the main objective of this study, because of the soil type, as well as other socio social, economic, and geographical

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characteristics as potential influencing factors (Gardasevic, Rasidagic, Krivokapic, Corluka, & Bjelica, 2017).

Systematic monitoring of the standing height, body weight, body mass index (BMI) and body proportions of children provides useful information on their development (Gusic, Popovic, Molnar, Masanovic, & Radakovic, 2017; NCD Risk Factor Collaboration, 2019). Additionally, every functional and diagnostic procedure for assessing the physical fitness of athletes and the health of adults usually begins by measuring standing height, body weight, and other body dimensions (Aslan et al., 2019). The data obtained form the basis for determining functional abilities and diagnosing a health condition. The importance of measuring standing height and predicting final growth in the selection process for certain sports disciplines is widely known and proven through numerous studies (Monson et al., 2018; Masanovic, 2018; Masanovic, Corluka, & Milosevic, 2018; Arifi, Bjelica, & Masanovic, 2019; Masanovic, 2019; Masanovic, Bavcevic, & Bavcevic, 2019; Gardasevic, Akpinar, Popovic, & Bjelica, 2019; Gardasevic & Bjelica, 2020). Furthermore, measuring standing height is essential when assessing the growth of children and their nutritional status, evaluating the basic energy requirements, adjusting measures of physical capacity and determining medication doses and setting standards of physiological variables (Masanovic, 2018; Masanovic, Gardasevic, & Arifi, 2018a; Popovic, 2019). However, in cases in which deformities (scoliosis, kyphosis, lordosis), bone fractures, amputations, height loss associated with ageing, and similar conditions do not allow the real standing height to be measured in a standard manner, the relative standing height must be calculated using various anthropometric measures that reliably predict objective standing height (Gardasevic, Masanovic, & Arifi, 2019; Masanovic, Popovic, Jarani, Spahi, & Bjelica, 2020). Previous studies have promoted the arm span and standing height relationship as the parameter that is most reliable in the indirect determination of standing height (Arifi et al., 2017a). Next, the relationship between foot length and standing height, and the relationship between sitting height and standing height as very reliable parameters are mentioned (Kanchan et al., 2008; Abou-Hussein et al., 2011; Nataraja Moorthy et al., 2014). The foot length measurement is used to indirectly determine standing height in subjects whose growth has not yet been fully completed because short bones of the foot complete the ossification process earlier, and this dimension is at that time closest to the final length (Jakhar et al., 2010). In contrast, it is known that the growth process is that the ratio of sitting height and standing height changes, meaning that the extremities initially grow faster and the trunk grows later, which is why the measure of sitting height is recommended for use only after the growth process is completed (Leung et al., 1996).

An aggravating circumstance in this way of determining standing height is that the relationship between long bones and standing height differs in various ethnic and racial groups (Masanovic, Gardasevic, & Arifi, 2019b), as well in residents of different regions (Norgan, 1994; Arifi et al., 2017b). For example, the Cormic index (provides an estimate of relative trunk length, and it is expressed as (Sitting height/standing height × 100) of the European population is 52%, while the African population has slightly longer legs on average, and this index is about 51% for them. Asian populations have shorter legs, so this index is slightly different (53–54%); at the low end of the scale, the Cormic index of Australian Aborigines is between 45% and 49% (Ukwuma, 2009). Therefore, it is necessary to establish specific formulas for each ethnic group when it is necessary to determine standing heights based on sitting height indirectly; the same applies to other parameters. Given that studies on local geographic differences in standing height conducted on the populations of Montenegro (Popovic, 2017) and Kosovo (Masanovic et al., 2019a) confirm the difference in standing height, it is necessary to conduct a similar study on the relationship of standing height and sitting height. The number of studies addressing this problem in Europe is quite limited (Fredriks et al., 2005; Ariba-Munoz et al., 2013), and no previous regional analyses exist. Considering the lack of suitable research, the purpose of this study was to examine the relationship between standing height and sitting height of men and women in the Central region of Kosovo.

Method

Subjects

The study included 193 final grade high-school students (100 male and 93 female) from the Central Region of Kosovo to be subjects. There are two reasons why this group was selected: the fact that the growth of an individual ceases by this age, and that no age-related loss in standing height exists at this age. The average age of the male subject was 18.26±0.44 years old (range 18-19 years), while the average age of the female subject was 18.15±0.36 years old (range 18-19 years). It should be noted that the researchers excluded individuals with physical deformities and those without informed consent from the data analysis. Another exclusion criterion was being non-Central Kosovan.

Variables

Standing height and sitting height were measured according to the protocol of the International Society for the Advancement of Kinanthropometry (Marfell-Jones et al., 2006). The measurement conducted trained measurer, while the quality of their performance was evaluated against the prescribed ISAK Manual". The age of each subject was reached directly from the birthdays.

Statistical Analysis

The analysis was performed by using the Statistical Package for Social Sciences SPSS version 20.0 (Chicago, IL, USA). Means and standard deviations (SD) were obtained for both anthropometric variables. A comparison of means of standing height and sitting height between genders was performed using a t-test. The relationships between standing height and sitting height were determined using simple correlation coefficients at a ninety-five per cent confidence interval, following which a linear regression analysis was carried out to examine the extent to which the sitting height can reliably predict standing height. Statistical significance was set at $p<0.05$.

Results

The overview of the anthropometric measurements of both genders is presented in Table 1. The mean of the standing height for male was 180.32±5.88 centimetres, and sitting height was 95.36±3.26 centimetres, while for female the standing height was 166.77±4.72 centimetres, and sitting height was 89.84±2.92 centimetres. The gender difference between standing height and sitting height measurements was statistically significant (standing height: $t=17.955$; $p<.000$, and sitting height: $t=12.355$; $p<.000$).

Table 1. Anthropometric Measurements of the Study Subjects

Subjects	Standing Height Range (Mean±SD)	Sitting Height Range (Mean±SD)
Male	170.3-198.8 (180.32±5.88)	86.7-104.3 (95.36±3.26)
Female	157.3-185.0 (166.77±4.72)	83.8-99.8 (89.84±2.92)

The simple correlation coefficients and their ninety-five per cent confidence interval analysis between the anthropometric measurements are presented in Table 2. The relationship between standing height and sitting height were significant (p<.000) and high in this sample, regardless of gender (male: 0.756; female: 0.782).

Table 2. Correlation between Standing Height and Sitting Height of the Study Subjects

Subjects	Correlation Coefficient	95% confidence interval	Significance p-value
Male	0.756	0.625-0.887	<0.000
Female	0.782	0.652-0.912	<0.000

The results of the linear regression analysis are presented in Table 3. The first model was extracted by including age as a covariate. However, the contribution of age was insignificant; therefore, age was excluded, and estimates were obtained as univariate analysis. The high values of the regression coefficient (male: 0.756; female: 0.782) signify that sitting height notably predicts standing height in both Central-Kosovan genders (male: t=11.434, p<.000; female: t=11.964, p<.000), which confirms the R-square (%) for the male (57.2) as well as for the female (61.1).

Table 3. Results of Linear Regression Analysis Where the Sitting Height Predicts the Standing Height

Subjects	Regression Coefficient	Standard Error (SE)	R-square (%)	t-value	p-value
Male	0.756	3.871	57.2	11.434	0.000
Female	0.782	2.956	61.1	11.964	0.000

The relationship between sitting height measurements and standing height among the above models is displayed as a scatter diagram (Figure 1).

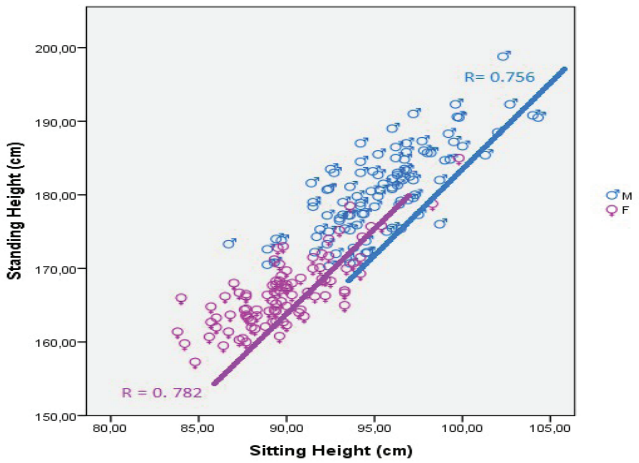

FIGURE 1. Scatter Diagram and Relationship between Sitting Height Measurements and Standing Height among Both Genders.

Discussion

The assessment of standing height of an individual using arm span has been studied by many researchers, each of whom emphasizes it as the most reliable parameter for predicting the standing height (Mohanty et al., 2001; Ter Goon et al., 2011). The studies conducted by Fredriks et al. (2005), Fatmah et al. (2010), and Arriba Munoz et al. (2014) also confirmed a very high linear correlation between standing height and sitting height in both genders of Dutch, Indonesian and Spanish populations. The high correlation coefficient in this population was calculated for sitting height in males (r=0.756) as well as in females (r=0.782), which fully confirms the studies mentioned above. However, it is important to emphasize that standing height and body proportions might vary from ethnic group to ethnic group as well as race to race, because the racial and ethnic differences affect these measures and reduce the possibility of generalizing (Bjelica et al., 2012; Grasgruber et al., 2019). Taking all of that into consideration, some recent studies have confirmed the regional differences between the same ethnic groups too, for stature (Popovic, 2017; Masanovic et al., 2019a), for the ratio of foot length and standing height (Popovic et al., 2017), and for the ratio of tibia length and standing height (Gardasevic, 2019); which is proved by the fact that for the population of Eastern Kosovo the calculated correla-

tion coefficient for sitting height and standing height ratio was r=0.743 in males and r=0.705 in females (Gardasevic, 2018). For the population of Western Kosovo, the correlation coefficient was r=0.661 in males and r=0.614 in females (Masanovic et al., 2019b), which is different when compared to the population in Central region of Kosovo (r=0.756 in males; r=0.782 in females).

All the above-mentioned results require additional caution and have confirmed the necessity for developing separate standing height models for each population on account of regional differences. Therefore, the main goal of this research was to examine the hypothesis that above-mentioned facts are true for the Central-Kosovan regions. As the correlation between sitting height and standing height was significant in both Central-Kosovan genders, the sitting height measure, therefore, seems to be a reliable indirect anthropometric indicator for estimating standing height in both genders of the Central-Kosovan population. Even though these relations are similar, the estimation equations, which are obtained for the Central-Kosovans, differ considerably from populations from other regions in Kosovo, which confirms that it is necessary to develop separate standing height models for each population on account of regional variations in Kosovo. The reason for regional differences for both genders in Kosovo can be based at the fact that the whole of Kosovo does not fall into the Dinaric Alps racial classification (Mustafa et al., 2012).

One limitation of this research might also be the composition of the measured sample that consisted of high school students. Some studies assume the growth of an individual does not cease at this age, which might be supported by the fact that university-educated individuals have been found to be taller than the high school population in Bosnia and Herzegovina (Grasgruber et al., 2017), in Poland (Wronka & Pawlinska-Chmara, 2009) and in Hungary (Szollosi, 1998). In contrast, this was not so in Montenegro (Popovic, 2017); comparing the average standing height measures of this study to the results of a study sample of university students might yield much more precise conclusions. Another obvious limitation of this study is the that the respondents were born in a time of war and poor economic situation, and it is thus assumed that both genders of Kosovo did not yet reach their full genetic potential. In the future, continuous monitoring is necessary, because it is expected the secular changes influencing standing height will rise in the following two or three decades.

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Conflict of interest
The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Influence of an Isotonic Sports Drink during Exercise and Recovery on Subsequent Endurance Capacity and Aldosterone Response in the Heat in Well-Trained Endurance Athletes

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Abstract

This study was designed to investigate the influence of isotonic sports drink ingestion during exercise and recovery on subsequent endurance capacity, aldosterone, and other physiological responses in the heat. Twelve male well-trained endurance athletes (27.55±3.87 yrs) performed three experimental trials in which they ingested a sports drink (750 ml), water only or none. Each trial consisted of 3000 m run, 1 h recovery, and time to exhaustion test. The trials were randomized and separated by seven days. Drinks were administered in a crossover design, with the double-blind provision of sports drink and water. Blood samples were collected before and immediately after 3000-m, following recovery, and at exhaustion. A repeated-measures ANOVA test revealed no differences in the physiological responses before and after 3000 m run ($p>0.05$). After recovery, heart rate was significantly ($p=0.050$) lower in the sports drink trial than with water and control, with no differences were noted in the other physiological responses ($p>0.05$). At exhaustion, however, the data showed no differences in oral temperature and heart rate, but the differences were shown in aldosterone, blood glucose, and sodium ($p<0.05$). A post hoc Bonferroni test revealed that aldosterone was lower with the sports drink (602.33±18.68 pmol/L) than with water (688.08±29.03 pmol/L) and control (695.25±49.21 pmol/L). Endurance capacity was significantly greater with sports drink (56.53±2.53 min) than with water (51.16±1.80 min, $p=0.001$) and the control (50.09±3.00 min, $p=0.001$), without differences between the water and control trials ($p=0.178$). In conclusion, the ingestion of isotonic sports drink increases endurance capacity and maintains aldosterone more effectively than with or without water probably due to improved fluid retention.

Keywords: *dehydration, fluid deficit, oral temperature, hyperthermia, glycogen*

Introduction

Prolonged moderate-intensity exercise can cause the depletion of muscle glycogen stores (Thomas, Morris, & Stevenson, 2009; Rollo & Williams, 2010), which can impair excitation-contraction coupling (Urdampilleta et al., 2015), and subsequently decrease performance. In addition, a fluid deficit during prolonged exercise may also develop (Pruna et al., 2016; Logan-Sprenger, Palmer, & Spriet, 2011), specifically when the exercise is performed in hot (> 30 ˚C) (Coso, Estevez, Baquero, & Mora-Rodriguez, 2008; Urdampilleta et al., 2015) and humid (> 60%; 30-60% refers to normal relative humidity) environments (Lee, Nio, Ang, Law, & Lim, 2011). Exercising for prolonged durations in the heat without adequate fluid intake can result in dehydration and hyperthermia

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(Paik et al., 2009), both of which are believed to have a negative effect due to the development of oxidative stress (Hillman, Vince, McNaughton, Mitchell, & Siegler, 2011) and cardiovascular strain (Cheuvront, Kenefick, Montain, & Sawka, 2010). Furthermore, hyperosmolality and cellular shrinkage, and subsequent apoptosis, may also occur without fluid replacement (Hillman et al., 2011). A fluid deficit over 3% of body mass during exercise can induce significant reductions in motor control, reaction times (Hoffman et al., 2012), aerobic power (Casa et al., 2010), and endurance capacity (Rollo & Williams, 2010). It has been documented that intake of water alone as a strategy to rehydration can induce hyponatraemia (Urdampilleta et al., 2015) and the ingredients in the drinking water are insufficient for energy supply (Urdampilleta et al., 2015; Noakes, 2012). Consequently, the intake of electrolytes and carbohydrate during prolonged exercise (Čugura, Pleština, & Kovačević, 2014; Lee et al., 2011; Pruna et al., 2016) in the heat may represent a nutritional strategy to reduce potential performance cessation.

Sports drinks are used by athletes before, during, and after exercise (Čugura et al., 2014) to counteract fatigue (Logan-Sprenger et al., 2011). Of relevance, the characteristics of sports drinks should be different in regard to the chronology of exercise (Urdampilleta et al., 2015). For instance, sports drinks should be hypotonic (4-6% carbohydrate; 0.5-0.7 g/L of sodium) before exercise, isotonic (6-9% carbohydrate; 0.5-0.7 g/L of sodium) during exercise, and hypertonic (9-10% carbohydrate; 1-1.5 g/L of sodium) after prolonged running (Maughan & Shirreffs, 2004; Evans, Shirreffs, & Maughan, 2009). In the heat, however, the concentration of sodium should be increased to 0.7-1.2 g/L when exercise is longer than 1 hour (Urdampilleta et al., 2015). Typical commercial isotonic sports drinks contain water to counteract dehydration (Čugura et al., 2014), electrolytes, namely sodium, to avoid hyponatraemia and hyperthermia (Urdampilleta et al., 2015), and carbohydrate to increase muscle glycogen content (Lee et al., 2011).

Aldosterone, a steroid hormone secreted by the adrenal cortex, is the most potent mineralocorticoids (Vaidya, Brown, & Williams, 2015). It is responsible for fluid and blood volume homeostasis through sodium and chloride reabsorption via the renal tubules and excretes potassium and hydrogen ions by urine (Catena et a., 2017); therefore, it plays an essential function in the human body during prolonged exercise in the heat. Most studies that have investigated the effect of commercially sports drinks have been focused on cycling endurance capacity (Rollo & Williams, 2010; Lee et al., 2011; Čugura et al., 2014), and sodium and potassium electrolytes (Palmer & Spriet, 2008). However, no research has investigated the aldosterone response to the ingestion of isotonic sports drink.

Consequently, the current study aimed to investigate the influence of isotonic sports drink ingestion during exercise and recovery on subsequent endurance capacity, aldosterone and other physiological (oral temperature, blood glucose, heart rate, and sodium) responses in the heat compared to water ingestion. The hypothesis was that the consumption of a commercially isotonic sports drink would be more effective in improving endurance capacity, probably due to its contents that may maintain plasma volume.

Methods

Participants

Twelve well-trained endurance male athletes from Jordan were recruited for the present study. The descriptive characteristics of the participants are presented in Table 1.

Table 1. Subjects demographic data

Variables	Mean±SD
Age (years)	27.55±3.87
Height (cm)	169.75±2.66
Mass (kg)	61.33±3.83
BMI (kg/m^2)	21.23±0.45
resting HR (bpm)	51.58±2.78
VO_{2max} (ml/kg/min)	60.08±4.96
Training volume (min/week)	707.50±61.87
Training experience (years)	10.00±3.47

All athletes were accustomed to training six times a week. Before trials, informed written consent form was provided by all participants. This study was performed in accordance with the ethical standards of the national research committee and with the 1964 Helsinki Declaration. The study was approved by the Local Scientific Committee (No. 02-07/2019 M).

Experimental design

Participants performed three experimental trials in which they ingested a commercially isotonic sports drink, water, or none (control). The trials were randomized, separated by seven days to complete recovery, and started at the same time (09.15 AM) for each athlete to maintain their circadian rhythm. Drinks were administered in a crossover design, with the double-blind provision of isotonic sports drink and water. Each trial consisted of three phases: 1) 3000 m run, 2) 1 h recovery at the laboratory, and 3) an endurance capacity test.

Experimental procedure

One week prior to the commencement of the trials, the participants visited the laboratory three times. On the first visit, the participants' characteristics were measured. After two days (on the second and third visits), each athlete was familiarized with the treadmill (TEC-GYM-EXC-700-UNTY, USA) at different speeds for at least 15 min, which was done to confirm a typical cadence. All athletes were instructed to standardize their dietary ingestion 24 h prior to the start of each experimental trial for not to affect their performance. The athletes were asked to avoid intensive training and physical activity and refrain from breakfast, coffee, and any ergogenic aids 24 h prior to each trial. They were asked to arrive at the location of the trials at 7:00 AM after an overnight fast.

Athletes wore the same attire and shoes for each trial.

Hydration protocol

All athletes were instructed to intake 500 ml of water 2 h prior to the beginning of a trial and refrain from eating and drinking thereafter, unless a trial procedure was indicated. The ingredients of isotonic sports drink and water are described in Table 2.

Table 2. Composition of test drinks

Contents	Sports drink	Water
Energy (kcal/L)	110	0
Protein (g/L)	0	0
Fat (g/L)	0	0
Sucrose (g/L)	32	0
Glucose (g/L)	18	0
Na^+ (mmol/L)	22	2
K^+ (mmol/L)	1.7	0.7
pH	7.1	7.0

Legend: Energy, electrolytes, and macronutrients content were obtained from the label of drink manufacturer

These drinks were served at 18 ˚C. Athletes were provided to intake either 150 ml of sports drink or water after 5 min of the beginning of 3000 m run. During the recovery period, athletes were asked to ingest either 150 ml of sports drink or water every 15 min. The total volume of each drink was 750 ml. The drinks were served in indistinguishable bottles, so that the participants did not know which drink they had ingested.

3000-m run

Participants entered the track of a stadium and completed a 10-min warm-up including 4 min stretching. Then, they ran 3000-m around the track in which the environmental temperature was warm in all three trials (25–28 ˚C) with normal relative humidity of 49–52%. Athletes were instructed to run each round on the track in 1.5 min to avoid reaching a heart rate at 160 bpm for preventing myocardial strain (Tortora & Derrickson, 2010), possible fatigue, and high fluid loss via sweating. The heart rate was monitored using a heart rate-vest monitor (Samsung Electronics, South Korea). The environmental temperature and relative humidity were observed using a thermo-hygrometer (A 1, China). The entire 3000-m run took 11.45–12.00 min.

Recovery period

On completion of the 3000-m run, athletes exited the track and entered a chamber at the laboratory in which the ambient temperature was set at 22 ˚C. Athletes sat resting in the chamber for one hour, during which they ingested their drinks. Recovery ensures the return of the muscle to its pre-exercise state after performance. It is suggested that the recovery period ensures performance in subsequent endurance capacity.

Endurance capacity test

Following the recovery period, athletes completed the endurance capacity test in all trials at a hot temperature (31–33 ˚C) and normal relative humidity (44–47%). The endurance capacity (time to exhaustion test) was carried out on the treadmill. After a standardized 5 min warm-up on the treadmill, athletes initially ran at 8 km/h, increased by 1 km/h every five minutes until volitional exhaustion. Athletes received verbal encouragement to continue running as long as possible. Running tolerance was defined as the incapacity to maintain a regular step cadence on the treadmill. At that point, the examiner pressed on the emergency stop button, and time to exhaustion was recorded.

Blood samples collection and analysis

Blood samples were collected from each athlete in the three trials and were withdrawn from the median vein of the athlete's left arm. Samples were taken at pre-trial, immediately after the 3000-m run, at the end of the recovery period, and immediately after the endurance capacity test. A total of 3 ml of blood was dispensed into a plain tube containing clot activator to measure blood glucose using Integral 400 (Switzerland), and 3 ml was dispensed into an anticoagulant EDTA tube. Oral temperature was measured by Digital thermometer-SDT-10A (Samsung, Korea). The plain blood tube was centrifuged at 3 ˚C and 3500 rev/min for 10 min to allow for the extraction of serum. Serum was used to measure concentrations of sodium using an ALI 480 Beckman electrolyte analyser (CO, Japan) and aldosterone hormone using chemiluminescent immunoassay (Elecsys Roche GmbH, Germany). The reference ranges of variables were as follows: 3.9–6.1 mmol/L for blood glucose, 111–860 pmol/L for serum aldosterone, 135–152 mmol/L for serum sodium. The normal range of body temperature is 36.6–37.4 ˚C.

Statistical analysis

Descriptive statistics are reported as Mean ± standard deviation (SD). Significance was set at $p<0.05$ for all analyses. A Shapiro-Wilk test was applied to check for normal distribution. All variables (aldosterone, oral temperature, blood glucose, heart rate, and sodium) at all the time points of the protocol were normally distributed ($p>0.05$). A repeated-measures analysis of variance (ANOVA) with a Greenhouse-Geisser correction was used to determine possible differences between trials in physiological responses and endurance capacity. When a significant F rate was achieved, post hoc tests using the Bonferroni correction was used for pairwise comparisons using adjusted means. Statistical analysis was conducted using SPSS version 18.0 and Microsoft Excel.

Results

There were no significant differences in the physiological parameters (aldosterone, oral temperature, blood glucose, heart rate, and sodium) measured before the commencement of all experimental trials (Table 3).

Table 3. Pre-trial physiological parameters

Parameters	SD trial	W trial	C trial	p
	M±SD	M±SD	M±SD	
Aldosterone (pmol/l)	428.25±6.52	430.25±7.22	431.08±6.81	0.588
TOral (˚C)	37.01±0.09	36.95±0.06	36.99±0.07	0.221
BG (mmol/l)	5.40±0.18	5.39±0.36	5.40±0.44	0.958
HR (bpm)	51.25±1.76	51.00±1.53	51.16±1.80	0.935
Na^+(mmol/l)	138.33±.88	138.58±.66	138.41±.66	0.709

Legend: SD-Sports drink, W-Water, C-Control, Toral-Oral temperature, BG-Blood glucose, HR-Heart rate, Na^+-Sodium (Significance level was set at p<0.05)

No differences existed between trials for any physiological parameters, insuring that the all parameters were normally distributed (p>0.05).

Table 4 illustrates the results of responses of these physiological parameters to isotonic sports drink, water or control at three time points: 1) after 3000 m run, 2) following recovery, and 3) at exhaustion. There were no differences in all physiological parameters after the 3000 m run between trials (p>0.05). After recovery, no differences were noted in the physiological parameters (p>0.05) except for heart rate that was significantly lower in the sports drink trial (p=0.050) than with water and control.

Table 4. Results of physiological responses to isotonic sports drink, water or control after 3000 m run, following recovery, and at exhaustion in 12 well-trained endurance athletes

Parameters	After 3000 m run			
	SD trial M±SD	W trial M±SD	C trial M±SD	p
Aldosterone (pmol/l)	524.5±13.94	529.5±17.92	531.5±19.99	.080
T_{Oral} (˚C)	37.62±0.08	37.64±0.13	37.68±0.12	.073
BG (mmol/l)	5.86±0.13	5.78±0.17	5.74±0.16	.162
HR (bpm)	127.83±4.23	128.50±2.74	130.16±3.58	.272
Na^+(mmol/l)	142.66±1.15	142.50±1.73	142.58±1.56	.964
Parameters	**Following recovery**			
Aldosterone (pmol/l)	494.41±7.98	496.75±8.84	500.08±8.11	.260
T_{Oral} (˚C)	37.29±0.90	37.32±0.12	37.35±0.10	.402
BG (mmol/l)	5.40±0.11	5.33±0.13	5.34±0.90	.237
HR (bpm)	108.00±4.38[a]	111.75±3.36	112.83±5.83	.050
Na^+(mmol/l)	138.16±0.93	138.00±0.73	137.91±0.99	.787
Parameters	**At exhaustion**			
Aldosterone (pmol/l)	602.33±18.68[a,b]	688.08±29.03	695.25±49.21	.001
T_{Oral} (˚C)	38.28±0.20	38.37±0.18	38.36±0.21	.061
BG (mmol/l)	4.96±0.21[a,b]	4.48±0.38	4.49±0.36	.031
HR (bpm)	167.50±14.25	168.33±11.53	170.16±9.92	.303
Na^+(mmol/l)	143.75±1.95[a,b]	142.16±1.19	142.00±1.27	.014

Legend: Post hoc with a Bonferroni adjusted means was used to determine the differences in aldosterone, blood glucose, and sodium between the three trials. aSports drink was significantly different from the control trial. blt was also significantly different from the water trial. No differences existed between the water and control trials (p>0.05). The significance level was set at p<0.05.

At exhaustion, data showed no differences in oral temperature and heart rate (F=1.321, p=0.061; F=1.354, p=0.303, respectively), but differences were present in aldosterone, blood glucose, and sodium (F=128.361, p=0.001; F=15.854, p=0.031; F=4.866, p=0.014, respectively, Table 4). Post hoc using Bonferroni with adjusted means revealed that aldosterone concentration was lower with sports drink than with water (p=0.001) and control (p=0.001), blood glucose levels were elevated with sports drink than with water (p=0.001) and control (p=0.001), and revealed greater serum sodium with sports drink than with water (p=0.046) and control (p=0.024). However, data reported no differences in aldosterone, blood glucose, and sodium between the water and control trials.

There were significant differences between trials (F=44.649, p=0.001) in endurance capacity (treadmill time to exhaustion). Endurance capacity was greater with the sports drink (56.53±2.53 min) than with water (51.16±1.80 min, p=0.001) and control (50.09±3.00 min, p=0.001), but no differences were observed between the water and control trials (p=0.178) (Figure 1).

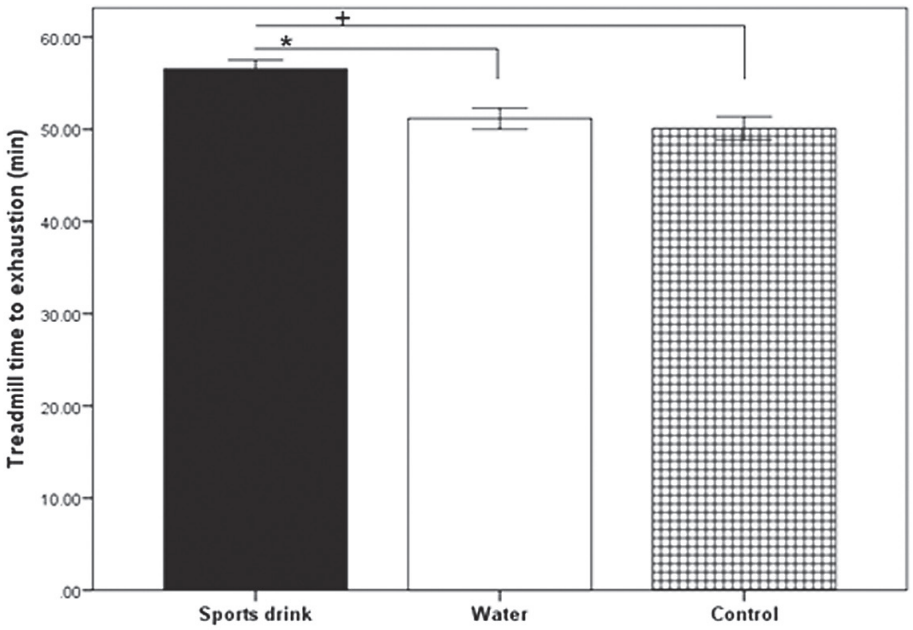

FIGURE 1. Treadmill time to exhaustion (endurance capacity)

Post hoc with a Bonferroni adjusted means was used to determine the differences in the endurance capacity between the three trials. *Sports drink significantly different from the control trial (p=0.001). +Sports drink significantly different from the water trial (p=0.012). No differences existed between the water and control trials (p=0.460). Significance level was set at p<0.05.

Discussion

The results of this study revealed that the endurance capacity (treadmill time to exhaustion) was longer with the isotonic sports drink than with water and the control. This result could be explained by the availability of carbohydrates in the sports drink during 3000 m run and recovery, contributing to maintained glycolysis during running, particularly at high speed on the treadmill. It is worth noting that a small elevation in carbohydrates promotes glucose and fluid uptake (Shirreffs, 2009), ensuring sustained energy supply. This result agrees with the study of Lee et al. (2011) who reported that in a hot environment (32 ˚C and 65% rh), the greater endurance capacity with a sports drink (1.5 L) was about 17.7 min longer than with water and about 13.5 min longer than with placebo in physically active males. However, the recovery period in that study was 5 h after 75 min run, which enhanced glycogenesis before beginning an endurance capacity test. Bilzon et al. (2000) showed 16 min longer running with a carbohydrate-electrolyte than with a placebo in healthy males. Pruna et al. (2016) found that time to exhaustion following 1 h run on a treadmill was significantly longer with ingesting 1 L of sports-electrolyte-glutamine drink compared to no hydration trial in 12 male endurance athletes. In the same study, they reported improved reactive ability to multiple visual stimuli in a 60-sec test following sports beverage ingestion compared to no hydration status. However, the trials of that study were performed in a cooler environment (22.9 ˚C and 44% rh). Thomas and colleagues (2009) reported improved cycle to exhaustion after ingesting chocolate milk (32 ± 11 min) compared to carbohydrate replacement drink (21 ± 8 min) and fluid replacement drink (about 23 min) in trained cyclists. They suggested that beverages containing protein are likely to benefit performance rather than carbohydrate or fluid alone. Stevenson et al. (2009) found improved performance and alertness in male golfers as a result of consumption of an isotonic drink (6.4 g carbohydrate and 16 mg caffeine per 100 ml) before a golf game and 1.6 mg/kg of caffeine plus 0.64 g/kg of carbohydrate during a game. In contrast, Rollo and Williams (2010) showed that ingestion of carbohydrate-electrolyte beverage (489 ml of water containing 6.4% carbohydrate) did not increase total running distance (13.6 min) compared to a placebo (13.5 min) in endurance-trained male runners.

The main finding of the present study is that athletes significantly completed the endurance capacity test with lower aldosterone concentrations in the sports drink than that of the water and control trials. This result might be attributed to sodium replacement by ingesting isotonic sports drink that can promote blood pressure homeostasis. Aldosterone is secreted from adrenal cortex as a result of the renin-angiotensin system (Vaidya et al., 2015). When blood flow is decreased, renin is synthesized from blood prorenin in the renal juxtaglomerular cells, which is, in turn, converted to angiotensin I by angiotensinogen found in the liver (Tortora & Derrickson, 2010; Guyton & Hall, 2006). Angiotensin I is then converted to angiotensin II by the angiotensin-converting enzyme, which stimulates the secretion of aldosterone from the adrenal cortex (Tortora & Derrickson, 2010). Aldosterone stimulates the renal tubules to increase reabsorption of sodium and water (Catena et al., 2017) to increase plasma volume and subsequent blood pressure. Thus, aldosterone was higher in the water and control trials to maintain plasma volume and electrolytes balance. In addition, the correlation between aldosterone and sodium is paralleled. The higher sodium content in the sports drink in comparison to water could explain this. This elevation may maintain a higher plasma volume and extracellular fluid (Below & Coyle, 1995), promoting an equilibrium of osmosis. Of relevance, sodium can improve performance through enhanced fluid retention during exercise (Lee et al., 2011). In line with this, Below and Coyle (1995) showed that the ingestion of 550 mg of sodium elevated its concentration

in bloodstream and enhanced the maintenance of plasma volume during 50-min cycling. Lee et al. (2011) also found higher sodium level at cycling exhaustion in a sports drink trial compared to water or a placebo.

The finding of the present study implies that blood glucose at exhaustion was significantly elevated following sports drink ingestion compared to the water and control trials. This result might be attributed to sufficient glycogen synthesis during recovery; what is more important is that blood glucose levels in the three trials were within the normal ranges, which might be related to the theory that stated that blood glucose is elevated or maintained while exercise is performed in the heat (Kay & Marino, 2000; Yaspelkis, Scroop, Wilmore, & Ivy, 1993). Furthermore, elevated blood glucose in the heat is related to the increased levels of catecholamines (Febbraio et al., 1994), which are responsible for glycogenolysis. Thus, blood glucose is unlikely to be the reason for exercise cessation in the present study.

Mean heart rates were not different between trials at all the time points except for following recovery, though the endurance capacity was significantly longer with the sports drink than with the water and control trials. This result could be explained by the role of sports drink in cardiovascular preparation during recovery, facilitating heart muscles to work effectively during the endurance capacity test. For instance, heart rates in the present study were insignificantly lower in the sports drink trial compared to the water and control (Table 4). Lee et al. (2011) suggested that sports drink reduced cardiovascular strain compared to water or placebo.

Data reported that mean oral temperatures were similar across trials at exhaustion. The explanation of this result might be attributed to the achieved greater time to exhaustion in the sports drink. This result agrees with the study of Lee et al. (2011), who found that mean core temperatures were similar across trials at exhaustion (sports drink: 38.7 ± 0.5 ˚C, placebo: 38.7 ± 0.4 ˚C, water, 38.6 ± 0.5 ˚C). However, the range of core temperature in all trials in that study was 38.0–39.7 ˚C, indicating that several athlete's temperatures have reached the point of hyperthermia (≥ 39 ˚C). In the present study, the range of oral temperatures was 37.8–38.7 ˚C. Nevertheless, the core temperature is higher than oral temperature by about 0.5 ˚C (Coso et al., 2008), ensuring that athlete's oral temperatures in the present study reached the point of hyperthermia similarly with those in the study of Lee et al. (2011).

Exercise in the heat poses a challenging effect on the ability of an athlete to control his/her body internal environment because of the high ratio of metabolic heat production and heat gain from the environment (Maughan & Shirreffs, 2004), which may result in the incidence of hyperthermia. A hot and humid environment impairs thermoregulation due to the competition between the skin and active muscles for blood flow (Butts et al., 2016). Furthermore, exercise-induced increases in thermal strain result in alterations in central activation and muscle contractile function (Pointon et al., 2012). Subsequently, the oral temperature in the present study might be the main reason for exercise cessation. A limitation of the present study was that urine specific gravity (USG), urine volume, and atrial natriuretic peptide (ANP) hormone were not measured, so further research to measure those variables is recommended.

According to the composition of the commercially available sports drink consumed in the present study, further studies should prove the significance of its influence. No studies evaluated the aldosterone hormone response to ingesting a commercially sports drink. Based on the current findings, this study concluded that the ingestion of isotonic sports drink attenuates elevation in aldosterone concentrations more effectively than with or without water ingestion. For athletes engaging in multiple endurance runs in a single day, consuming isotonic sports drink during exercise and recovery may improve subsequent endurance capacity.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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SportMont

ORIGINAL SCIENTIFIC PAPER

Testing Sponsorship Recall and Recognition after the Games of the Small States of Europe – Montenegro 2019

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Abstract

To explore sponsorship awareness, two approaches are most commonly used: recall and recognition. While researching sponsorship recall, respondents are asked to state a brand name from memory without any prompting. In contrast, recognition refers to a consumer's ability to name a brand after being presented with a brand list as a prompt. This study aimed to test sponsorship recall and recognition six months after the Games of the Small States of Europe were held in Montenegro (GSSE 2019). An online survey was distributed to participants of the games, as well as the volunteers and potential spectators. Survey data were analysed using descriptive statistics. Our results show that not all companies that invested and sponsored the GSSE 2019 were recognized by the respondents. Specifically, the top-of-mind sponsors were companies that activated their sponsorship investment using other marketing channels. Other sponsors, whose names were also displayed in official documents and in the playing courts and sport halls, achieved low recall levels. Therefore, we conclude that sponsorship, as an isolated medium, cannot achieve good results. Our findings suggest that the sponsorship investment itself is not sufficient to maximize the potential marketing effects. Companies that engage in sponsorship activation achieve higher sponsorship awareness, which can lead to positive attitudes towards the brand.

Keywords: *sport sponsorship, sponsor recall, sponsor recognition, sponsorship activation*

Introduction

Sponsorship has been one of the fastest-growing forms of marketing over the last two decades; it is defined as the compensation in cash or in-kind paid to an entity (most commonly related to sports, arts, entertainment, or humanitarian activities), while in return it is expected to access and exploit the commercial potential of that entity (Madrigal, 2001; Meenaghan, 1991). In 2017, global sponsorship investments were estimated at USD 62.7 billion (IEG, 2018). The declining efficiency of traditional media and the growing need for two-way communication, as well as changes in personal priorities and social values, are some of the factors contributing to the exponential growth of the application of this element of integrated marketing communications (Rogic, 2015). In this regard, sponsorship has proven to be a very successful communication channel, especially in the field of sports. The main goals of sponsorship are the improvement of image and attitudes, as well as the increase of the level of brand awareness by consumers; however, certain goals are related to the behavioural segment: the influence on purchasing intention and decision (Meenaghan, 1991).

The concept of sponsorship is gaining increasing attention in both academic literature and practice. As well as enabling the transfer of a positive atmosphere from events to the brand, it also brings to prestige to the company, as well as protection from unfair competition, which is understandable, given the

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fees paid for sponsorship. This concept has evolved rapidly over the last two decades, and from a simple philanthropic activity has become one of the most significant forms of media of corporate and brand communication. Thus, sport event sponsorship can be highly beneficial to sponsors, due to its ability to create a more positive impression and association through image transfer, compared to other sponsorship forms (Mullin, Hardy, & Sutton, 2014).

However, sponsorship as an isolated medium cannot achieve notable success in communicating with consumers. Marketing managers believe that event sponsorship should be accompanied by an adequate marketing programme, which includes activities such as sample distribution, giveaways, advertising, publicity, and the like (Kotler & Keller, 2006). Therefore, the sponsorship activity does not end with the payment of the sponsorship fee, but it is necessary to manage and leverage the investment and achieve maximum visibility for the investment to be profitable. To this end, companies use different techniques and media to "activate" sponsorship. In a survey conducted by IEG in 2014, social networks ranked first among the selected techniques, with nine out of ten companies using them for this purpose. In the same year, social networks replaced public relations in the first place among selected techniques for sponsorship activation (IEG Sponsorship Report, 2014).

To explore brand awareness, two measures are most commonly used: recall and recognition (Keller, 1993). In researching the recall, consumers are asked to state the brand name from their memory without any prompting. In contrast, recognition refers to a consumer's ability to cite prior brand exposure after being presented a brand list as prompt. Therefore, recalling the respondents' ability to remember sponsors of events through pure recollection. The brand that comes to the respondent's mind first is a construct that is often termed "top of mind" by practitioners (Bennett, Henson, & Zhang, 2002). Top-of-mind recall usually means that the respondents are more aware of the brand and, hopefully, will purchase more of that specific product than that of its competitors. Previous research has shown that accurately citing sponsors indicates a greater interest from viewers/participants in the message and the event itself (Wells, 2000). These measures were used in the study of sponsorship effects by Bennett (1999), Tan and Pyun (2018), Biscaia, Correia, Ross, and Rosado (2014), Lardinoit and Derbaix (2001), Wakefield, Becker-Olsen and Cornwell (2007) and others.

Previous literature suggests that brand exposure to consumers and congruence (i.e., a connection between sponsor and sports entity) is a crucial aspect for increasing sponsorship awareness (Biscaia et al., 2014). Also, numerous studies have suggested that consumers who are more loyal to the team or event can more easily identify sponsors, which speaks to their greater level of awareness (Rogic, Djurisic, Radonjic, & Vukovic, 2019). In his 2003 study, Madrigal found that consumers who have a higher level of knowledge of the sport, and who are more emotionally involved in following it, view and form attitudes about the sport event more critically than the average viewer (Biscaia et al., 2014). He states that this consumer group processes more information about the sponsorship itself than other groups and, at the same time, they are more likely to seek additional information about sponsors. In this regard, Maricic, Kostic-Stankovic, Bulajic, and Jeremic (2018) state that "through sponsoring a sport event, sponsors can be sure that their message will be effectively transmitted to the ones who are fans of the sport and the sponsored competition".

The results of a survey conducted by Bennett, Cunningham, and Dees (2006) after a professional tennis tournament showed a high rate of sponsorship recognition among spectators, with 65.4% accurately identifying sponsors. Similarly, by researching sponsorship awareness among judo athletes, Silva (2016) achieved 62.1% correct recognition. Tan and Pyun (2018) explored recall and recognition for the F1 Singapore Grand Prix and showed that logo placement on cars and driver's clothing was more effective than placement on the venue, and explained this by arguing that both cars and drivers get more attention from the viewers than the venue itself did. Another study examined sponsorship awareness of the 2007 Cricket World Cup by conducting a quasi-experiment on brand recall and brand recognition levels of respondents before and after the competition; it was found that both the brand recall and the brand recognition levels of the sponsors increased significantly, but that neither the brand recall nor the brand recognition levels of non-sponsor brands increased significantly (Boshoff & Gerber, 2008).

Leng (2017) states that sponsorship of sports events with a short duration can be as effective as of longer events. The main factors that influence the effectiveness of sponsorship of these events are the prominence of the sponsor, the duration of the event and spectator involvement. The Games of the Small States of Europe (GSSE) is just one short event, and this paper aims to explore the effectiveness of sponsorship through the two previously mentioned measures: recall and recognition.

The Games of the Small States of Europe is a biennial multi-sport event. In 2009, Montenegro joined eight other countries with fewer than one million inhabitants, and, as the ninth member, for the first time, organized the 18th occurrence of the Games, from May 27 to June 2, 2019. Nine countries participated with 846 athletes, who competed in 10 sports participating, and a total of 2331 registered participants. The Games of the Small States of Europe was the largest sporting event ever held in Montenegro.

Methods

Being able to recall (unaided) or recognize (aided recall) the sponsors of the event is often used as a measure of awareness of sponsorship activities (Bennett, Cunningham & Dees, 2006). These measures, together with top-of-mind recall, were used to examine the participants' sponsorship awareness six months after the Games of the Small States of Europe were organized in Montenegro.

Empirical research was conducted through an anonymous online survey. The questions were formulated so that the obtained data clearly contributed to the conclusion of the research problem. The survey was conducted in November 2019. The sample consists of 104 respondents: 33.65% male (35 respondents) and 66.3% female (69 respondents). Five age intervals were created: 16-25 (70.1%), 26-35 (19.2%), 36-45 (4.8%), 46-55 (2.88%), and over 55 (2.88%). In addition to age and gender, respondents were asked to select an education level. In the sample, 56.7% were students, 19.2% have a bachelor's degree, 8.65% have a master's degree, 6.7% have completed primary, and 8.7% have completed secondary school. An eliminatory question was whether the respondent had (in any form), participated in the GSSE Montenegro 2019. If they did, they were asked to select their role. Participants' roles are given in Figure 1.

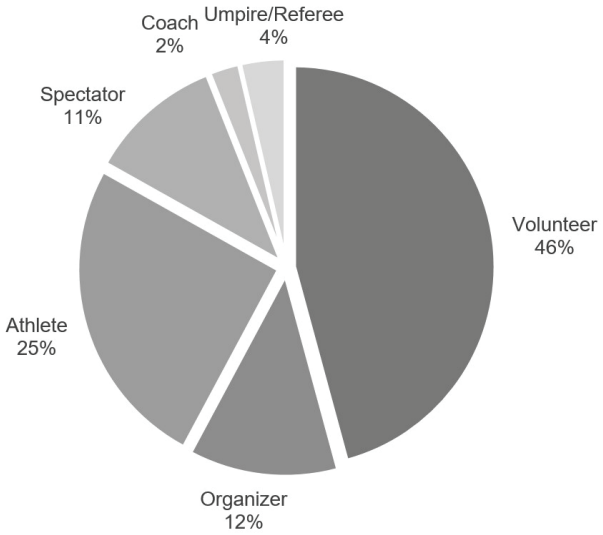

FIGURE 1. Respondents' roles at the GSSE Montenegro 2019

In this research, content analysis was conducted, along with a statistical method, to analyse the survey data. To interpret the data, it was presented graphically, which enabled making conclusions.

Results

This paper aimed to test the sponsorship recall and recognition after the Games of the Small States of Europe – Montenegro 2019. As previously mentioned, the games were the biggest sporting event ever held in Montenegro, and it required significant organizational, technical, human and financial resources. Therefore, the sponsors' investment was one of the crucial factors in organizing the event, as sport is usually not financially self-sufficient. On the other side, sponsor companies seek for sponsorship benefits while investing; therefore, sponsorship and brand awareness, besides image transfer, are one of the main goals of sport sponsorship.

To explore the sponsorship awareness of participants, (unaided) recall was tested first. To distinguish top-of-mind recall from the recall about several sponsors, respondents were first asked to name one sponsor that they remember first. The following Figure 2 shows brands listed as top-of-mind recall.

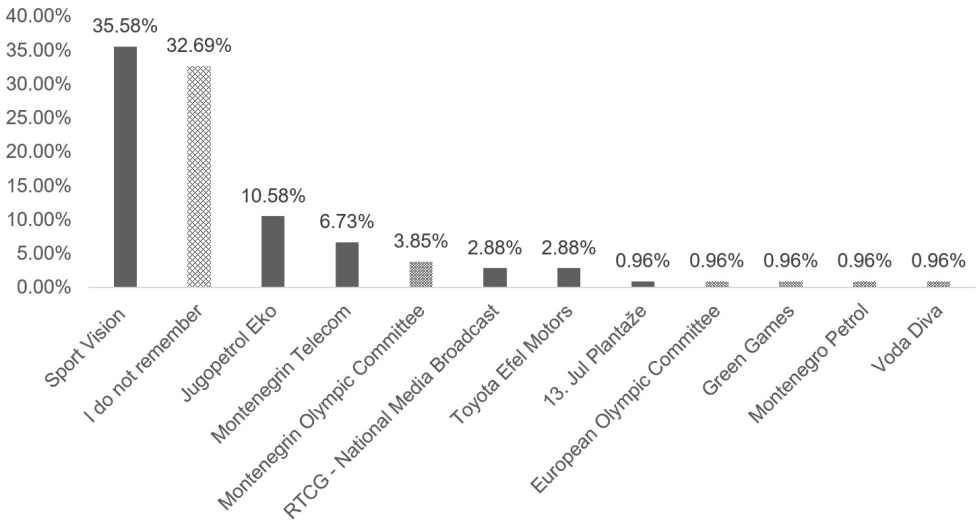

FIGURE 2. Top of mind recall after the GSSE 2019

Figure 2 shows that the company with the highest top of mind recall level of 35.58% is the sport equipment distributor Sport Vision, as the highest percentage of respondents listed this company when asked to name one sponsor of the games. However, 32.69% of respondents wrote that they did not remember any sponsor company, and this is the second most frequent response. Jugopetrol Eko and Montenegrin Telecom follow with 10.58% and 6.73% of recall, respectively. Two other sponsors (Montenegro Radio Television (RTCG), the national broadcaster and Toyota achieved 2.88% top-of-mind recall, while 13. Jul Plantaže achieved 0.96%. In contrast, some companies and organizations were named by the respondents, but they were not the sponsors of the event. One of those is the Montenegrin Olympic Committee, which was the included of the event, and some others were Montenegro Petrol and Voda Diva (0.96%), as shown in Figure 2.

The highest level of top-of-mind recall was achieved by Sport Vision. A leader in sport equipment distribution in Montenegro, Sport Vision became a sponsor of the Montenegrin Olympic Committee in 2015 (Montenegrin Olympic Committee, 2015). Since then, the company has con-

nected its brand with Olympic values and leveraged the sponsorship in every opportunity using different activation methods. Specifically, during the games, this company was the most active on social media, making it the most visible sponsor of the games (Figure 3). Also, since the company was the official supplier of the equipment for the Montenegrin delegation, it is important to state that 73% of the athletes that have listed a top of mind sponsor listed Sport Vision.

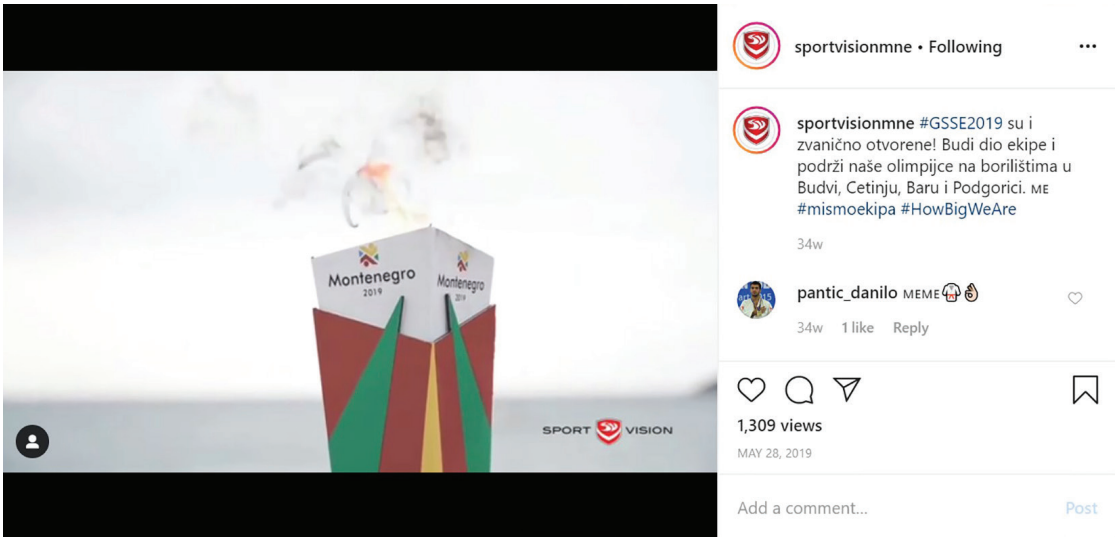

FIGURE 3. Sponsorship activation on Social Media – Sport Vision (Source: Sport Vision Montenegro)

The second highest top of mind recall was achieved by Jugopetrol Eko. It became a sponsor of the Montenegrin Olympic Committee only in April 2019, a month before the Games (Montenegrin Olympic Committee, 2019). Achieving 10% of top-of-mind recall can be seen as a good result for the company, taking into account the time frame.

Figure 4 shows the structure of the sample when testing brand "memorability", meaning how capable respondents are of recalling brands sponsoring GSSE in Montenegro and which of those they have remembered. This figure is of great importance for marketers since there was no suggestion about companies in the survey. As assumed from Figure 4, the companies Sport Vision and Jugopetrol Eko have the biggest recall with 33% and 22% of all responses, respectively. They are followed by the companies Montenegrin Telekom (7%), Lovćen Insurance (6%), Toyota (5%), RTCG (4%). It may be assumed that Montenegrin Telekom has higher recall percentage than other three companies as a consequence of being a more established and better-known brand, even though the visibility of the companies' logos at GSSE was the same. The fact that 1 out of 6 respondents could not recall by themselves any company sponsoring GSSE held in Montenegro is significant.

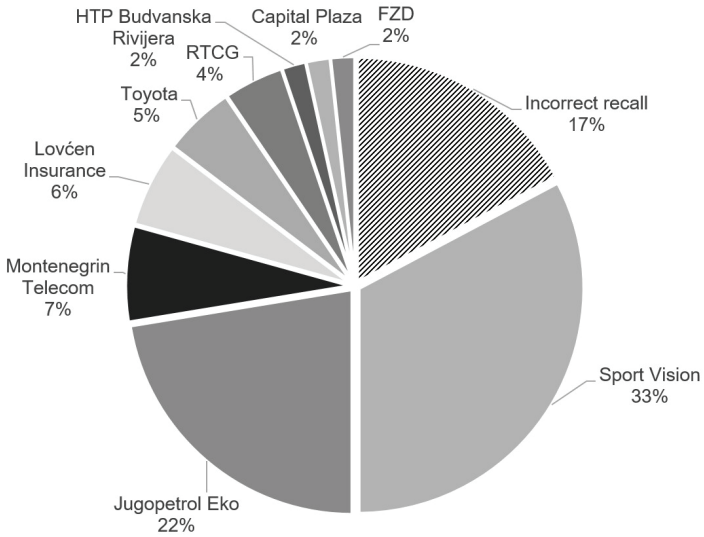

FIGURE 4. Sponsorship recall (unaided)

This survey question was given in the form of multiple-choice; however, the main difference in comparison to the previous one is that suggestions/prompts were given. Therefore, in this section, recognition was examined. A deeper analysis of the responses regarding the sector of transport shows a more balanced distribution. Specifically, almost a quarter of all respondents recalled the companies Montenegro Airlines and Monteput: 23% for each of them. Afterwards, Port of Bar, Podgorica Airport and Toyota are recognized in 1 out of 6 cases. Percentages distributed to the Montenegrin logistics company Montenomax and car producer Renault are rather small: 3 and 2 percentage points, respectively, however, neither of these companies were a sponsor of the games.

Analysis of the recall of sports equipment sponsorship at sports events is of particular importance. A logical assumption could be the respondents taking part in the sport event (GSSE Montenegro) represent an important and committed group of buyers of sport goods and equipment (Figure 5). Therefore, Sport Vision could be satisfied with the effects of their sponsorship investments during GSSE Montenegro since over 80% of respondents could recognize Sport Vision name as well as the strongest brand in their portfolio in Montenegro –Nike (equipment sponsor). Around 18% of all responses were incorrect, indicating sports equipment companies not sponsoring GSSE activities or Montenegrin competitors.

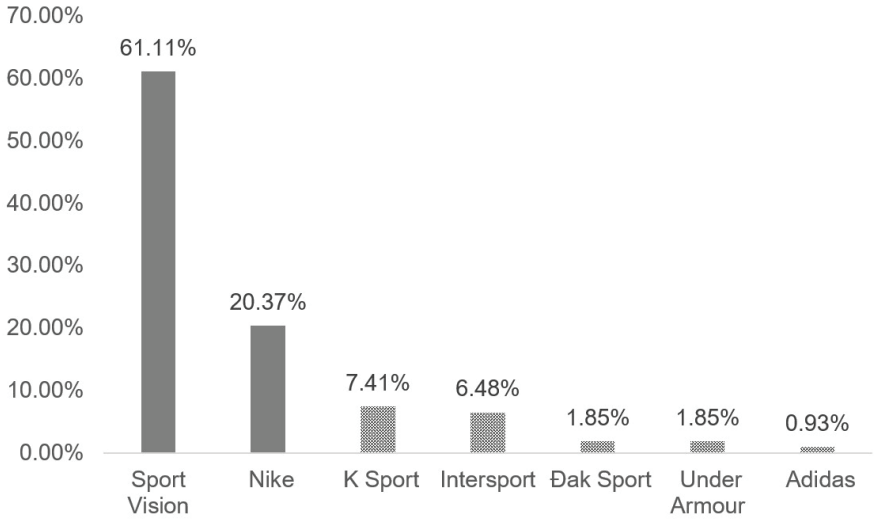

FIGURE 5. Sponsorship recognition (aided: company names) – sport equipment sector

Concerning the telecommunication industry, high recognition of the company sponsoring GSSE Montenegro is observed: 78% of respondents chose Montenegrin Telecom (Figure 6). Roughly one out of five respondents could not recognize the telecommunication sponsor of the GSSE in Montenegro. This percentage of incorrect answers appears as a consequence of strong competition among players on the market in Montenegro, in general. Additionally, M:tel is a sponsor of the Montenegrin Basketball Team, while Telenor used to be a sponsor of the Montenegrin Olympic Committee in 2010 (Montenegrin Olympic Committee, 2010). These facts can potentially explain the confusion of the respondents, as both companies still do, or have in the past, linked themselves to sport through sponsorship investment.

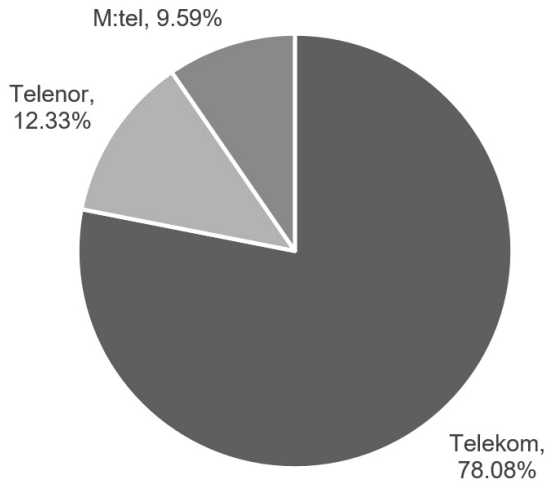

FIGURE 6. Sponsorship recognition (aided: company names) – telecommunications sector

Regarding financial institutions, Lovćen Insurance received the highest level of recognition at 31.88%, while the only other sponsor from this sector was listed only by 15.94% of respondents. In contrast, NLB Bank achieved 20.29% recognition, even though it was not a sponsor of the games. We can explain this result with respondents' confusion, as this company is often a sport sponsor. For example, NLB Bank is a sponsor of Montenegro's most successful basketball club, Budućnost Voli, as well as the international women's tennis tournament NLB Royal Cup. Another significant result regarding incorrect recognition was CKB Bank at 23.19%, as well as Addiko Bank at 8.70%.

Compared to previous questions in the survey, in which respondents were presented with only names of the companies, in the last question, respondents were presented with company logos. This was supposed to increase the correct recognition, compared to previous questions, since sponsor logos were placed around the Olympic village, courts and halls,

the website and on all other official documents. Some of the actual event sponsors achieved higher recognition, compared to unaided recall from the previous questions. For example, Jugopetrol Eko achieved 29.31% recognition, compared to 22% recall (Figure 4). Also, Montenegro Radio Television (RTCG) achieved 27.59% recognition, compared to only 4% recall (Figure 4).

Discussion

In general, the results of this research have shown a satisfying level of recall and (even more) recognition six months after the Games of the Small States of Europe. This indicates that sponsors were receiving significant visibility during the Games, which allowed for their brands to be remembered by the participants, since logo placement is significant in understanding the decision-making process by the consumer (Cornwell, 2008). However, a more in-depth analysis indicates that the provided brand visibility by the organizer through logo placement is not sufficient to achieve the full potentials of the sponsorship investment. Therefore, the companies should have put more effort into investment activation.

From the results presented above, we can conclude that it is precisely two-way communication that is gaining in importance from year to year. Companies that follow market trends respond appropriately and in a timely manner and activate the sponsorship through channels that enable such communication, such as social networks, on-site interaction, and the like. In this regard, sponsors of the 2012 Olympic and Paralympic Games, among other media, used Twitter to activate their investment. Chadwick, Donlan, and Anagnostopoulos (2017) grouped the types of tweets by sponsors into four categories (i.e., informing, entertaining, rewarding, and interacting) and showed that 68% of tweets fell into the first category. One of the successful examples of two-way communication during the games was a set of activities organized by Sport Vision on their Facebook page. One of them was a "caption this" contest, where five winners received an award from the company. Another was an in-store meet up with the mascot of the games, Mr Smokvich. Finally, the company organized another giveaway on Facebook, in which fans could predict the medal count for Montenegro at the GSSE; three correct answers received an Olympic gift package.

Also, sponsorship of the event can, in a way, only be seen as a prerequisite for generating a creative and innovative marketing campaign or individual activity, which will present the company to the target market, and again we emphasize the importance of channels through which the company will "activate" sponsorship. The results of the research suggest that the "activation" of sponsorship is necessary to maximize both investment results and potential effects. These results are in line with those obtained by Degaris, Kwak and McDaniel (2017), who state that the effect of awareness was fully mediated by engagement with sponsorship-linked advertising and promotions; therefore, additional efforts in marketing communication are essential in leveraging sponsorship awareness into more desirable consumer attitudes and behaviours. Additionally, the results of Dees, Gay, Popp, and Jensen (2018) showed that fans were 55% more likely to recognize sponsors with on-site activation.

The results of our research show a satisfying level of sponsorship recall for some companies, while not as satisfactory for the others. However, even though the recall was not at a significant level for companies such as Telecom or Lovćen Insurance, the recognition of these companies was at a high level. Therefore, it is clear that such companies gained visibility and strengthened their brand; however, additional activities, such as those organized by top-of-mind sponsors (i.e., Sport Vision and Jugopetrol Eko) were necessary to impact the participants' memory.

Moreover, W.W. Smith, Pitts, Mack, and J.T. Smith, (2016) suggest that the highest levels of sponsorship were associated with higher levels of recall when accompanied by significant leverage activities. While the obvious conclusion is the higher levels of sponsorship correlate with increased sponsor benefit, the recall results support the proposition that even major sponsors must aggressively leverage their sponsorship to optimize their investment.

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Conflict of interest
The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Morphological Characteristics and Functional Capabilities of Ground Forces Soldiers and Soldiers of the Navy of Montenegro

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Abstract

The objective of this research is to determine the status and eventual differences in morphological and functional characteristics with soldiers of Ground Forces and Navy soldiers of the Army of Montenegro. The sample of examinees was made of 50 soldiers, 18–45 years old, divided into two groups: 25 professional military personnel of Ground Forces and 25 professional military personnel of the Navy. The sample of measures has been made of the following morphological and functional indicators: body height, body mass, waist size, hip size, thorax size, upper leg size, forearm size, abdomen skinfold, chest skinfold, skinfold of the upper leg, body mass index, body fat percentage, waist-to-hip ratio, Forced Vital Capacity, Forced Expiratory Volume in 1 second, the ratio of Forced Expiratory Volume in 1 second and Forced Vital Capacity and Peak Expiratory Flow. Central and dispersion variables of parameters have been calculated; to determine differences in morphological and functional characteristics, the T-test for small independent samples has been applied. For military personnel of the Ground Forces, it was stated that this is a healthy population without obesity risk and without obstruction in the functioning of the respiratory organs. For military personnel of the Navy, notwithstanding the good respiratory function, the existence of the possibility of adverse effects of hypokinesis was determined on specific segments of their health status. Statistically significant differences between the subsamples of examinees have been determined in the morphological variables abdomen skinfold and body fat percentage; therefore, a conclusion has been made that there is a mutual dependency of the stated differences towards different possibilities of manifesting movement forms with the examined subsamples of examinees.

Keywords: *morphological and functional characteristics, differences, Ground Forces, Navy*

Introduction

The human factor with it morphological characteristics, as well as motor and functional abilities, was and has remained one of the most important objectives and qualities in the national defences worldwide, notwithstanding modern battlefield technology (Maric et al., 2013). During the selection of recruits and potential cadets, as well as during training, the analysis of morphological status tells us that the problem with overweight and excess of body fat is ongoing (Crawford et al., 2011). Such status of forces in the morphological sense, based on research studies worldwide, is a direct consequence of inadequate nutrition and insufficient physical activity, which affects functional abilities and, in a later age, seriously jeopardizes the health status of an individual (Kyrolainen et al., 2008). No soldier can be healthy if he cannot, thanks to his anthropological abilities and characteristics, perform the everyday and extraordinary tasks under increased workload and increased requests on the complete anthropological status of the body. The health of soldiers of the Army of Montenegro should be defined, among other things, by the high or optimal status of

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functional abilities and desired morphological proportions of bodily compositions (Banjevic, 2012).

Morphological characteristics describe the body constitution of a soldier based on a higher amount of anthropometric data (Jukic et al., 2008). There are various opinions regarding the ideal body composition for professional soldiers to optimize the physical fitness necessary to perform multi-purpose military tasks (Crawford et al., 2011). Since the tests of physical fitness are not a perfect indicator of condition potentials, nor do those potentials represent perfect indicators of abilities to perform concrete military duty, for example, the standard of body fat level would be an additional indicator of the level of physical activity and the ability for a certain level of desired physical performances. Furthermore, even with the adequate level of condition capacities, an inappropriately high level of body fat can be a risk factor for the cardiovascular system and musculoskeletal injuries. These risks, at least in the Army and other security services, justify the existence of standards of body size and composition, in addition to fitness standards (Vogel & Friedl, 1992).

Functional diagnostics makes an insight into certain physiological and biochemical characteristics of a soldier's body possible. For the assessment of structurally functional characteristics of the respiratory composition, spirometry tests are used (Jukic et al., 2008). Pulmonary Function Tests (PFTs) are usually used for the assessment of respiratory status and have become part of the routine health research within respiratory, work, and sports medicine (Kaur, Subhedar, Dave, Mishra, & Sharma, 2015). In his historic research, John Hutchinson (the inventor of the spirometer) found that age and height are the most important anthropometric determinants of lung function; since then many research studies have confirmed that lung function increases with the height and reduces with age (American Thoracic Society). Although the effect of body weight on lung function is visible, an additional deviation has been explained by the Body Mass Index (BMI). Lung function is reduced at both extremities of weight (i.e., emaciation or obesity) (Dockery et al., 1985). Few research studies have analysed the size of FM (body fat mass) and FFM (fat-free mass) concerning lung function. For FM, it has been observed that it is negatively connected with lung function, especially with very obese persons, while it is positively connected with FFM (De Lorenzo et al., 2001).

Recently, several studies, in Montenegro and throughout the world, have dealt with the analysis of the morphological indicators and functional abilities of soldiers (Collins, Hoberty, Walker, Fletcher, & Peiris, 1995; Rakovic & Savcic, 1999; Harik-Khan, Wise, & Fleg, 2001; Jukic et al., 2008; Banjevic, 2012; Abt et al., 2016). Based on the above-mentioned studies, it was found that significant differences appear in morphological and functional space with reference to ethnographic regions, as well as specificities of formation, age and speciality structure in the armies of the region and the world.

Accordingly, as well as with the need to analyse certain morphological and functional indicators of military personnel of different military branches, the objective of this research has been set. It includes determining the status and defining eventual differences in morphological characteristics and functional abilities of soldiers of Ground Forces and the Navy of Montenegro Army.

Methods

Sample of examinees

The sample of examinees was made of soldiers of Ground Forces and Navy soldiers of Montenegro Army of the ages 18-45. The average age was 32.3±6.5 years for the soldiers of Ground Forces, and 34.2±7.3 years of age for those of the Navy of Montenegro Army. The total number of examinees is 50, and they are divided into two subsamples. The first subsample was made of 25 soldiers from the Mountain Infantry Troop from Kolasin, while the other subsample was made of 25 soldiers of the Command and the Patrol Ship of the Navy of the Montenegro Army from Bar.

Sample of measures

The measuring was done in specially prepared premises of military quarters in Kolasin and Bar, and the examinees were dressed in sports clothing typical for physical training.

The sample of measures was made of the following morphological and functional indicators: body height, body mass, waist size, hip size, thorax size, upper leg size, forearm size, abdomen skinfold, chest skinfold, skinfold of the upper leg, body mass index, body fat percentage, waist-to-hip ratio, Forced Vital Capacity, Forced Expiratory Volume in 1 second, the ratio of Forced Expiratory Volume in 1 second, and Forced Vital Capacity and Peak Expiratory Flow.

For the assessment of morphological status, the following measuring instruments were used: anthropometer (Martin model), 200 cm long with calibrated notches on centimetres and millimetres, which makes possible a precision of measuring to 1 mm; pelvimeter with a scale on horizontal handrails which connects the two arms. The scale has a span of 60 cm, and it was calibrated to 0.1 cm; Martin's drawing compass with a scale with a span of 20 cm, was calibrated to 0.1 cm; scales (transportable), which make possible the precision of measuring to 0.5 kg, with which there is the possibility of regulating the pointer to zero position; a metal measuring tape, 150 cm long with marked centimetres and millimetres, which makes possible the precision of measuring to 1 mm; a calliper (John Bull model), for measuring skinfolds, adjusted so that the pressure of arms tips on the skin is 10 gr/mm^2. Centimetres and millimetres are marked on the calliper scale. The precision of measuring is 0.5 mm.

Parameters of body structure have been calculated in accordance with the following: Body Mass Index BMI=Body mass (kg)/Body height (m^2); percentage of body fat PTM=4.95/body density – 4.50; waist-to-hips ratio KSK=waist size/hip size.

Parameters of functional abilities have been measured employing spirometry. The test is performed in controlled microclimatic conditions. The examinee takes the turbine on which there is the cardboard ending and puts it in the mouth. He then puts the clip on the nose. Through the turbine, several times normally, in a relaxed manner, he inhales and exhales and, after that, maximally fills the lungs with air (inhales maximally). After maximum inhalation, the examinee, strongly and explosively, in as short as time possible, exhales the air from the lungs and continues exhaling, without repeating the inhale, as long as he can. After that, the examinee takes out the cardboard ending from the mouth and removes the clip from the nose.

Anthropometric measuring has been implemented by complying with basic rules and principles regarding the selection of measuring instruments and techniques of measurement, which have been standardized in accordance with the

International Biological Programme (IBP). The parameters of body structure have been calculated based on the Protocol of the Manual for the Assessment of Physical Form Connected with Health (Kaminsky, 2013). Spirometric testing has been realized in accordance with the Protocol of Soldiers Functional Abilities Diagnostic (Jukic et al., 2008).

Methods of data processing

The obtained results were first arranged appropriately, and then statistically processed on a personal computer with SPSS 20.0 software. The data were processed using descriptive and comparative statistical procedures. The central and dispersion parameters of variables have been calculated, for determining differences in morphological and functional characteristics; the T-test has been applied for small independent samples with the statistical significance of $p<0.05$.

Results

Tables 1-4 show the basic statistical descriptive parameters of morphological and functional variables of soldiers of the Ground Forces and Navy soldiers of the Montenegro Army.

Given the insight into the descriptive statistics of morphological variables of the parameters of Ground Forces soldiers of the Montenegro Army, shown in Table 1, the discrimination of measurement by the analysis of standard asymmetry ratio has been determined. The skewness value for variables of body height, forearm size and waist-to-hip ratio shows the negative asymmetry with the domination of better results, while the positive asymmetry is visible with the other variables; therefore, it is concluded that the results are in the zones of weaker values with normal or moderate asymmetry. The negative value of kurtosis for six morphological indicators shows the deviations with reference to the platykurtic curve (heterogeneity of results), meaning on more explicit discrimination among examinees, while its positive value for the remaining variables shows leptokurtosis (homogeneity of results). With reference to the measure of thorax skinfold (Kurt=5.02), we can state that the soldiers of Ground Forces of Montenegro Army are the most homogenous (significant leptokurtosis).

Table 1. Central and dispersion parameters of morphological variables of Ground Forces soldiers of the Montenegro Army

Variable	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
body height	170.2	190.6	182.7±6.21	38.56	-.542	-.708
body mass	76.6	125.8	93.2±12.03	144.76	.872	.676
waist size	81.0	114.0	95.8±8.35	69.78	.361	-.419
hips size	83.5	113.0	94.8±6.57	43.22	.844	1.29
thorax size	95.0	119.0	104.9±7.24	52.54	.146	-1.10
upper leg size	50.0	71.0	59.9±4.91	24.18	.350	.272
forearm size	26.0	32.5	29.4±1.69	2.86	-.480	-.324
abdomen skinfold	9.0	40.0	20.1±8.59	73.94	.770	-.215
thorax skinfold	3.0	10.0	5.1±1.42	2.02	1.46	5.02
upper leg skinfold	4.0	18.0	7.6±3.91	15.32	1.31	.701
Body Mass Index	22.4	37.2	28.0±3.33	11.14	.685	.891
percentage of body fat	2.8	16.8	8.8±4.17	17.41	.314	-.888
waist-to-hip ratio	0.9	1.08	1.00±.033	.001	-.087	.508

Legend: Min.–minimum result; Max–maximum result; Mean–arithmetic mean; SD–standard deviation

With further inspection of results in Table 2, which refer to functional indicators of Ground Forces soldiers of the Montenegro Army, the following has been determined: skewness values for the variable regarding the ratio of the Forced Expiratory Volume in 1 second and the Forced Vital Capacity, show the negative asymmetry with the domination of better results, while for other variables, the results are in the zones of weaker values; the positive value of skewness for variables Forced Expiratory Volume in 1 second shows the homogeneity of obtained values, while platykurtosis and heterogeneity of results have been observed.

Table 2. Central and dispersion parameters of functional variables of Ground Forces soldiers of the Montenegro Army

Variable	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
FVC	4.29	6.74	5.43±.672	.453	.097	-.748
FEV1	3.41	6.00	4.46±.630	.398	.882	.627
FEV1/FVC	64.5	99.90	82.65±9.75	95.11	-.367	-.553
PEF	3.50	12.50	7.85±2.80	7.87	.428	-.653

Legend: FVC–Forced Vital Capacity; FEV1–Forced Expiratory Volume in 1 second; FEV1/FVC–ratio of Forced Expiratory Volume in 1 second and Forced Vital Capacity; PEF–Peak Respiratory Flow

Based on the results of the morphological indicators of Navy soldiers of the Army of Montenegro in Table 3, we can see the normality of distribution of the majority of variables. According to the values of skewness, positive asymmetry has been dominantly present with more distinct weaker results, except for the variables body height and waist-to-hip ratio, for which a negative asymmetry is found with better results. The curve ratio indicates the heterogeneity of results and platykurtosis of the curve with the variables body height and upper leg skinfold, while with the majority of the remaining measures the homogeneity of results has been

found and leptokurtosis of the curve. With the inspection of the stated results, a distinctly expressed homogeneity for variables has been expressed: body mass (Kurt=4.63), waist size (Kurt=5.26), hip size (Kurt=8.53) and thorax skinfold (Kurt=6.30).

Table 3. Central and dispersion parameters of morphological variables of the Navy soldiers of the Montenegro Army

Variable	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
body height	162.0	189.5	179.2±7.11	50.62	-.346	-.045
body mass	62.0	147.2	92.5±16.28	265.25	1.30	4.63
waist size	70.0	145.0	99.6±13.39	179.52	1.10	5.26
hips size	80.0	137.5	97.6±10.46	109.55	2.17	8.53
thorax size	93.0	138.0	107.1±9.62	92.58	1.34	3.42
upper leg size	52.5	65.5	57.6±3.34	11.21	.723	.609
forearm size	24.0	34.0	28.8±1.84	3.40	.174	2.95
abdomen skinfold	14.0	53.0	30.4±8.99	80.84	.325	.461
thorax skinfold	4.0	22.0	7.0±4.87	23.75	2.61	6.30
upper leg skinfold	4.0	13.0	8.0±2.56	6.57	.306	-.970
Body Mass Index	22.3	46.0	29.0±4.79	22.96	1.69	5.50
percentage of body fat	4.4	27.0	14.3±5.01	25.19	.491	1.00
waist-to-hip ratio	.87	1.1	1.01±.003	.002	-1.25	3.31

Regarding the descriptive indicators of functional parameters for the subsample of Navy soldiers of the Montenegro Army, shown in Table 4, and based on values of skewness, the following has been found: for variables of Forced Expiratory Volume in 1 second and the ratio of Forced Expiratory Volume in 1 second and Forced Vital Capacity, a negative asymmetry with the domination of better results, and for the remaining two variables, a positive asymmetry with the domination of weaker results. Negative kurtosis for variables Forced Vital Capacity, and Peak Expiratory Flow shows the platykurtosis and heterogeneity of results. With other variables, based on positive values of kurtosis, homogenous results can be seen, especially with the variable of the ratio of Forced Expiratory Volume in 1 second and Forced Vital Capacity (Ku=15.67).

Table 4. Central and dispersion parameters of functional variables of Navy soldiers of the Montenegro Army

Variable	Min	Max	Mean±SD	Variance	Skewness	Kurtosis
FVC	3.62	6.57	5.10±.715	.512	.080	-.262
FEV1	2.80	5.11	4.17±.466	.218	-.576	2.20
FEV1/FVC	5.00	94.70	79.06±17.07	291.57	-3.58	15.67
PEF	4.20	12.50	8.42±2.38	5.67	.404	-.201

Per the obtained results of the T-test for morphological indicators of Ground Forces soldiers and Navy soldiers of the Montenegro Army, shown in Table 5, statistically significant differences have been found in the morphological variables of abdomen skinfold and body fat percentage. It was determined that the Navy soldiers of Monrenegro Army have higher values of abdomen skinfold for 10.32 mm and of body fat percentage for 5.46%.

Table 5. The values of T-test between the arithmetic means of variables for the assessment of morphological characteristics of Ground Forces soldiers and Navy soldiers of the Montenegro Army

Variable	Rang	Mean	t	df	Sig.	Mean Dif.
body height	Ground Forces Navy	182.76 179.21	1.87	48	.066	3.54
body mass	Ground Forces Navy	93.26 92.52	.184	48	.855	.744
waist size	Ground Forces Navy	95.84 99.65	-1.20	48	.233	-3.81
hips size	Ground Forces Navy	94.84 97.64	-1.13	48	.263	-2.80
thorax size	Ground Forces Navy	104.93 107.10	-.898	48	.374	-2.16
upper leg size	Ground Forces Navy	59.90 57.65	1.88	48	.065	2.24
forearm size	Ground Forces Navy	29.42 28.86	1.11	48	.269	.560

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Variable	Rang	Mean	t	df	Sig.	Mean Dif.
abdomen skinfold	Ground Forces Navy	20.12 30.44	-4.14	48	.000	-10.32
thorax skinfold	Ground Forces Navy	5.12 7.00	-1.85	48	.070	-1.88
upper leg skinfold	Ground Forces Navy	7.64 8.08	-.470	48	.640	-.440
Body Mass Index	Ground Forces Navy	28.01 29.09	-.924	48	.360	-1.07
percentage of body fat	Ground Forces Navy	8.86 14.32	-4.18	48	.000	-5.46
waist-to-hip ratio	Ground Forces Navy	1.00 1.01	-.807	48	.424	-.009

Legend: t–t value; df–degrees of freedom; Sig.–significance; Mean Dif.–differences of arithmetic means;

Based on the obtained results of T-test for functional indicators of Montenegro Army soldiers of the Ground Forces and Navy, shown in Table 6, statistically significant differences have not been found.

Table 6. The values of T-test between arithmetic means of variables for the assessment of the functional characteristics of Montenegro Army soldiers of the Ground Forces and Navy

Variable	Rang	Mean	t	df	Sig.	Mean Dif.
FVC	Ground Forces Navy	5.43 5.10	1.65	48	.104	.325
FEV1	Ground Forces Navy	4.46 4.17	1.86	48	.068	.293
FEV1/FVC	Ground Forces Navy	82.65 79.06	.912	48	.366	3.58
PEF	Ground Forces Navy	7.85 8.42	-.782	48	.438	-.576

Discussion

Body height, as the most reliable parameter of following the growth and development with soldiers of Ground Forces of the Army of Montenegro, has the average value of 182.7 cm, which is the tallest compared to soldiers of foreign armies, whose body height has been determined by research in the Army of Serbia (Glavac, 2015), USA Army (Steed, Krull, Morgan, Tucker, & Ludy, 2016), the Army of Finland (Kyrolainen et al., 2008), the Army of Canada (Tingelstad, Theoret, Spicovck, & Haman, 2016), the Army of Turkey (Tugcu, Ozaslan, Ozaslan, & Koc, 2016) and the Army of Belgium (Mullie, Vansant, Mieke, Clarys, & Degrave, 2008). Based on that, a conclusion can be made that Montenegrin soldiers are typical representatives of their national corps, by which are confirmed the results of studies that show that Montenegrins are among the tallest nations in Europe (Bjelica et al., 2012; Milasinovic, Gardasevic, & Bjelica, 2017).

The progression of acceleration phenomenon regarding body height of soldiers can be determined by comparing the results of this research with the study realized in the 1980s in the Yugoslav National Army (Todosijevic, 1989); in 1982, the recruits from Montenegro had an average height of 176.6 cm, and in 1989 an average height of 178.9 cm. If we also take in consideration the results obtained in this study, it can be concluded that the differences found are completely in compliance with the commonly held notion that the last fifty years have brought a significant acceleration of growth in population: on average, 1–1.2 cm per decade. The increase of longitudinal dimension of the Montenegro Army Ground Forces soldiers was followed by a significant increase of their body mass and thorax size, which compared to indicators from the study (Todosijevic, 1989): 24.5 kg and 13.2 cm, respectively.

Regarding skinfolds, which are the main indicators of body fat percentage, there are lower values for soldiers of our study compared to the study or Ivkovic and Pejic (1989). Also, significantly lower values of body fat percentage have been confirmed with Montenegrin soldiers compared to the candidates of the Military Academy in Brazil. Specifically, by comparing the values of this component of body composition obtained in the study of Avila et al. (2013) with equivalent values in our study, we come to the data that the soldiers of Ground Forces of Montenegro Army are with lower values of body fat for 4.82 %. In addition, compared to the fat tissue percentage, and in accordance with the norms for the assessment of fat tissue of the Couper Institute (Kaminsky, 2013), the soldiers of the Army of Montenegro have been classified as "excellent". Regarding the level of nutritional status, based on the value of body mass index (BMI), according to Kristoforovic-Ilic (2001), the Montenegrin soldiers are classified in the category of excess body weight.

According to the results of descriptive statistical indicators of functional abilities for the subsample of Montenegro Army Ground Forces soldiers, the middle value of their Forced Vital Capacity is for 0.83 l higher than the determined value according to Guyton (1985), i.e., 0.65 l higher than the determined value towards Comroe, Forster, Dubois, Briscoe,

and Carlsen (1965). It is found that the Forced Expiratory Volume in 1 second accounts for 82.65% of vital capacity, which is a feature of healthy people with good respiratory function according to R. Medved, Heimer, Kesic, and V. Pavišic-Medved (1979). This value represents the so-called Tiffeneau Index, whose normal (reference values), according to Davidovic et al. (1975), are higher than 70%. The values of Peak Expiratory Flow, confirm the diagnosed status of lung infection and show that there is no danger from any type of airways obstruction.

Regarding the morphological indicators of Navy soldiers of the Montenegro Army, in addition to the fact that on average they are 3.5 cm shorter than the military personnel of Ground Forces, we can confirm that they are taller than the subjects the majority of previously mentioned studies.

In addition, bearing in mind the domination of longitudinal dimensions, there is also a difference in the majority of anthropometric measures in favour of soldiers of the Montenegro Army: body mass (11.9 kg), waist (10.1 cm), Body Mass Index (3.4) (Rakovic-Savcic, 1999); thorax size (1.1 cm) (Glavac, 2015). However, with the Navy sailors, a lower percentage of body mass by 4.81% has been registered compared to the Chieftains of the Army of Serbia (Rakovic-Savcic, 1999), and, in accordance with the norms for the assessment of tissue of the Couper Institute (Kaminsky, 2013), they are being classified in the category with the descriptive mark "very good". The same as the soldiers of Ground Forces, according to Kristoforovic-Ilic (2001), they belong to the population with excessive body weight. Bearing in mind that waist-to-hip ratio, with military personnel of the Navy of Montenegro Army at >0.95, they have the dominant distribution of fat tissue in the upper part of the body (Collins et al., 1995). Based on that, and in compliance with the results of the study by Harik-Khan et al. (2001), we can conclude that there is the possibility of a negative influence of fat tissue in the abdomen on the diaphragm and thoracic walls.

The obtained parameters of functional abilities of Navy soldiers of the Montenegro Army are somewhat lower than the equivalent parameters with Ground Forces soldiers, but it can be concluded that these are also healthy persons with good respiratory function, without the possibility of its obstruction on any basis. The obtained values of functional indicators with the Montenegrin Navy soldiers are lower compared to parameters of lung function of pilots of the Croatian Armed Forces (Jukic et al., 2008), in the following: Forced Vital Capacity-0.83 l, Forced Expiratory Volume in 1 second-0.48 and Tiffenau Index-1.45. Bearing in mind that our examinees are sailors, it is presumed that the stated differences are subject to specific needs and selection, which is being implemented in the Air Force.

By applying the T-test, it was determined that among the subsamples of examinees, there are statistically significant differences in morphological indicators (i.e., abdomen skinfold and percentage of body fat) in favour of Montenegro Navy soldiers. Bearing in mind the fact that these are the military personnel of the Navy Command of one of the Patrol Ships of the Montenegro Army, their limitation is stated in the sense of regular implementation of adequate physical activities, which would also condition lower values of the said morphological measures. In contrast, the military personnel of Ground Forces from the Mountain Infantry troop in Kolasin have physical training every day accompanied by specific-purpose tasks, which include the high energy activities (mountaineering, alpinism, skiing, camping in winter conditions, etc.). These differences indicate one of the basic problems in the Army of Montenegro regarding personnel employed on static working positions and spaces limited for movement (Headquarters, Unit Command structures, administration, Navy vessels, radar positions, mountain networking node etc.). The insufficient movement activity and inadequate habits of these persons condition numerous health problems and system disorders in the work-active process. These conclusions were made by numerous studies in the army, among which is the research Kyrolainen et al. (2008), which emphasizes that insufficient muscular functionality and aerobic abilities, as well as the high BMI of soldiers, are risk factors in the sense of possible absence from work due to sickness leave and inadequate performance of set tasks. The authors especially point out obesity as a factor that has social and economic and health implications in the sense of limiting functional abilities, increased mortality, and premature pension with soldiers in Finland.

Bearing in mind that this was a higher number of applied morphological indicators, there is no basis for any general statement about morphological differences between the stated groups of examinees. Furthermore, there is the fact that the results of the T-test for functional parameters have not shown statistically significant differences, bearing in mind their close connection with certain segments of morphology and body composition.

In accordance with the obtained results, it is possible to make certain conclusions. The Montenegrin soldier is taller than his counterparts from the armies of the region and throughout the world. This confirms the assumptions that this soldier is a typical representative of his people, and that Montenegrins are among the tallest people in Europe. It was found that the examined soldiers of Ground Forces of Montenegro Army are a healthy population at no risk regarding the occurrence of obesity or obstructions in the functioning of respiratory organs. With the military personnel of the Navy of Montenegro Army, notwithstanding the good respiratory function, there is a possibility of negative effects of hypokinesis on certain segments of their health status.

Accordingly, the conclusion is that the soldiers of Ground Forces of Montenegro Army can professionally and efficiently perform demanding multi-purpose military tasks without endangering their health, which is very important from the aspect of organization and realization of training. It would eventually produce a soldier who would, in accordance with all relevant standards, be compatible with his counterparts of the most developed members of NATO.

The results of this research represent the contribution in the direction of shedding light on the status of morphological and functional parameters of soldiers in the Army of Montenegro. It would be significant to implement a wider study in which comparisons would be performed of morphological and functional indicators of soldiers according to age, all branches of the army, and military specialty. Bearing in mind the size of the analysed sample, it is not possible to make additional conclusions that would be in compliance with the general principles of statistics and kinesiology. However, this does not diminish the value of this study which has indicated the great importance of following the morphological space and functional abilities of soldiers.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

The Influence of Social Support from Parents on the Level of Physical Activity in Adolescents

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Abstract

A survey has been conducted on a sample of 974 randomly selected respondents from several faculties within the University "Hasan Prishtina" in Prishtina, Kosovo, to determine how social support from parents influences the level of physical activity in adolescents of both genders. Physical activity is assessed with the standardized IPAQ questionnaire (International Physical Activity Questionnaire), intended to investigate the frequency, duration, and intensity of physical activity. Social support from parents was assessed using the Parental Support Scale, which consisted of five items. The data were processed by using appropriate statistical nonparametric methods ($\chi 2$ test and Mann-Whitney U-tests). Based on the obtained results, it can be concluded that parents can have a significant influence on the physical activity in adolescents of both genders. Parents can promote physical activity for their children in various ways, such as: by the conveyance of positive attitudes and values, by organizing activities for their children, by participating in joint activities with children, and by providing transportation to places where they can be physically active. Research has shown that there are no differences in the perceived social support from parents between male students and female students; however, for girls, social support from parents is a more significant determinant that affects whether and to what extent they will engage in physical activity.

Keywords: *physical activity, students, attitudes, IPAQ criteria*

Introduction

In all its activities, the World Health Organization indicates the importance of physical activity in the preservation of health, especially in the prevention and treatment of chronic diseases (McKenzie et al., 2002; WHO, 2010). Numerous scientific-expert studies emphasize the causal relationship between physical activity, physical fitness, and the health of the individual (Dzepina & Cavlek, 2004; Misigoj-Durakovic, 2008). These studies point out causes such as lack of physical activity, sedentary lifestyle, inadequate nutrition, weight gain, cigarette smoking, alcohol consumption and drug abuse, and increasingly common eating disorders in the form of anorexia or bulimia. Previous studies have emphasized the problem of insufficient physical activity and a propensity to engage in risky behaviours, especially among the student population (Huddleston, Mertesdorf, & Araki, 2002; Dzepina & Cavlek, 2004). Students are a part of the population of young people preparing for an essential role in social life, who, as academically educated people, with their knowledge and experience, will influence future generations of children and youth. The sharp decline in physical activity is particularly expressed during adolescence (15-19 years of age) and in young adults (20-25 years of age), which puts students within the risk group (Wallace, Buckworth, Kirby, & Sherman, 2000).

The explanation regarding the influence of the factors on behaviour changes is crucial in designing interventions, strategies, and educational programmes that will contribute to increasing the level of physical activity in young people (Trost et al., 1997; Sallis, Prochaska, & Taylor, 2000). Current guidelines recommend that all young people should participate in physi-

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cal activity of at least moderate intensity for one hour per day.

The results of the previous research indicate that self-efficacy (confidence in one's abilities to perform a particular activity in specific situations), the increase of the level of perceived benefits of physical activity, the reduction of the perceived barriers, the increase of social support from the closest persons in the environment (parents and peers/friends), the enjoyment in physical activity, and the access to equipment and facilities are factors associated with physical activity in the period of adolescence (Baranowski et al., 1992; Sallis et al., 1992a; Pate, 1997; Sallis et al., 2000; Cavill & Biddle, 2003).

The primary goal of the study was to determine the influence of social support from parents on the level of physical activity in adolescents.

Methods

Sample of respondents

The research was conducted on a sample of 974 randomly selected respondents from several faculties within the University "Hasan Prishtina" from Prishtina, Kosovo. The sample consisted of 572 (58.7%) male respondents (students) and 402 (41.3%) female respondents (students). The average age of the respondents of both genders was 20.2 years. The respondents were treated according to the Declaration of Helsinki.

Sample of variables

The data was collected by using the method of a structured survey questionnaire. The dependent variables analysed social support for physical activity.

Description of measuring instruments

IPAQ-C: The nine-item IPAQ-C records self-reported physical activity in the last seven days. Responses were converted to Metabolic Equivalent Task minutes per week (METmin/wk) (Craig et al., 2003) according to the IPAQ scoring protocol: total minutes over last seven days spent on vigorous activity, moderate-intensity activity, and walking were multiplied by 8.0, 4.0, and 3.3, respectively, to create MET scores for each activity level. MET scores across the three sub-components were totalled to indicate overall physical activity (Craig et al., 2003).

Parental Support: Levels of paternal and maternal support for being active were measured using an adapted version of a scale from the Amherst Health and Activity Study (Sallis, Taylor, Dowda, Freedson, & Pate, 2002; Prochaska, Rodgers, & Sallis, 2002). Five items assessed different aspects of parental support, including encouragement, participation in joint activities, provision of transport, observation and praise. Responses ranged from "a lot" to "not at all". A mean score, ranging from 1-5, was computed by averaging responses to the five items.

Methods of data processing

The basic descriptive statistical parameters were calculated for all variables, as follows: arithmetic mean (X), standard deviation (SD), distribution kurtosis (KURT) and asymmetrical distribution (SKEW). The normality of the distribution of the variables was tested with the Kolmogorov-Smirnov test. Since most of the applied variables showed deviation from the normal distribution, the results are processed by nonparametric statistical methods ($\chi 2$ test and Mann-Whitney U-tests). The data were processed with the SPSS for Windows Version 22.0 statistical package.

Results

The research was conducted on a sample of 974 randomly selected respondents from several faculties within the university. The sample consisted of 572 (58.7%) male respondents (male students) and 402 (41.3%) female respondents (female students). The average age of the respondents of both genders was 20.2 years.

Based on the IPAQ scoring recommendations and the physical activity classification criteria, the respondents are classified into three categories of physical activity, and the results are presented in Table 1. From the table overview, it is observable that 17.50% of the male students are classified in the category of low physical activity, 30.60% are classified in the category of moderate physical activity, and 51.90% are classified in the category of high physical activity. Furthermore, 15.20% of the female students are classified in the category of low physical activity, 34.30% are classified in the category of moderate physical activity, and 50.50% are classified in the category of high physical activity. From the overview of the $\chi 2$ test ($\chi 2=1.88$; $p<0.391$), it is observable that there are no statistically significant differences in the level of physical activity between male students and female students.

Table 1. Classification of respondents into three categories of physical activity and differences regarding the gender of the respondents

	Boys		Girls	
Low FA	100	17.50%	61	15.20%
Moderate FA	175	30.60%	138	34.30%
High FA	297	51.90%	203	50.50%
$\chi 2=1.88$		p (sig)=.391		

Mann-Whitney U tests were applied to determine if there are differences in the claims (the items) from the scale for assessment of social support from parents among the respondents classified into different categories of physical activity in male respondents.

The overview of Table 2 shows that statistically significant differences were found between male respondents from different categories of physical activity in the following items of the scale for assessment of social support from parents.

From the Mean Rank values of the items and the arithmetic means, it is observable that the group of male respondents classified in the category of high physical activity shows higher values of these two items compared to the respondents classified in the moderate and low physical activity.

Mann-Whitney U tests were applied to determine if there are differences in the claims (the items) from the scale for the assessment of social support from parents among female students classified into different categories of physical activity.

From the overview of Table 3, it is observable that statistically significant differences were found among female

Table 2. Differences in claims (items) from the scale for assessment of social support from parents among male students who are classified into different categories of physical activity

Males	Low FA	Moderate FA	High FA	Chi-Square	Sig.
	Mean±SD	Mean±SD	Mean±SD		
Parent encourages adolescent to do physical activity or sports	3.33±1.41	3.60±1.36	3.69±1.44	6.27	0.04*
Parent does physical activity or sports with adolescent	2.59±1.46	2.29±1.53	2.49±1.62	2.68	0.26
Parent provides transportation to physical activity setting	3.05±1.63	3.25±1.71	3.40±1.69	4.79	0.09
Parent watches adolescent do physical activity or sports	2.90±1.46	2.55±1.61	2.95±1.62	7.43	0.02*
Parent tells adolescent she or he is doing well in physical activity or sports	3.93±1.26	3.77±1.41	3.77±1.45	0.60	0.74
Parent Support (Total)	3.16±0.99	3.09±1.12	3.26±1.16	3.16	0.21

Legend: * - p<0.05

respondents that belong to different categories of physical activity in the following items of the scale for assessment of social support from parents "Parent does physical activity or sports with adolescent" and "Parent provides transportation to physical activity setting". Furthermore, the overall score of the scale showed statistically significant differences among the female students classified into different categories of physical activity.

From the Mean Rank values of the items and the arithmetic means, it is observable that the group of female respondents who are classified in the category of high physical activity show a higher level of social support from parents compared to the respondents classified in the category of moderate and low physical activity.

Table 3. Differences in claims (items) from the scale for assessment of social support from parents among female students who are classified into different categories of physical activity

Females	Low FA	Moderate FA	High FA	Chi-Square	Sig.
	Mean±SD	Mean±SD	Mean±SD		
Parent encourages adolescent to do physical activity or sports	3.02±1.61	3.40±1.38	3.62±1.48	8.48	0.01*
Parent does physical activity or sports with adolescent	2.10±1.63	2.19±1.41	2.55±1.55	6.34	0.04*
Parent provides transportation to physical activity setting	2.97±1.72	3.25±1.53	3.59±1.58	9.76	0.01*
Parent watches adolescent do physical activity or sports	2.53±1.60	2.69±1.47	2.94±1.70	4.12	0.13
Parent tells adolescent she or he is doing well in physical activity or sports	3.59±1.65	3.68±1.50	3.83±1.60	2.61	0.27
Parent Support (Total)	2.84±1.19	3.04±0.98	3.31±1.18	12.07	0.00*

Legend: * - p<0.05

Discussion

The identification of the causes associated with the involvement, that is, non-involvement in physical activities is a step in the development of strategies to promote physical activity, and coping with them is the first step to overcome this condition (Heimer, & Rakovac, 2006).

The social environment in which physical activity takes place has a crucial impact on young people. Family members, friends, teachers, and coaches can play a significant role in promoting physical activity among adolescents. The social influence can function through a variety of mechanisms, including encouragement, activity modelling, common activity, and practical support. The results of our research have shown that parents can significantly influence physical activity in students of both genders. Previous research suggests that the parents' role in promoting physical activity of their children can take various forms, such as the conveyance of positive attitudes and values (Iannotti et al., 2005), participation in joint activities with children (Stucky-Ropp & DiLorenzo, 1993), organizing activities for their children (Anderssen & Wold, 1992; Stucky-Ropp & DiLorenzo, 1993), and providing transportation to places where children can be physically active (Sallis et al., 1992b). Research has shown that there is no difference in perceived social support from parents between male and female students; however, for girls, social support from parents is a more critical determinant that affects whether and to what extent they will engage in physical activity.

For both male and female respondents, an important determinant that affects the level of physical activity is the conveyance of positive attitudes and values (encouragement and support from parents to engage in physical activity), whereby male respondents want their parents to observe them as they

engage in physical activity; in contrast, female respondents find it necessary that parents provide them transportation to places where they can be physically active and participate together with them during their physical activity.

Other family characteristics, such as the socioeconomic status and the education of parents, may affect physical activity in adolescents. The studies on the impact of the socioeconomic status on physical activity in children and adolescents are contradictory. The research carried out within the Scottish Health Survey suggests that girls from families with lower socioeconomic status have higher levels of physical activity than girls from families with higher socioeconomic status (Stamatakis, 2005). Contrary to this, the results of the research within the Health Behaviour of School-aged Children (HBSC) study suggest that adolescents from wealthier families are more physically active (Levin et al., 2007) and more likely to participate in vigorous exercise in their free time (Inchley, Kirby, & Currie, 2008).

On the basis of all abovementioned, one can conclude that a national plan and programme for promoting physical activity need to be developed in order to help young people change unhealthy lifestyle habits and increase physical activity, and thus improve their health. These strategies, plans and programmes should be prepared by considering the specifics of the environment, the customs and the cultural characteristics of the region.

There is evidence that anyone who increases their level of physical activity can have health benefits even after a long period of inactivity, regardless of age.

Changes can be made through extensive adjustments in policy and practice, and in particular through an increase of the cross-sectoral cooperation and the adoption of new roles by different entities that are already proven and respected in their fields. Minor changes in policy and practice are needed, aimed at promoting and increasing physical activity among the young population.

Different approaches can be used: individual work, group work, workshops, counselling, and similar. The primary promoter of these educational programmes and strategies should be the school; however, it is necessary to involve more governmental and non-governmental organizations, the family, as well as the local government and the country with a broad media campaign. Changes in school should be directed towards changing the curricula, which should include contents for physical activity and its importance, the inclusion of new forms of physical activity in the curriculum, the improvement of the infrastructure (facilities, devices, etc.).

On the basis of the obtained results, one can conclude that parents can have a significant influence on physical activity in adolescents of both genders. Parents can promote physical activity for their children in various ways, such as: by conveying positive attitudes and values, by organizing activities for their children, by participating in joint activities with children, and by providing transportation to places where they can be physically active. Research has shown that there are no differences in the perceived social support from parents between male students and female students; however, for girls, social support from parents is a more significant determinant that affects whether and to what extent they will engage in physical activity.

The results of the research suggest the importance of the preparation of a national plan and programme to promote physical activity to help young people change unhealthy lifestyle habits and increase physical activity, thereby improving their health.

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ORIGINAL SCIENTIFIC PAPER

Analysis of Trends in Anthropometric Characteristics of Montenegrin Young Men from Niksic from 1957 to 1969

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Abstract

The aim of this study is to observe the trend of body height, body weight, and body mass index in Montenegrin young men from Niksic from 1957 to 1969. The sample of respondents in this study numbered a total of 10,738 future soldiers with an average age of 18.25±0.78, who were tested for military service in the period from 30 June 1957 to 28 December 1969. The average body height of the total sample of future recruits was 178.58±6.86, the average body weight was 68.56±8.66, and the average value of body mass index was 21.48±2.27. The highest body height (180.83±8.13) and body weight (73.26±9.38) was in the group of respondents born in 1958. The highest body mass index (22.84±2.50) was found in the respondents of group born in 1957. The value of the body mass index of all respondents shows that everyone was in the zone of normal weight. The highest body mass index (22.84±2.50) was found in the respondents of group born in 1957. It should be noted that many of these respondents were measured before the age of 18. This means that their growth was not complete. There is a possibility that they on average had a higher body height with the completion of growth and development than this research shows. The results show that all generations of young men from Niksic were at that time of a normal weight. This fact is not surprising because it is known that life was different then than it is now. The results of this study are very important in monitoring the trend of these 3 variables in the Montenegrin population, but they also have some limitations. As mentioned above, the rule for recruiting future soldiers was to be tested before the age of 18, when growth and development were not complete yet, and the results after the completion of the growth and development of the respondents would probably be slightly different from these results.

Keywords: *body height, body weight, body mass index, secular trend, Montenegro*

Introduction

The results of many recent studies show a trend of growth in average body height in adults in countries with economic growth (Milasinovic, Gardasevic, & Bjelica, 2017; Arifi et al., 2017; Masanovic, Bavcevic, & Prskalo, 2019a; Gardasevic, 2019a; Gardasevic, 2019b). Better conditions of life and a better lifestyle have a positive impact on increasing the average body height of the population. The same is the case with adults in Montenegro (Popovic, 2017). Many researchers around the world are determining and analysing body height of adults for more than 2 centuries (NCD Risk Factor Collaboration, 2016). The researches, carried out by European anthropologists a century ago, have proved the assumption that the tallest people are living in the Dinarides (Pineau et al., 2005), among whom are the Montenegrins, and among first their body height was recognized by Robert Ehrich at the beginning of

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the 20th century (Coon, 1975). Considering that Montenegro was a part of a great state of Yugoslavia until 2006, there is not much preserved data on the body height of Montenegrins. Only since the independence of Montenegro, the number of studies on the body height of Montenegrins has increased and all of them confirm that Montenegrins are one of the highest nations in the world (Bjelica et al., 2012; Milasinovic, Popovic, Matic, Gardasevic, & Bjelica, 2016). This study should contribute to the small amount of data in recent decades on the average height of men in Montenegro.

Body mass index represents the ratio of body weight to body height. It is a parameter that provides information on 4 levels of nutrition, and 3 of these 4 levels of body mass index can show a health risks throughout life (NCD Risk Factor Collaboration, 2017). Underweight, overweight, or obesity are categories of body mass index which can show a health risk. Deficiency or excess of adipose tissue have detrimental consequences for human metabolism (Masanovic, Bavcevic, & Prskalo, 2019b). In children, underweight gives a higher risk for infectious diseases, in youth underweight can also endanger reproductive ability (Han, Mulla, Beiene, Liao, & McDonald, 2010, Masanovic, Milosevic, & Corluka, 2018; Masanovic, Corluka, & Milosevic, 2018). Overweight and obesity can cause a variety of cardiovascular and chronic diseases (Singh, Mulder, Twisk, Van Mechelen, & Chinapav, 2008).

Searching index databases, the authors of this study did not find enough researches on trends in body mass index of the population in Montenegro. Considering the very specific body height and appearance of Montenegrins, it was very interesting to observe the trend of body height, body weight, and body mass index in this population in previous decades. The data the authors used for this study will help eliminate the problem of deficiency of these kind of data for the entire male population in Niksic from 1957 to 1969. Niksic is the second largest city in Montenegro (Figure 1). In these 13 consecutive

FIGURE 1. Niksic, the second largest city in Montenegro

years, in the second half of the last century, trend of variables of body height, body weight and body mass in the male population will be presented.

Methods

All young men from the city of Niksic, the second largest town in Montenegro, during the 13 consecutive years of the last century were included in the sample of this research. Respondents were measured during mandatory medical examinations that served to test their preparedness for military service. Usually, the testing of young men was done before the age of 18, and military service was served after the end of high school, at the age of 19. However, there was a rule that military service could be postponed until the age of 27, if there were some very important reasons, such as further education, etc. Therefore, some of the recruits whose results were included in this study, had medical examinations after the age of 18, which increased the average age of each generation and the complete sample in this study.

The sample of respondents in this study numbered a total of 10,738 future soldiers with an average age of 18.25±0.78, who were tested for military service in the period from 30 June 1957 to 28 December 1969. Testing was conducted with 13 age generations. The complete sample of respondents was divided into 13 groups, in order to check the trend of body height, body weight and body mass index in all young men in this city in the mentioned 13 years. The first group numbered 31 respondents born in 1957 with an average age of 23.53±1.31, the second group numbered 42 respondents born in 1958 (22.86±1.82), the third group numbered 44 respondents born in 1959 (21.75±1.66), the fourth group numbered 109 respondents born in 1960 (20.29±1.46), the fifth group numbered 1,153 respondents born in 1961 (18.43±0.63), the sixth group numbered 1,349 respondents born in 1962 (17.96±0.64), the seventh group numbered 1,420 respondents born in 1963 (18.31±0.40), the eighth group had 533 respondents born in 1964 (17.88±0.53), the ninth group had 1,291 respondents born in 1965 (17.91±0.71), the tenth group had 1,444 respondents born in 1966 (18.30±0.36), the eleventh group numbered 1,286 respondents born in 1967 (18.23±0.60), the twelfth group numbered 1,118 respondents born in 1968 (18.34±0.29), and the thirteenth group numbered 918 respondents born in 1969 (18.05±0.20).

During the testing in the medical clinic, all subjects were in the underwear. Anthropometric measurements were performed according to the guidelines International Biological Program (IBP). Of all the variables measured by the subjects, body height and body weight were taken for the purposes of this study. An anthropometer was used to estimate body height, and a medical scale with moving weights with a stadiometer was used to estimate body weight. Body mass index is calculated as the ratio of body weight in kg and body height in m^2.

The analysis was performed by using the Statistical Package for Social Sciences (SPSS) version 20.0. Means and standard deviations (SD) were obtained for all anthropometric variables. Analysis of nutrition status was done based on body mass index (World Health Organization, 2010).

Results

Descriptive data of all respondents, members of 13 age groups, are shown in Table 1. Analysis of the average body

height, body weight and body mass index of young men is shown in Table 1. The average body height of the total sample of 10738 future recruits was 178.58±6.86. The highest body height (180.83±8.13) was in the group of respondents born in 1958, and the lowest body height (176.45±7.61) was in the respondents born in 1957. In the total number of respondents, the average body weight was 68.56±8.66. Respondents born in 1958 had the highest body weight (73.26±9.38), and respondents born in 1964 had the lowest body weight (67.31±8.79). In the total number of respondents, the average value of body mass index was 21.48±2.27. This value of the body mass index shows that everyone was in the zone of normal weight. The highest body mass index (22.84±2.50) was found in the respondents of group born in 1957, and the lowest body mass index (21.12±2.29) was found in the respondents of group born in 1964.

Table 1. Descriptive data for a complete sample of young male from Niksic

Year of Birth	Mean±SD			
	Age	Body Height (cm)	Body Weight (kg)	Body Mass Index (kg/m^2)
1957 (N=31)	23.53±1.31	176.45±7.61	71.06±8.25	22.84±2.50
1958 (N=42)	22.86±1.82	180.83±8.13	73.26±9.38	22.40±2.48
1959 (N=44)	21.75±1.66	176.77±7.73	68.14±9.74	21.79±2.85
1960 (N=109)	20.29±1.46	178.76±7.04	69.10±8.52	21.60±2.12
1961 (N=1,153)	18.43±0.63	178.36±6.68	68.25±8.44	21.42±2.11
1962 (N=1,349)	17.96±0.64	178.71±6.90	68.66±8.36	21.47±2.04
1963 (N=1,420)	18.31±0.40	178.55±6.57	67.73±8.65	21.22±2.25
1964 (N=533)	17.88±0.53	178.41±6.88	67.31±8.79	21.12±2.29
1965 (N=1,291)	17.91±0.71	178.00±6.60	68.57±8.89	21.62±2.33
1966 (N=1,444)	18.30±0.36	178.92±7.00	68.90±8.63	21.50±2.25
1967 (N=1,286)	18.23±0.60	179.04±6.86	68.54±8.21	21.38±2.24
1968 (N=1,118)	18.34±0.29	179.00±6.88	70.18±8.83	21.89±2.33
1969 (N=918)	18.05±0.20	178.02±7.24	67.97±9.07	21.44±2.55
Total (N=10,738)	18.25±0.78	178.58±6.86	68.56±8.66	21.48±2.27

The trend of average body height in these 13 years analysed, on a total sample of 10,738 respondents, is shown graphically in Figure 2.

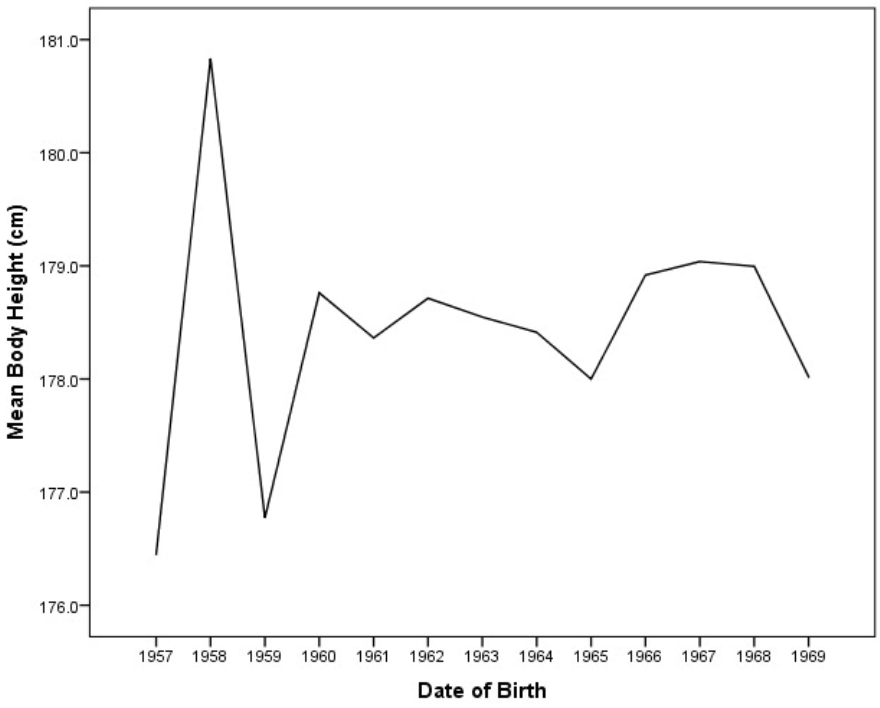

FIGURE 2. The trend of average body height from 1957 to 1969 of young men of Niksic

The trend of average body weight in these 13 years analysed, on a total sample of 10,738 respondents, is shown graphically in Figure 3.

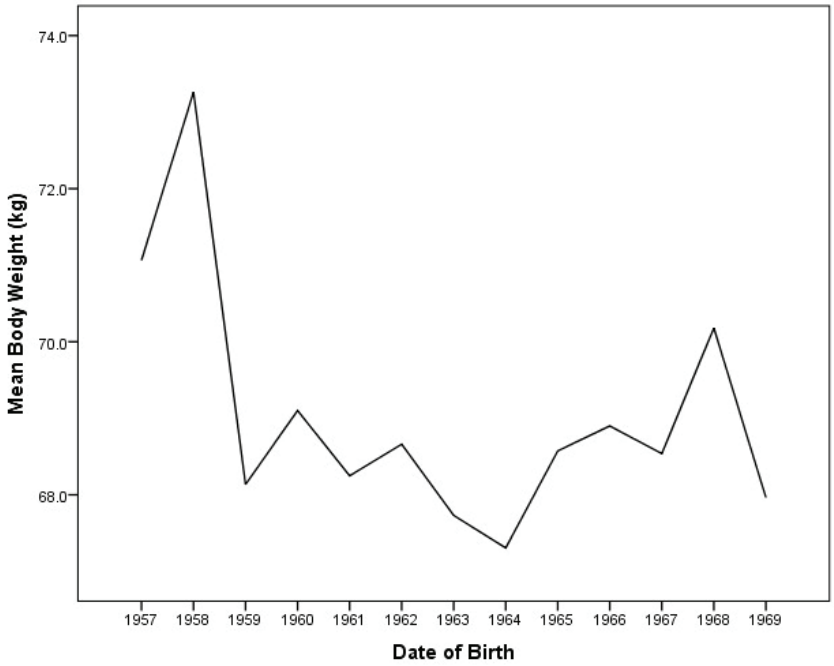

FIGURE 3. The trend of average body weight from 1957 to 1969 of young men of Niksic

In relation to the limit values of the categories of nutrition (underweight, normal weight, overweight and obesity) prescribed by the World Health Organization, it can be seen from Table 1 that all respondents here belonged to the category of normal weight. The limit values for normal weight are values of body mass index from 18.5 to 24.9. The trend of the average body mass index in these 13 years analysed, on a total sample of 10,738 respondents, is shown graphically in Figure 4.

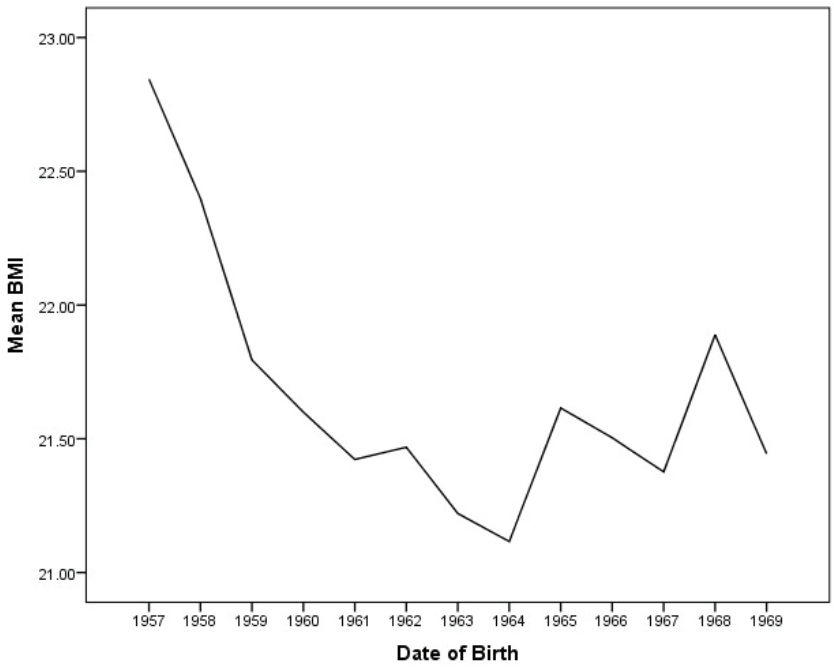

FIGURE 4. The trend of average body mass index (BMI) from 1957 to 1969 of young men of Niksic

Discussion

The aim of this study is to contribute the increase in the number of studies that have followed the change in body height in Montenegrins in the last century. According to research by Robert Ehrich at the beginning of the last century, the average body height of Montenegrins was 177 cm (Coon, 1975). Our research showed that, sixty years later, the inhabitants of Niksic, the second largest city in Montenegro, were tall on average 178.58±6.86. This is evidence of the secular trend and increase in average body height in the population of Montenegro by 1.58 cm. It should be noted that many of these respondents were measured before the age of 18. This means that their growth was not complete. There is a possibility that they on average had a higher body height with the completion of growth and development than this research shows. Montenegrin researcher Popovic (2017) found that Montenegrins are one of the tallest nations in Europe with an average body height of 183.36 cm. He based his results on

a survey of the average body height of young men from 13 Montenegrin municipalities, and based on his results, this positive secular trend of average body height can be seen. In our study, it can be seen that young men born in 1957 had the lowest body height, and those born only a year later had the highest body height in the total sample of respondents. The reason for this difference in just one year certainly lies in the fact that even the smallest number of respondents in this study were from these two groups of respondents (31 respondents born in 1957 and 42 respondents born in 1958). If these two groups had a larger number of respondents, their body height ratio would probably be different.

According NCD Risk Factor Collaboration (2017) in the previous 40 years, in 189 countries, an average body height, body weight, body mass index (more than 0.05 kg/m² for every 10 years) are increased for children and adolescents. Obesity increased for 6.9% the percentage of underweight decreased.

The results of this study do not show a trend of increase or decrease in the variables body weight and body mass index. The reason for this is the fact that 13 years is not a long period to discuss it. The results show that all generations of young men from Niksic were at that time of normal weight. This fact is not surprising because it is known that life was different then than it is now. Sedentary lifestyle was less represented, virtual life was not led through social networks, much greater physical activity was represented among young people and a much healthier diet than today. These are some of the reasons for today's increase in body mass index among young people. If we analyse the body weight and body mass index in this study, it is noticeable that these are the highest values in the first two age groups, born in 1957 and 1958. But again, the reason, as with the average body height, should be found in the fact that these two age groups had the lowest number of respondents. Montenegrin researchers Gardasevic et al. (2015) found that in Montenegrins of age of 17 the average body mass index was 24.9 kg/m², and in Montenegrins of age of 18 the average body mass index was 22.8 kg/m². If these values are compared with the values from this study, it is clear that the secular trend among Montenegrin youth is noticeable in this variable as well.

The results of this study are very important in monitoring the trend of these 3 variables in the Montenegrin population, but they also have some limitations. As mentioned above, the rule for recruiting future soldiers was to be tested before age of 18, when growth and development were not complete yet. It can be stated with certainty that they did not reach their final growth then. Table 1 shows that the average age of the complete sample was 18.25±0.78. The reason for this average age of the total sample of respondents, which was slightly higher than 18 years, are those respondents who were tested after the age of 18. It has already been mentioned that military service could be postponed until the age of 27 of respondent, and thus the recruitment was moved a few years later. Probably half a century ago, when this measurement was made, the average values of body height in the subjects would be even higher if the measurement was realized when the growth and development of all subjects were completed. And surely the difference would be bigger between the results of Robert Ehrih and these results and there would be a bigger secular trend. Based on this, it can be concluded that the data from this study are not completely reliable. However, these results make a major contribution to the small amount of trend data in these three variables over the past century, from the research of Robert Ehrich, to the last years when research on this topic has intensified.

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Conflict of interest
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ORIGINAL SCIENTIFIC PAPER

Intellectual Capital Efficiency Management in Professional Football Clubs' Performance: Problems of Assessment

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Abstract

Professional success is one of the objective non-financial displays of the effective management of a company's intellectual capital (IC) as the basis of its economic and financial prosperity. This study analyses the adequacy of the results of some assessment methods of IC efficiency based on football clubs' public financial statement data and their professional performance based on professional ranking. This study empirically considers the advantages and disadvantages of specific methods for assessing IC efficiency with the example of football clubs that were TOP 50 of UEFA Club Ranking in 2014–2018. The goal of the study is to compare professional ranking as an objectively formed non-financial indicator of a company's professional performance with IC efficiency to assess its management successfulness in a highly competitive environment. We used the Value Added Intellectual Capital Coefficient (VAIC), MV/BV ratio, and Tobin's q to assess the IC efficiency of the sampled football clubs. The specialized method of assessing IC efficiency provides results that are more relevant to clubs' professional performance than methods based on the principles of the theory of investment. We believe that the study of the relationship between company's IC efficiency with its financial and professional performance has significant prospects with the use of specialized Return on Assets Methods (ROAM), in particular, Intangible Driven Earnings (IDE) and Calculated Intangible Value (CIV).

Keywords: *football club's management, human capital, intellectual capital efficiency, professional performance*

Introduction

During the previous two decades, mostly due to media rights deals, professional football clubs have been transforming into complex and profitable businesses (Morrow & Howieson, 2014). They create and develop their brands to promote additional products and services and increase profits (Jankovic & Jaksic-Stojanovic, 2019). Thus, the strategic development and financial success of professional football clubs strongly depend on not only human capital (Rohde & Breuer, 2016), but also on IC (intellectual capital) management. IC elements' diversity and particularities of impact determination, which they impose on business, make it objectively impossible to apply a single measure to them. At the same time, the consistency of their development beyond the calculation of different indicators for regular assessment, analysis and control of the achieved level is unresolved. Football clubs need to determine IC efficiency for the balanced management of various aspects of their businesses in conditions of a highly competitive environment and limited financing opportunities.

The authors of recent specialized football efficiency studies (Zambom-Ferraresi, García-Cebrián, Lera-López, & Iráizoz, 2015; Zambom-Ferraresi, García-Cebrián, & Lera-López, 2017) suggest applying coefficients of revenue

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distribution (from UEFA Champions League) as a measurement of sporting results. Espitia-Escuer and García-Cebrián (2010) have a similar opinion: that a club's survival depends on increased profits and income, which are achieved via broadcasting rights and tickets sales if it wins competitions.

However, in our opinion, the UEFA Club Ranking is the most suitable instrument of professional performance measurement for football clubs' comparative IC efficiency assessment. This ranking is internationally recognized by relevant institutions, is logical and understandable in the ranking method, transparent, and regularly updated. Given the existence of different approaches to IC valuation based on public financial statements and their stock market values, we chose following methods to determine IC efficiency of the Top 50 of UEFA Club Ranking: Value Added Intellectual Capital Coefficient - VAIC (from ROAM), MV/BV and Tobin's q (from Market Capitalization Methods (MCM)).

The goal of the study is to compare professional ranking as an objectively formed non-financial indicator of the professional performance with IC efficiency to assess management successfulness of the business in a highly competitive environment. As a result, to achieve this goal, we have empirically collated football clubs' IC efficiency and their place in professional performance ranking. In addition, we have determined the advantages and disadvantages of IC efficiency assessment methods based on the sampled European football clubs.

Methods

Data collection

Collecting the data for calculations, we established that some clubs of the Top 50 of UEFA Club Ranking are registered as private limited companies (Bayer 04 Leverkusen, Chelsea FC, Dynamo Kyiv, Manchester City FC, etc.), which means they are not required to publish their financial statements. Other clubs are registered as non-quoted public limited companies (Arsenal FC, PSV Eindhoven, Shakhtar Donetsk, FC Villarreal, FC Zenit, etc.) or joint-stock companies (FC Bayern München, etc.), and they are not listed on stock exchanges. Spanish football giants (Real Madrid CF, Club Atlético de Madrid, FC Barcelona, Sevilla FC, etc.) operate as registered associations, whose ownership rights are granted exclusively to members of the association. Some clubs' annual reports (SL Benfica, Beşiktaş JK, Fenerbahçe SK, FC Porto, Sporting CP, etc.) do not contain all of the information necessary to assess IC efficiency by VAIC, MV/PV and Tobin's q for the entire research period.

To fulfil the tasks set for this study, all necessary information was collected for seven clubs (public companies from the Top 50 UEFA Club Ranking): Juventus, Borussia Dortmund, Manchester United, Olympique Lyonnais, S.S. Lazio, AS Roma, and Celtic.

One significant aspect of UEFA Club Ranking formation is that club coefficients are based on the results of clubs competing in the five previous seasons. The football season falls on two calendar years, so in European championships clubs' annual financial statements are formed each year on the 30th of June. Thus, their financial statements for the five previous reporting periods were processed for the comparison of UEFA Club Ranking on June 30, 2018, with the IC efficiency of sampled teams. The clubs' market capitalization was taken on each year's reporting date.

Instruments and analysis

IC efficiency coefficient by VAIC technique (Pulic, 2000) is calculated by the formula:

$$ICE = HCE + SCE \quad (1)$$

Where ICE is the IC efficiency coefficient; HCE is the human capital efficiency coefficient; SCE is the structural capital efficiency coefficient.

Pulic (2008) defines ICE for different levels of a company's performance to describe VAIC results comprehensively. Iazzolino and Laise (2013) complement them by HCE levels and SCE levels (Table 1).

Table 1. Description of Efficiency Levels According to VAIC (Iazzolino & Laise, 2013; Pulic, 2008)

Levels			Description
HCE	SCE	ICE	
<1.00	<0.00	<1.00	Worst IC efficiency
[1; 1.13)	[0; 0.12)	[1; 1.25)	Low IC efficiency
[1.13; 1.44)	[0.12; 0.31)	[1;25; 1.75)	Acceptable IC efficiency
[1.44; 2)	[0.31; 0.5)	[1.75; 2.5)	Sufficient IC efficiency
≥2.00	≥0.5	≥2.50	High IC efficiency

VAIC also depends on capital employed efficiency:

$$VAIC = ICE + CEE \quad (2)$$

Where CEE is the capital-employed efficiency coefficient (ratio of value-added to the company's net assets).

Some features of IC are related to goodwill, which is why such MCM as MV/BV and Tobin's q are used for IC assessment. According to Ghosh and Wu (2007), MV/BV demonstrates a significant difference between market value and book value, which is the direct indication of IC effective using. Tobin (1969) suggested assessing the gap between the market value and replacement value of a company's assets. Since IC is the prime reason for the gap, Tobin's q using for IC efficiency assessing has a strong theoretical basis, as well as an elaborate calculation method.

We made an interim ranking of the sampled teams based on selected IC efficiency indicators for the period in which the UEFA Club Ranking was formed. The basis for the interim ranking was the following approach: the club's position in the sample by IC efficiency corresponded to the number of points scored. Then we accumulated the obtained ranking results into an additional ranking, formed by each method applied separately. The higher a club's IC efficiency during the research periods, the lower the number of points the club gains in the additional ranking.

Results

Table 2 contains results of HCE, SCE, ICE, CEE and VAIC based on public financial statements of the sampled football clubs.

Table 2. VAIC and its Components for the Sampled Football Clubs in 2014-2018*

Football club	Season	HCE	SCE	ICE	CEE	VAIC
Juventus	2013/2014	1.658	0.397	2.055	6.532	8.587
	2014/2015	1.725	0.420	2.145	6.947	9.091
	2015/2016	1.758	0.431	2.189	6.513	8.702
	2016/2017	2.079	0.519	2.599	5.219	7.817
	2017/2018	1.819	0.450	2.269	5.891	8.160
Borussia Dortmund	2013/2014	1.456	0.313	1.769	1.080	2.849
	2014/2015	1.471	0.320	1.792	0.607	2.398
	2015/2016	1.618	0.382	2.000	0.733	2.733
	2016/2017	1.416	0.294	1.710	0.807	2.517
	2017/2018	1.678	0.404	2.082	0.932	3.014
Manchester United	2013/2014	1.614	0.380	1.994	0.695	2.689
	2014/2015	1.699	0.412	2.111	0.720	2.831
	2015/2016	1.722	0.419	2.141	0.872	3.013
	2016/2017	1.806	0.446	2.253	0.996	3.249
	2017/2018	1.653	0.395	2.048	1.150	3.199
AS Roma	2013/2014	0.936	-0.068	0.868	-1.212	-0.343
	2014/2015	1.570	0.363	1.933	-2.041	-0.108
	2015/2016	1.394	0.282	1.676	-1.794	-0.119
	2016/2017	1.304	0.233	1.537	-2.132	-0.596
	2017/2018	1.417	0.294	1.711	-2.144	-0.433
Olympique Lyonnais	2013/2014	2.137	0.532	2.670	1.477	4.147
	2014/2015	2.586	0.613	3.200	1.424	4.624
	2015/2016	2.813	0.645	3.458	1.940	5.398
	2016/2017	1.406	0.289	1.694	0.616	2.310
	2017/2018	1.422	0.297	1.719	0.634	2.353
S.S. Lazio	2013/2014	1.354	0.262	1.616	0.890	2.506
	2014/2015	1.409	0.290	1.699	3.972	5.672
	2015/2016	1.140	0.123	1.263	7.561	8.824
	2016/2017	1.640	0.390	2.030	4.619	6.649
	2017/2018	1.815	0.449	2.264	2.533	4.797
Celtic	2013/2014	1.500	0.333	1.833	1.052	2.886
	2014/2015	1.160	0.138	1.298	0.909	2.206
	2015/2016	1.200	0.167	1.367	0.971	2.337
	2016/2017	1.351	0.260	1.611	1.227	2.838
	2017/2018	1.356	0.263	1.619	1.103	2.722

Legend: * - calculated by the authors using clubs' annual reports (AS Roma, 2018; Borussia Dortmund, 2018; Celtic FC, 2018; Juventus, 2018; S.S. Lazio, 2018; Manchester United, 2018; Olympique Lyonnais, 2018).

VAIC components results show that, with some exceptions, the sampled teams do not have IC efficiency below the acceptable level. Three teams did not fall below the 20th position in the UEFA Club Ranking in 2014–2018 (Juventus, Borussia Dortmund and Manchester United). They had high all-efficiency coefficients and low amplitude of their fluctuations. Complete adherence of these trends is the result of the professional performance of the most successful teams. The comparative analysis of Borussia's Dortmund and Celtic's indicators proves this conclusion. Celtic is the only club in the research sample that had constant progress in its professional performance. This club has steadily progressed in professional achievements, and over five seasons has risen 15 positions in the UEFA Club Ranking (from 62nd in season 2013/2014 to 47th position in season 2017/2018). Although the VAICs of these clubs are not very different, Borussia's Dortmund VAIC is characterized by higher IC efficiency and the relative stability of its level. Instead, Celtic showed higher CEE, but its ICE rarely reached an acceptable level.

Olympique Lyonnais displayed relatively stable professional performance moving from 12th to 28th position during the research period. This club had comparatively high VAIC and its separate components. As a result, comparing its HCE, SCE, ICE, and CEE based on financial statements with UEFA Club Ranking, we observed that Olympique Lyonnais demonstrated an increase in VAIC and its components over the 2013/2014 and 2014/2015 seasons, exceeding Juventus and Borussia Dortmund in UEFA Club Ranking in 2013/2014, and having higher HCE and SCE. These trends were accompanied by a collapse in its professional ranking (from 12th to 28th position), in the 2013/2014 season. Subsequently, this club was unable to maintain IC efficiency and consolidate short-term professional success (23rd position in 2016/2017 and 25th position in 2017/2018). At the same time, Olympique's Lyonnais HCE decreased by half.

It is challenging to explain this paradox by arguments used in VAIC. It is worth taking into account the multi-faceted intangible nature of IC, which is difficult to measure with finan-

cial statements. In particular, psychological aspects (conflicts between players, with coaches, etc.) play a critical role in a club's professional performance, as does the players' physical health, which at present cannot be adequately reflected with value measurements.

Roma's acceptable and low IC efficiency during the studied seasons can be construed as one of the reasons for the mediocre results the club has demonstrated. Trends in the change of Roma's HCE are quite revealing. Despite its constant loss-making activity, Roma managed to maintain its HCE comparable to Celtic's and Olympique's Lyonnais indicators, which was accompanied by a constant increase in Roma's UEFA Club Ranking from 55th in 2013/2014 to 21st position in 2017/2018. Obviously, the club's owners strategy helped to preserve personnel potential, and the proper level of human capital financing supported its motivation in professional performance.

Lazio's best achievement (27th position in season 2015/2016) was accompanied by the highest VAIC over all the studied seasons, which was due to a substantial increase in CEE, while HCE, SCE, and ICE showed the lowest levels. Among all the sampled clubs, Lazio's IC efficiency coefficients had the most significant fluctuations. Lazio's regular fluctuations in UEFA Club Ranking can likely be explained by the instability of VAIC components' management results.

Table 3 shows the MV/BV results of the sampled football clubs in 2014–2018.

Table 3. MV/BV for the Sampled Football Clubs in 2014–2018*

Football club	UEFA Club Ranking (2017/18)**	Seasons				
		13/14	14/15	15/16	16/17	17/18
Juventus	5	5.201	6.456	5.248	6.255	12.072
Borussia Dortmund	10	2.093	1.228	1.186	1.806	1.669
Manchester United	12	2.300	2.580	3.509	3.732	4.640
AS Roma	21	-0.298	-0.210	-0.004	-1.341	-1.282
Olympique Lyonnais	25	0.327	0.656	0.787	0.693	0.670
S.S. Lazio	36	9.597	1.802	3.309	2.086	1.730
Celtic	47	1.300	1.420	1.368	1.636	1.664

Legend: * - calculated by the authors using clubs' annual reports (AS Roma, 2018; Borussia Dortmund, 2018; Celtic FC, 2018; Juventus, 2018; S.S. Lazio, 2018; Manchester United, 2018; Olympique Lyonnais, 2018; UEFA, 2018) and their stock quotes (Yahoo! Finance, 2018); ** - in accordance with UEFA (2018).

Table 3 allows us to state that Juventus has the most significant gap between the market value and the book value of equity. This club was consistently rising in UEFA Club Ranking for five consecutive years and ranked highest among all sampled teams in 2017/2018. Manchester United demonstrated the second-best result of MV/BV. This single club provided the annual growth of this indicator and eventually doubled it over the past five years. Effective use of clubs' available IC allowed them to gain professional performance and translate it into rather high stock quotes. Borussia Dortmund, Celtic, and Lazio had MV/BV > 1. These clubs are in different segments of the professional ranking, but each of them showed some progress compared with the base season. These teams' MV/BVs suggest that market estimates them reasonably well. Therefore, their stocks do not cause particular interest among potential investors.

Olympique Lyonnais and Roma have highly paradoxical results (Olympique Lyonnais has MV/PV<1 and Roma has negative MV/PV caused by negative net assets). Although Olympique Lyonnais has not been able to recover over four seasons after steadily shrinking from 12th position in 2013/2014 to 25th position in 2014/2015, it steadily remained in the first thirty of UEFA Club Ranking. Roma and Borussia Dortmund doubled their rankings in 2014–2018, but Roma's negative equity did not allow adequately applying MV/BV to evaluate its IC efficiency. It is appropriate to assume that these clubs' MV/BVs have been caused by circumstances not directly related to IC. In particular, this is a result of the lack of stock market liquidity, investors' disinterest, and manipulation of financial statements of the purpose of tax optimization, etc.

Most of the sampled clubs have chosen their domestic stock exchanges than international ones for their IPOs. The only exception is Manchester United, which placed its stocks on the New York Stock Exchange (NYSE). Therefore, it is likely that Olympique's Lyonnais MV/BV is the logical consequence of its listing on the Euronet Paris, which traditionally prefers debt securities.

Table 4 shows Tobin's q for the sampled football clubs in 2014–2018.

Table 4. Tobin's q for the sampled football clubs in 2014–2018*

Football club	UEFA Club Ranking (2017/18)**	Seasons				
		13/14	14/15	15/16	16/17	17/18
Juventus	5	1.404	1.575	1.427	2.109	2.644
Borussia Dortmund	10	1.543	1.169	1.136	1.526	1.47
Manchester United	12	1.533	1.58	1.792	1.85	1.999
AS Roma	21	2.899	1.414	1.342	1.477	1.505
Olympique Lyonnais	25	0.764	0.9	0.949	0.876	0.864
S.S. Lazio	36	1.179	1.097	1.121	1.108	1.165
Celtic	47	2.092	2.27	2.271	2.542	2.718

Legend: * - calculated by the authors using clubs' annual (AS Roma, 2018; Borussia Dortmund, 2018; Celtic FC, 2018; Juventus, 2018; S.S. Lazio, 2018; Manchester United, 2018; Olympique Lyonnais, 2018) and their stock quotes (Yahoo! Finance, 2018); ** - in accordance with UEFA (2018).

Table 4 shows that Celtic had the highest Tobin's q together with its stable growth tendency. This team was the single club that has Tobin's q>2. In each of the research seasons, Celtic ranked the lowest position among all sampled football clubs in UEFA Club Ranking. However, this club systematically improved its professional performance, rising from 62nd position in 2013/2014 to 47th position in 2017/2018. Manchester United had the second-best result of Tobin's q in the sample and demonstrated its growth for all five seasons. However, the club did not display professional success stability. In this sample, Manchester United is the only club whose stocks are quoted on the world's largest stock exchange (the NYSE), which places quite high demands on issuers' financial performance, as well as the regular activity of buying and selling of their listed securities. The excess of market value growth of Manchester United's assets over their replacement value growth is due to the NYSE members' steady interest in its stocks, which is influenced by the club's ability to provide high financial performance and increase the brand value.

Juventus, Roma, and Borussia Dortmund had high Tobin's q, but none of them managed to increase Tobin's q over the research period. Juventus and Roma list their stocks on the Milan Stock Exchange, and Borussia Dortmund does so on the Frankfurt Stock Exchange. Most European exchanges have two or three 'favourite' issuers, which provide up to 75% of stock exchange turnover. Since the merging EU stock exchanges into a unified European securities market is not yet complete, these clubs cannot hope for significant investors' interest. Therefore, there is every reason to assert that Tobin's q of Juventus, Roma, and Borussia Dortmund should be interpreted on the assumption that the excess of their market value over their assets' replacement value is due to effective use of IC.

Juventus mostly had the best Tobin's q, and the club regularly improved its rating for the research period. Instead, Borussia Dortmund and Roma did not demonstrate a direct correlation between their professional performance and Tobin's q. Overall, their achievements indicated effective use of IC that led to climbing in UEFA Club Ranking, as well as to increasing the value of unregistered intangible assets, which raised the market value of these clubs.

Lazio had quite mediocre Tobin's q, which barely exceeded 1. At the same time, the club's professional performance can hardly be described as spectacular. Lazio showed unstable results, minor rises in the UEFA Club Ranking were replaced by the same falls, which may be evidence of not very successful IC management. Clearly, Olympique Lyonnais was an outlier in the research sample. Its Tobin's q was consistently less than 1. This team's professional performance was also comparatively worse. Olympique Lyonnais had internal problems with IC efficiency, which were reflected in the investors' interest.

We formed additional ranking of the sampled football clubs for summarizing the connection between their IC efficiency and professional performance, based on their financial statements using VAIC, MV/BV and Tobin's q. This ranking is shown in Table 5. Ranking of search results was carried out by summation score method for each of the selected methods of IC efficiency assessing in 2014–2018 separately. In addition, we showed the clubs' rankings according to HCE and ICE, taking into account the importance of VAIC intermediate stages for correct interpretation of the results.

Table 5. Rankings of IC Efficiency Assessment Results of the Sampled Football Clubs in 2014-2018 by VAIC, MV/BV and Tobin's q*

Football club	UEFA Club Ranking (2017/18)**	Scores of methods of IC efficiency assessment				
		VAIC	ICE	HCE	MV/PV	Tobin's q
Juventus	5	1	1	1	1	3
Borussia Dortmund	10	4	4	4	4	5
Manchester United	12	3	3	3	2	2
AS Roma	21	6	6	6	7	4
Olympique Lyonnais	25	7	2	2	6	7
S.S. Lazio	36	2	5	5	3	6
Celtic	47	5	7	7	5	1

Legend: * - ranked by the authors; ** - in accordance with UEFA (2018).

Table 5 indicates that in the 2014–2018 UEFA Club Ranking positions of the sampled football clubs mostly corresponded with their HCE and ICE calculated according to VAIC. CEE had a decisive influence on the VAIC of Olympique Lyonnais, Lazio and Celtic. Instead, MCM have shown rather contradictory results in the context of the objectives of this study. Since these methods are fundamental tools for assessing stocks' investment potential, they determine the relationship between investors' interest and a company's IC only indirectly, guided by theories of IC origin. MCM considers a company's market value as a critical business success indicator that formed under the influence of numerous endogenous and exogenous factors. The simplicity of MV/BV and Tobin's q formulas does not allow eliminating third-party factors. Therefore, it is incorrect to affirm that these techniques can be used to assess changes in resulting indicators under the influence of IC itself. It is challenging to establish and assess specific parameters of IC efficiency, taking into account its diversity as an integral economic phenomenon. The use of MV/BV and Tobin's q does not guarantee the adequacy of resulting indicators interpretations in terms of IC impact. VAIC shows more convincing results of the interconnection of IC efficiency with a football club's professional performance.

Discussion

The research conducted shows that, in the conditions of a highly competitive environment, the results of companies' IC efficiency assessment do not always match their professional ranking as objectively formed non-financial indicator of business success. The methods used for comparative assessment of IC efficiency are limited by existing databases, which should be reliable and comparable. Financial statements became the databases for assessing IC efficiency due to the adapting of some methods used in corporate finance and investing for

evaluating the ability of an issuer to make profits and generate cash flows (MV/BV, Tobin's q). However, existing accounting methods are unable to fully recognize and evaluate all IC elements. Therefore, the results of company's IC efficiency assessment obtained with general methods (MV/BV, Tobin's q) have low practical significance for determining the role of IC management in improving a company's professional performance. Consequently, the further evolution of IC assessment methodology should be focused on the theoretical substantiation and development of highly specialized tools for IC value measuring and results of its management.

The comparing UEFA Club Ranking positions of the sampled football clubs with their IC efficiency indicators showed a relative advantage of results obtained by the specialized ROAM (VAIC) compared to the two general MCM (MV/BV, Tobin's q). This is because VAIC was developed solely for IC efficiency assessment, taking into account IC formation the particularities and specificity of the impact on a company's performance.

Based on the preceding, we believe that the study of the relationship between company's IC efficiency with its financial and professional performance has significant prospects precisely with the use of specialized ROAM, in particular, IDE (Gu & Lev, 2003) and CIV (Stewart, 1997). These methods are based primarily on the use of financial statements. At the same time, there is a need for additional information on some average analytical indicators, specifically, the return on physical assets, the return on financial assets, and the discount rate of intangibles-driven earnings (for IDE) and industry ROA and company's cost of capital as a discount rate (for CIV). The available and reliable data about these indicators will ensure expanded use of these methods and increase the credibility of IC efficiency assessment results.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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SportMont

ORIGINAL SCIENTIFIC PAPER

Evaluation of Kazakhstan Students' Views on Health, Lifestyle, and Physical Activity

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Abstract

The purpose of this research was to investigate students' perception of their health, the development of their healthy lifestyle habits, and the role and place of physical activity in their daily lives. The research subjects were freshmen of one of the largest universities in the country, Al-Faraby Kazakh National University (n=100), at the age of 17.77±0.12 years, 64 of whom were female, and 36 were male. Respondents were asked to reply to a questionnaire consisting of 39 questions at the initial stage of adaptation to academic and physical activity at the university. The questionnaire included research on students' perception of their health, the development of healthy lifestyle habits, such as the quality of food, water consumption, the amount of time dedicated to sleep and its quality, the presence of bad habits, as well as the research on the role and place of working out in shaping the students' lifestyle, volume and intensity of physical activity. It was revealed that students, even those having an understanding of the role and place of a healthy lifestyle, the significance of health in life, including their future professional career, were still distinguished by the insufficiently formed habits of healthy lifestyles, and did not work out to preserve and strengthen their health. The physical activity of most of the surveyed students did not even meet the recommended minimum. This research showed that the problem of a healthy lifestyle for young people studying in different socio-cultural contexts remains relevant and requires further more extensive research.

Keywords: *students' health, nutrition, lifestyle, physical activity*

Introduction

In recent decades, the close attention of researchers in many countries has been riveted on the medical state of health of students. Such attention is not unintentional, since researchers have stated that the health of students is declining. According to Kazakhstani researchers (Batrymbetova, 2008), only 10.6% of freshmen belong to the "healthy" group, and the number of students with five or more diseases increases from year to year.

The problem of students' health is one of the urgent issues, since it ultimately is a matter of the quality of human resources who will become part of the workforce of the country in the near future. Only healthy students will be able to withstand fierce competition in the labour market (Alekesheva et al., 2017).

It is noted that the behaviour formed in the course of learning, continuing into adulthood (Takomana & Kalimbira, 2012), is the cause of diseases that threaten health in later periods of life (Desai, Miller, Staples, & Bravender, 2008). Change of place of residence, lifestyle, and environment often leads to adverse changes in health behaviour (Norkus, 2012), such as alcohol consumption, neglect of rational nutrition, and decreased physical activity (Dobrovolskis & Stukas, 2012). Such risk factors can be avoided by paying attention to the formation of continued habits of healthy lifestyles and physical activity among students during the period of study, which can

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continue throughout their subsequent life.

In this regard, it is essential to research the state of health of young people through an investigation of the indicators characterizing their lifestyle. This can help to develop the tactics of physical education of students in higher education, contributing to the improvement of their health and the formation of a long-term setting to maintain a healthy lifestyle.

The purpose of this research was to investigate the students' perception of their health, the development of their healthy lifestyle habits, the role and place of workout in their daily lives.

Method

To achieve this goal at the initial stage of adaptation to study loads (3-4 weeks of research, September 2018), we conducted an anonymous questionnaire survey. Respondents were asked to answer a shortened questionnaire (Deniozou, 2015), consisting of 39 questions. According to their semantic meaning, the questions are divided into three groups. The first group researched the role of health in the system of values of students and self-assessment of the level of health. The second group of questions focused on the identification of the components of students' lifestyles, such as the quality of food, water consumption, the amount of time dedicated to sleep, and its quality. The remaining questions concentrated on the importance of workout in the formation of students' healthy lifestyles as well as the volume and intensity of physical activity.

The research was attended by freshmen of one of the largest universities in the country, Al-Faraby Kazakh National University (n=100), at the age of 17.77±0.12 years, 64 of whom were female, and 36 were male. The average body height of girls was 162.7±6.0 cm, body weight was 52.9±9.1 kg, and BMI was 20.0±3.1 kg/cm². The average body height of males was 169.3±8.1 cm, body weight was 57.9±10.4 kg, and BMI was 20.2±2.9 kg/cm². The permit from the Ethics Committee of the Kazakh Academy of Sport and Tourism was obtained for the purposes of conducting the research (No. 09-01-08-500 of September 4, 2018). The confidentiality of the personal data of participants, as well as other ethical standards, have been respected.

Statistical analysis of the research data was carried out using the SPSS software, version 16.5. Traditional statistical methods were used: absolute frequencies, percentage frequencies were calculated. To establish the differences between the variables, a nonparametric criterion (chi-square) was used.

Results

As a result of the research, we found that the majority of respondents, in particular 61.5% of females and 80.0% of males, did not show particular concern about their state of health. Thus, to the question "Do you consider yourself a healthy person?" most students, both males and females, answered positively, the difference in their opinions was not statistically significant (χ2=5.933, p=0.053). It is noteworthy that there is a group of students who are not aware of their health issues (29.2% of females and 8.6% of males).

Analysing the data of the questionnaire survey, we found that some students, even those stating the presence of chronic diseases, considered themselves to be absolutely healthy people. This tendency was overlooked in the responses of both females and males. Also, the majority of students (64%) show no particular concern about their health, only 22% of surveyed students of both gender groups are concerned about their health (χ2=11.304, df - 3, p=0.01) (Table 1).

Table 1. The percentage distribution of answers to the question, "Does your state of health bother you?"

Evaluation criteria	Males	Females	General
Yes	8.6	29.2	22.0
No	85.6	52.3	64.0
Sometime	2.9	13.8	10.0
Not sure	2.9	4.7	4.0

χ2=11.304; df – 3; p=0.01

In studies of the medical activity of students, we found that about half of female students (41.5%) attend medical facilities for preventive purposes no more than once every half a year, and 33.8% of the surveyed females use the services of doctors no more than once a year (Figure 1a). As for males, 37.1% of surveyed male students go to doctors once every half a year, and 18.6% do not consult doctors more often than once a year. Only a small percentage of respondents use the services of medical institutions once a month or once in several months. The difference between the responses of females and males was not statistically significant (χ2=1.416; df - 3; p=0.702).

The data presented in Figure 1b indicates that the majority of the surveyed students (75.2% of females and 61.8% of males) consider health an important factor for the success in future professional activities (χ2=6.554, df - 2, p=0.038; F=6.349, p=0.04). Some students generally consider health to be important but not the determining factor for the success of a professional career; 2.8% of surveyed females and 8.8% of the males are sceptical about this definition.

Table 2 presents the results of a survey on students' commitment to a healthy lifestyle. 60.0% of males believe that they adhere to a healthy lifestyle, whereas only 40% of female adhere to this opinion; 35.4% of surveyed females admitted the lack of awareness in matters of maintaining a healthy lifestyle; 20.0% of surveyed females and males on this issue gave a negative answer. A comparative analysis revealed that, according to the established criteria, the difference between the responses of males and females was not statistically significant (χ2=5.608, df - 3, p=0.132).

Most of the surveyed students of both gender groups consider that giving up bad habits is one of the most important things to consider themselves to be adherents of a healthy lifestyle (males: 91.2%, females: 75.0%; χ2=3.805, df=1, p=0.051). Students consider regular and good nutrition to be another essential component of a healthy lifestyle. Based on their answers, it is maintained by 34.4% of females and 52.9% of males (χ2=3.168, df=1, p=0.075). According to the students, the third most important thing in keeping a healthy lifestyle was regular walks in the park, and hiking in the mountains at weekends. This option of maintaining a healthy lifestyle is preferred by 35.9% of females and 26.5% of males (χ2=0.905, df=1, p=0.341).

Figure 1c shows that working out (morning exercises, regular running, intensive classes in fitness clubs) as a means of

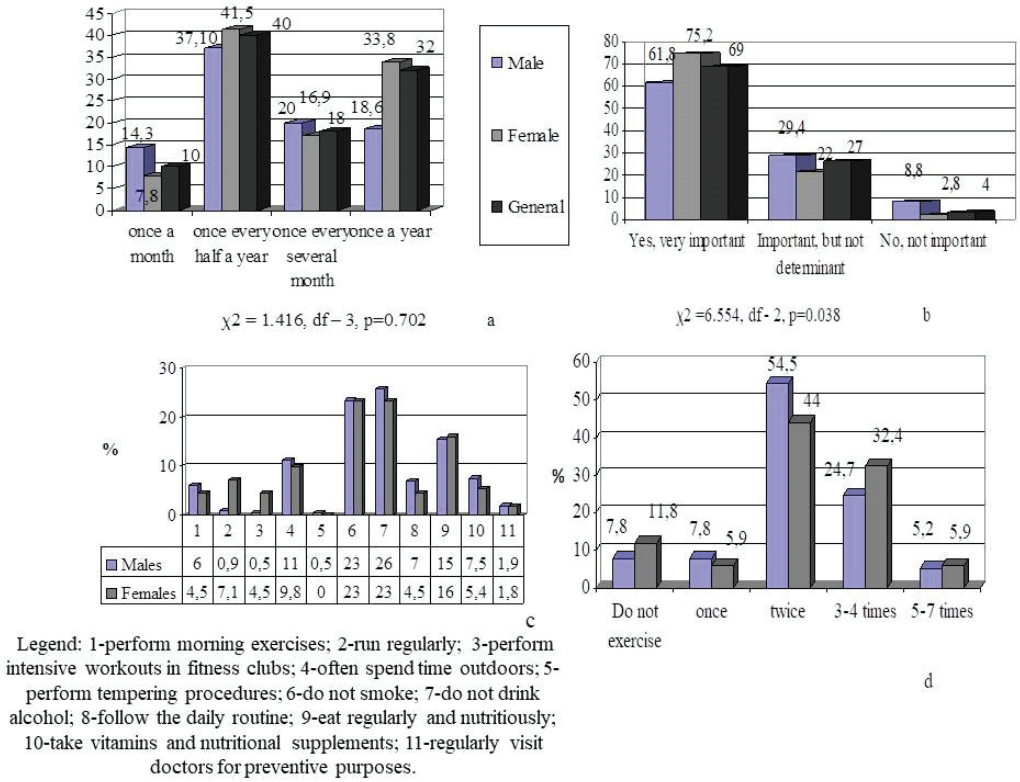

FIGURE 1. The percentage distribution of answers to the questions, "How often do you visit a doctor?" (a); "Do you consider health an important factor for success in life and your future profession?" (b); "What actions do you take to lead a healthy lifestyle?" (c); "How many times a week do you work out?" (d)

maintaining a healthy lifestyle, is preferred by a small number of surveyed students, and in all respects the involvement of males in regular workouts is greater than that of females. The exception is morning exercises: 6% of females and only 4.5% of males include them in their daily routine.

One of the important components of a healthy lifestyle, according to students, is a regular and balanced diet. Most authors who research healthy lifestyles believe that human health depends largely on the nutritional value of food. Our studies assessing the diet of students in Kazakhstan showed that only half of females (54.7%) and males (58.8%) consider their diet to be healthy and balanced, the difference between the studied groups is not statistically significant ($\chi2$=0.154, df – 3, p=0.695).

Table 2. The percentage distribution of answers to the question, "Do you maintain a healthy lifestyle, in your opinion?"

Evaluation criteria	Males	Females	General
Yes	60.0	40.0	47.0
No	20.0	20.0	20.0
Not always	5.7	4.6	5.0
Not sure	14.3	35.4	28.0

$\chi2$=5.608; df – 3; p=0.132

After analysing the percentage distribution of respondents' answers about the multiplicity of food, it should be noted ($\chi2$=9.616, df - 6, p=0.0142) that 33% of females and 57.9% of males have access to regular 3-4 meals a day (the difference between groups is statistically significant); 25.9% of females and 18.4% of males admitted that during the day they had a snack on the run, and the main meal was only lunch or only dinner; most of them admitted that they mostly consume fast food as a snack. Also, among the respondents there are students (10.6% of males and 23.5% of females), whose diet is not normalized, in other words, students eat only when they find the time (Table 3).

Table 3. The percentage distribution of answers to the question, "What is your diet?"

Evaluation criteria	Males	Females	General
3-4 times	57.9	33.0	44.0
Twice	10.5	12.9	14.0
Just having breakfast	0	4.7	3.0
Nutrition routine is not normalized	10.6	23.5	16.0
Just having lunch or just having dinner	18.4	25.9	14.0
Fast food	2.6	0	9.0

$\chi2$=9.616; df – 6; p=0.0142

Water is a vital component of nutrition and performs essential body physiological functions. A healthy adult is recommended to consume at least 2-3 litres of water per day. Our research has shown that most of the surveyed students consume insufficient amounts of water throughout the day (Table 4). Thus, the daily water intake of most students does not exceed 1000 ml, 25.7% of males and 20.5% of females consume up to 2000 ml of water, and 1.5% of females and 5.7% of males are limited to the fluid that enters the body with food. On this issue, a statistically significant difference between gender groups was established.

Table 4. The percentage distribution of answers to the question about "The amount of daily water consumed."

group	The amount of water consumed by students (ml)					
	0	<1000	<2000	<3000	<4000	<5000
Males (%)	5.7	54.3	25.7	2.9	2.9	2.9
Females (%)	1.5	77.9	20.5	3.0	-	-

χ2=34.489, df-3, p=0.000

The analysis of students' responses regarding the duration and quality of sleep did not reveal significant differences between females and males. It turned out that only 50% of males and 48.4% of females sleep 7-8 hours. At the same time, 70.6% of males and 57.8% of females noted having solid, uninterrupted sleep. Some of the females (4.3%) and males (5.7%) questioned were worried about the lack of a clear sleep schedule, due to the need to combine study with work.

Physical activity as a means of maintaining and promoting health interests students less than other components of a healthy lifestyle. Thus, Figure 1d shows that the majority of students, in particular 54.5% of males and 44.0% of females, exercise twice a week and, for most of them, physical education classes of the compulsory programme are almost the only means to fill the need of physical activity. There is no statistically significant difference between the two gender groups (χ2=6.328, df=12, p=0.899).

In total, 24.7% of males and 32.4% of females include additional workouts in their daily routine, and about 5.2% of males and 5.9% of females exercise 5-7 times a week (Figure 1d). Some of the surveyed students did not consider workouts a necessary part of their daily routine. The number of such physically inert students was greater among males than among females and amounted to 7.8% and 11.8%, respectively.

The weekly volume of physical activity of most students did not exceed 80 minutes (Table 5). The majority of students' (70.6% and 84.4% of males and females, respectively) noted that physical activity lasted up to 80 minutes a week; 26.5% of males and 14.1% of females said that they spent up to 110 minutes a week on workouts. The workouts performed by 47.1% of males and 87.5% of females were low-intensity (their heart rate did not exceed 120 beats/min); 44.1% of males and 9.4% of females reported their heart rate reaching 120-150 beats/min during exercise. Moreover, only 8.8% of males and 3.1% of females performed high-intensity exercise load on the pulse, exceeding 150 beats/min. The difference in the intensity of physical exertion between males and females is statistically significant.

Table 5. *The amount and intensity of students' training loads*

group	Parameters of students' training loads							
	Weekly volume (min)					Intensity of single session (beats/min)		
	<80	<110	<120	<150	>150	<120	120-150	>150
Males (%)	70.6	26.5	2.9	0	0	47.1	44.1	8.8
Females (%)	84.4	14.1	1.6	0	0	87.5	9.4	3.1
	(χ2=2.598, df-2, p=0.273)					(χ2=21.217, df-2, p=0.000)		

Despite an evident lack of physical activity, the majority of females and males view it favourably, claiming it to be an integral part of their life, also affecting the success of their studies at the university. Thus, 64.7% of males and 75.0% of females believe that working out helps to prevent the fatigue that arises in the process of study, thereby having a positive impact on the effectiveness of the learning process. At the same time, 5.6% of females and 20.6% of males are sceptical about the relationship between workout and the success of the learning process. On this issue, a statistically significant difference between gender groups was established (χ2=6.211, df=2, p=0.045). In addition, 56.0% of males and 48.4% of females note the importance of working out as a means of preventing stressful situations that arise in the learning process.

Discussion

Decreased physical activity in both adults and children and young people is a global phenomenon (Hallal et al., 2012; Kohl et al., 2012). Out of all the components that contribute to human health, it was the lack of physical activity that made the top five causes of premature death in many countries around the world, according to the experts of the World Health Organization (WHO). In contrast, a healthy lifestyle, namely regular workout and a rational work and rest schedule, promote health and significantly increases the efficiency of students' learning activities (Mull & Tietjen-Smith, 2014). Thus, Wahl-Alexander and Chomentowski (2018) revealed that students engaged in aerobic workouts strengthening the cardiovascular system have greater physical fitness and achieve higher learning accomplishments. This fact prompted us to conduct this study.

The results of our research showed that the majority of students consider themselves healthy and do not show any particular concern about their health, with the exception of 22.0% of the surveyed students who were concerned about their health. The number of male students who considered themselves to be completely healthy was bigger than that of female students, but the difference between the gender groups was not statistically significant. Moreover, even the presence of chronic diseases in some cases did not prevent students from positively perceiving their health.

While researching the medical activity of students, we

found that more than a third of females and less than half of males attend medical institutions for preventive purposes once every half a year. About a third of all respondents, both males and females, are limited to annual mandatory medical examinations. Similar data were obtained by other authors. El Ansari et al. (2011), who studied the issue of medical activity, healthy behaviour, and lifestyle features of 3.706 students at seven universities in the UK, believe that only a small percentage of students adhere to positive medical practices to control their health.

Also, the majority of surveyed respondents recognize the importance of health in life, including in their future professional careers, and understand the role and place of lifestyle in shaping individual health.

The majority of students who adhere to a healthy lifestyle believe that the rejection of bad habits and consuming regular and nutritious food is enough to qualify them as adherents of a healthy lifestyle. According to students, one of the important components of a healthy lifestyle is a regular and balanced diet and adherence to it.

One third of female students and more than one half of male respondents who took part in our research answered that they follow the correct routine and dietary frequency. This, the difference between gender groups was statistically significant. However, a sufficiently large number of students do not eat regularly, eat less often than recommended, and use fast food as a snack. There is also a group of students who eat only when they find the time.

In our research, it was revealed that the majority of students do not consume enough water, and some students are limited to the fluid that enters the body with food. Meanwhile, Gurevich, Hanfer'yan, and Kambarov (2017) believe that insufficient water intake or mild dehydration may be associated with the risk of developing chronic diseases.

Furthermore, an indisputable factor in the health status of physically active people is the quantity and quality of sleep. About half of the surveyed students showed concern about insufficient time for sleep. About a third of male students and about half of female students complained about the quality of sleep, and 4.3% of females and 5.7% of young men noted the lack of a clear schedule of sleep due to the need to combine study with work. Meanwhile, according to Mickey, Trockel, Barnes, and Egget (2010) and Papadaki, Hondros, Scott, and Kapsokefalou (2007), the lack of time allowed for sleep, as well as earlier awakening has a negative impact not only on health but also on the academic performance of freshmen.

Analysing our data, we came to the conclusion that students, realizing the importance of physical activity in shaping health, considering it a necessary condition for the success of their studies and future professional activities, do not include workouts in the daily routine. The physical activity of the majority of the surveyed students does not even meet the hygienic minimum, neither in terms of volume nor intensity. For most students, compulsory workout at the university is the only way to fill the need for movement, while 29.4% of males and 38.8% of females include additional physical activities in the daily routine. Students do not make up for the volume and intensity of physical activity recommended by WHO (Global recommendations on physical activity for health, 2010). In our opinion, a two-time low-intensity workout, the length of which is up to 80 minutes a week and the intensity does not exceed 120 beats/min, is not enough even to meet the necessary hygienic standards of physical activity, not to mention the acquisition of additional benefits for health.

Thus, the results of this survey show the insufficiently formed habits of the interviewed students to maintain a healthy lifestyle. There are more male than female students positively evaluating their health and lifestyle, adhering to correct eating habits, and having positive medical practice. Females are more often include working out in their daily routine.

According to Tarabarina and Kononec (2018), the main reason for the formal attitude of students towards their health, its preservation and strengthening is a misunderstanding of the beneficial effects of physical activity on health, low motivation to engage in physical education, lack of development of self-control skills and in many ways inadequate perception of the state of their own body. In this regard, the physical education system is tasked with justifying the widespread use of physical education means and methods, promoting healthy lifestyles in order to shape students' readiness for health-saving physical activity and increase their physical activity and recovery.

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Conflict of interests
The authors declare that there is no conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

Priority Indicators of Sports Activity of Jumps in Water at the Stage of Advanced Sports Training

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Abstract

An analysis of the sports activities of divers conducted over three years, with boys (n=104) and girls (n=102), has determined that the sports activities of such divers are in general similar. For instance, indicators of physical development and sports-technical preparedness are similar in significance and contribution to the factorial structure for boys (11.4–21.8%) and girls (12.8–22.6%). The indicators of nystagmus reactions to rotational loads in 10-year-olds are common for all groups (boys: 10.0%; girls: 6.9%) but differ in their place in the factorial structure and contribution to the total dispersion. Thus, in the boys' group, indicators of physical development and sports-technical preparedness remain valid throughout the study period, while girls aged 12 to 13 experience changes in the significance of the identified factors and the integration of factors' indicators, which makes their interpretation difficult. The analysis carried out will allow the development of an integrated assessment of athletic suitability, taking into account the rank correlation of the indicators of children's sports-technical preparedness by years of training.

Keywords: *indicators, analysis preparedness, age, boy, girl, diver, water*

Introduction

The popularity of Olympic sports in the modern world, its intense commercialization and professionalization, and the ever-increasing socio-political importance of athletes' successes have led in recent years to the formation of highly effective systems of training athletes (Tovstonoh, 2010). In the practice of modern sport, numerous scientific research studies testify that world-level results are accessible only to exceptionally gifted athletes who have clearly expressed natural inclinations to achievements in a specific sport (Platonov, 2013; Shinkaruk, 2013; Romanchuk & Arabsky, 2019) or were able to realize them through the long-term improvement process (Krasova, 2012).

The definition of sports fitness in diving has become especially important. In scientific studies, this issue has been little studied, and the development trends of this sport are such that there is a continuous process of complicating dives and increasing requirements for the quality of their performance.

Only an athlete who possesses sufficient abilities can master the programme of dives and execute it at a high technical level. The urgent issue in the training of divers is the correct selection for children's and youth sports schools, on which the quality of the national teams depends.

Purpose of the study is analyze the sports activity of divers boys and girls. Determine whether the sports activities of such divers are generally similar.

Methods

The following research methods were used: the analysis and generalization of literary sources, factorial analysis, and

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methods of mathematical statistics.

The use of the analysis and generalization of literary sources enabled obtaining concise and relevant information on the topic of the study. Attention was primarily paid to the study of issues such as the current state of selection of young athletes in various sports, the importance of physical development, and the physical, sports, and technical preparedness of young divers in the selection system, which facilitated the scientific reason for the problem raised and the specification of the subject basis of the study.

According to the program of youth sports schools, the stage of in-depth sports training includes classes in educational groups of children from 10–12 to 13–15 years old and lasts an average of four years (Table 1). In this regard, our comprehensive study involved a dynamic three-year observation of young divers aged 9–13 years old.

Table 1. Pedagogical experiment strategy

Survey stage	Age groups
Stage 1	9 10 11 12 13
Stage 2	9 10 11 12 13 14
Stage 3	9 10 11 12 13 14 15

Legend: The arrows indicate the movement of athletes from one age group to another by stage of the study.

Thus, we studied five age sections of 9–13-year old children and five dynamic sections of children aged 9–11, 10–12, 11–13, 12–14, 13–15 years.

The study was conducted annually in January–March during the competitive period from 2016 to 2019. It was attended by children involved in diving in the Children's and Youth Sports School Number 3, Lviv. The dynamic experiment was attended by 104 boys and 102 girls.

Testing the physical fitness of young athletes was carried out using a competitive method in groups. Anthropometric measurements, determining the speed of a simple sensorimotor reaction and conscious self-regulation of sensorimotor activity, and studies of vestibular stability were carried out in laboratory conditions at training facilities. All measurements were carried out before the start of training sessions at 9.00 am and at 3.00 pm.

To identify the relationships between different types of preparedness that more fully characterize the sports activities of young divers in the age periods from 9 to 13 years old and to determine the differences between boys and girls of the same age, a factorial analysis was carried out (the method of main components with reference axes rotation by the Varimax criterion).

Factorial analysis was applied to selected indicators characterizing various types of preparedness and developmental characteristics of young athletes. The factors highlighted as a result of this analysis give a relatively complete picture of the structure of sports activity of young divers of 9–13 years old. Considering that the number of factors identified by the program in each age group was large (from 14 to 18) and their contribution to the generalized dispersion was unequal, the most significant first five or six factors from the set of indicators that had the most considerable factorial weight were interpreted.

Results

As a result of factor analysis, it turned out that the structure of indicators characterizing the sports activity of divers changes with the age development of athletes of both sexes. Thus, in the group of 9-year-old boys and girls, 16 and 14 factors stood out, respectively, while the contribution of the six most significant was 69.2% (Table 2) and 70.3% (Table 3), respectively.

Table 2. The factorial structure of sports activities of 9–13-year-old boys involved in diving

№	9 years		10 years		11 years		12 years		13 years	
	Factor	%	Factor	%	Factor	%	Factor	%	Factor	%
1	Physical development	21.8	Sports and technical preparedness	19.3	Physical development	15.4	Physical development	16.7	Physical development	20.4
2	Sports and technical preparedness	15.0	Physical development	11.4	Autonomic reactions to rotational load	14.4	Physical and sports-technical preparedness	14.2	Sports and technical preparedness	14.2
3	Autonomic reactions to rotational load	10.4	Rate of sensorimotor reactions	9.7	Sports and technical preparedness	10.6	Ability to self-regulate sensorimotor activity	9.7	Autonomic reactions to rotating load	10.0
4	Nystagmus response to the rotational load	9.5	Autonomic reactions to rotating load	8.8	Rate of sensorimotor reactions	10.2	Rate of sensorimotor reactions	8.6	Rate of sensorimotor reactions	9.4
5	Ability to self-regulate sensorimotor activity	6.6	Nystagmus response to the rotational load	6.9	Nystagmus response to the rotational load	7.5	Autonomic reactions to rotational load	5.9	Ability to self-regulate sensorimotor activity	7.7
6	Learning ability	5.9	Physical development	5.8	Learning ability	5.9	Learning ability	5.7	Learning ability	6.2
	Total:	69.2		61.9		64.0		60.8		67.8

The first factor is interpreted as physical development, and its contribution to the generalized dispersion was 21.8% in boys (Table 2) and 22.6% in girls (Table 3). The most significant factorial masses are found in indicators characterizing the size and structure of the body. Quite high factorial masses in Factor 1 were obtained in exercising raising legs on the gymnastic wall (r=0.562), and bent-downs and straighten-ups with turning right and left (r=0.506) in boys and pull-ups on the horizontal bar (r=0.624) and supine leg lifts until touching the floor behind the head (r=0.631) in girls, which characterize strength and special speed-strength training.

Table 3. Scheme of the factorial structure of sports activities of 9–13 years old girls involved in diving

№	9 years		10 years		11 years		12 years		13 years	
	Factor	%	Factor	%	Factor		Factor	%	Factor	%
1	Physical development	22.6	Sports-technical preparedness	20.1	Physical development	18.6	Sports-technical preparedness	21.6	Rate of sensorimotor reactions	25.8
2	Sports-technical preparedness	14.3	Physical development	12.8	Rate of sensorimotor reactions	17.1	Ability to self-regulate sensorimotor activity	15.5	Sports-technical preparedness	17.9
3	Learning ability	10.6	Nystagmus response to the rotational load	10.0	Autonomic reactions to rotational load	12.1	Physical development	13.6	Physical fitness	16.6
4	Ability to self-regulate sensorimotor activity	9.3	Ability to self-regulate sensorimotor activity	7.9	Physical fitness	8.9	Nystagmus response to the rotational load	10.8	Physical fitness and Physical development	13.3
5	Nystagmus response to the rotational load	7.4	Physical fitness	6.9	Sports-technical preparedness	6.3	Rate of sensorimotor reactions	9.5	Physical fitness and Physical development	10.4
6	Rate of sensorimotor reactions	6.1	Learning ability	6.1	Ability to self-regulate sensorimotor activity	6.1	Physical fitness	8.9	Physical fitness and Physical development	10.0
	Total	70.3		63.8		69.1		79.9		94.0

The second factor in both groups is identified as sports-technical preparedness. The contribution of the second factor to the total dispersion was 15.0% for boys and 14.3% for girls. The highest factorial weight was obtained by the following indicators of sports-technical preparedness: the sum of the complexity coefficients for the entire programme (rb=0,921; rg=0,979), the sum of the complexity coefficients of free dives (rb=0.929; rg=0.976), the average complexity coefficients of a free program (rb=0.930; rg=0.976), the average score for an free programme (rb=0.849; rg=0.969), and the sports result in points (rb=0.837; rg=0.958). In addition, in the group of boys, physical fitness indicators: the horizontal body holding (r=0.688) and the total indicator of physical fitness (r=0.652) have a high factorial weight. Thus, the common and main factors in the structure of the motor activity of 9-year-old divers are the factors of physical development and sports-technical preparedness.

For the next four factors that we considered, there are significant differences for 9-year-old boys and girls.

For boys, the third factor is interpreted as autonomic reactions to a rotational load. The contribution of this factor to the total dispersion was 10.4%. A high factorial mass was obtained by heart rate during rotations to the left (r=0.891), after rotations to the left (r=0.849), during rotations to the right (r=0.866), after rotations to the right (r=0.922) which were measured during vestibular resistance studies.

The fourth factor for boys (9.5% of the total dispersion) was identified as a factor of nystagmus response to the rotational load. The highest factorial weight was obtained by the indicators of the frequency of nystagmus after rotation to the left (r=0.821), the frequency of nystagmus during rotation to the left (r=0.858), the amplitude of nystagmus during rotation to the left (r=-0.740), the frequency of nystagmus after rotation to the right (r=0.588) and the amplitude of nystagmus after rotation to the right (r=0.714), which characterize the nystagmus reactions to a rotational load.

The fifth factor was interpreted as the ability to self-regulate sensorimotor activity; its contribution to the total dispersion was 6.6%. Significant factorial mass was obtained by the average rate of the motor reaction in the third task (r=0.549) and the range of indicators in the third task (r=0.871) that characterize the difference between the response time when setting to a record and keeping the optimal reaction speed, which is one of the indicators of the ability to self-regulate.

The sixth factor was 5.9% of the total variance. The highest factorial weight was obtained by the indicators of the index of the technical improvement rate (r=0.861) and the learning index (r=0.855); therefore, the factor was interpreted as a learning ability factor.

In the girls' group, the third factor was identified as a learning ability factor. Its contribution to the total dispersion was 10.6%. Significant factorial weight was obtained by indicators of the index of technical improvement rate (r=-0.921) and the learning ability index (r=-0.915).

The fourth factor in girls (9.3% of the total dispersion) was identified as the ability to self-regulate sensorimotor activity.

The greatest factorial weight is indicators of self-regulation ability (r=-0.915). Significant factorial weight in this factor is also shown by indicators of active vestibular tests (r=-0.682), heart rate during rotations to the right (r=-0.586), forearm length (r=-0.596), chest excursion (r=0.600), and subcutaneous fat (r=-0.771).

In the fifth factor, indicators characterizing the nystagmus reaction to rotational loads have the most significant factorial weight: the amplitude of nystagmus during rotation to the left (r=0.660), the amplitude of nystagmus after rotation to the left (r=0.799), the amplitude of nystagmus during rotation to the right (r=0.768) and the amplitude of nystagmus after rotation to the right (r=0.831). Indicators of physical fitness also have significant factorial weight: an upward jump without the help of hands (r=0.636), an increase in the jump upward with the help of hands (r=0.609) and 20-metre run (r=0.586). The factor is interpreted as nystagmus response to rotational loads and corresponds to the third factor in the group of boys. The contribution of the factor to the total dispersion is 7.4%.

The sixth factor in girls was identified as a factor of the rate of sensorimotor reactions; its contribution to the total dispersion of the sample is 6.1%. The most significant factorial mass was obtained by the indices of the rate of sensorimotor reactions: the minimum reaction time to a light stimulus (r=-0.876) and the average indicator of the maximum reaction rate to a light stimulus (r=-0.904).

At the age of 10 years, 17 and 18 factors stood out in the groups of boys and girls, respectively; the contribution of the most significant six was 63.8% for girls and 61.9% for boys. As in 9-year-old athletes, the first two factors in the groups of boys and girls have the same interpretation. The first factor is identified as sports-technical preparedness. The contribution to the total dispersion in boys was 19.3%, in girls 20.1%. The highest factorial mass in both groups was obtained by such indicators of sports-technical preparedness: the sum of the complexity factors for the entire program (rb=0.932; rg=0.922), the sum of the complexity factors of free dives (rb=0.950; rg=0.926), the average complexity coefficient of a free programme (rb=0.933; rg=0.928), the average mark for a free programme (rb=0.819; rg=0.933) and the sports result in points (rb=0.901; rg=0.906) as well as the sport experience (rb=0.529; rg=0.933) and sports qualification (rb=0.675; rg=0.760). In addition, in the group of boys, a significant factorial weight belongs to the indicator of raising legs on the gymnastic wall (r=0.551) which characterizes the strength of the muscles of the flexors of the body while in girls' the indicator of oncoming bending to a high angle (r=-0.691) which characterizes special speed-power qualities.

The second factor is identified as a factor in physical development. The contribution of this factor in boys is 11.4%, and 12.8% in girls (of the total dispersion of the sample). The largest factorial mass in both comparative groups was obtained by indicators of physical development (Rmen=0.938-0.563; Rwomen=0.866-0.506). In the group of boys, a significant factorial weight was also obtained by the indicators of jumping upwards without the help of hands (r=0.562) and with the help of hands (r=0.639), characterizing jumping ability. The third factor in the group of boys is identified as a factor in the rate of sensorimotor response. The contribution of the factor to the total dispersion was 10.6%. The greatest factorial mass was obtained by the sensory-motor reaction rate indices (r=0.950) and a 20 m run (r=0.639), which characterizes the speed of movements. The fourth factor in boys, whose contribution was 8.8% of the total dispersion of the sample, was identified as a factor of autonomic reactions to a rotational load. The highest factorial mass was obtained for heart rate with a standard rotation test (r=0.911–0.653). The fifth factor (6.9% of the total dispersion) is identified as nystagmus response to a rotational load. Significant factorial mass was found for indicators of the frequency and amplitude of nystagmus (r=0.890–0.653). The sixth factor in the group of boys in its content corresponds to the second factor. A significant mass was obtained by excursions of the chest (r=0.918) and relative bone mass (r=0.739). The contribution of the factor to the total dispersion of the sample is 5.8%.

The third factor in the group of girls was identified as nystagmus response to rotational loads. Its contribution is 10% of the total dispersion of the sample. The most significant mass is of indicators of nystagmus reactions to a rotational load (r=-0.876–0.528). The fourth in the group of girls was a factor that can be interpreted as the ability to self-regulate sensorimotor activity. The contribution of the factor to the total dispersion is 7.9%. The fifth factor was 6.9% of the total variance and was interpreted as physical fitness. Indicators of physical fitness (r=0.887–0.538) and the total indicator of physical fitness (r=0.866) received a significant factorial mass. The sixth factor stood out among girls, which we interpreted as learning ability. Its contribution amounted to 6.1% of the total dispersion.

Summarizing the above findings, it can be stated that, like 9-year-olds, 10-year-old boys and girls have the same identification and approximately the same contribution to the total dispersion with first two factors: sports and technical preparedness and physical development. Common to children of this age is the factor of nystagmus reactions to a rotational load. This factor in the group of girls with a contribution of 10% to the total dispersion ranks third while in the boys' it occupies the fifth position with a contribution of 6.9% to the total dispersion.

At the age of 11, only 17 factors stood out in the group of boys; the contribution of the most significant six was 64.0% of the total dispersion of the sample. For girls of this age, the total number of identified factors is 15; the contribution of the most significant five factors is 63.0% of the total dispersion.

The first factor in both groups was identified as a factor in physical development. The contribution of this factor to the total dispersion of the sample was 18.6% in girls and 15.4% in boys. The most significant factorial mass was obtained by indicators of physical development characterizing the longitudinal and transverse dimensions of the body and the structure of the body (r=-0.914-(-0.511)). In addition, a significant factorial mass in the group of boys was obtained by indicators of physical fitness, raising legs on the gymnastic wall (r=0.538) and oncoming bending to a high angle (r=0.507), which characterize strength and speed-strength qualities.

The second in boys with a contribution of 14.4% of the total dispersion, was a factor that we identified as autonomic reactions to a rotational load. The most significant mass refers to indicators of heart rate during rotations to the left (r=0.912), after rotations to the left (r=0.900), during rotations to the right (r=0.924), after rotations to the right (r=0.954). The third factor in the group of boys was identified as sports-technical preparedness. The contribution of this factor to the total dispersion was 10.6%. In addition to such indicators of sports and technical preparedness as the sum of the complexity factors for the entire program (r=0.885) and the sports result in points

(r=-0.890), a significant factorial mass was obtained by the indicators of the sport experience (r=0.506) and sports qualifications (r=0.695). The fourth factor for boys is distinguished as the rate of sensorimotor reactions factor. Its contribution to the total dispersion is 10.2%. A significant factorial mass is noted in the indicators of the speed of sensorimotor response (r=0.874–704), as well as in the indicators characterizing the ability to self-regulate sensorimotor activity (r=0.646–606). The fifth factor in boys was interpreted as a nystagmus response to a rotational load. The contribution of the factor to the total dispersion was 7.5%: and the sixth factor was identified as learning ability; its contribution to the total dispersion was 5.9%.

In 11-year-old girls, the second factor was identified as the speed of the sensorimotor response. The contribution of this factor to the total dispersion was 17.1%. The most significant mass was obtained by the indicators of the minimum reaction time to a light stimulus (r=-0.809), and the average indicator of the maximum reaction rate to a light stimulus (r=-0.883). The third factor in 11-year-old girls was the factor of autonomic reactions to a rotational load. The contribution of the factor to the total dispersion was 12.1%. The greatest factorial weight was obtained by resting heart rate (r=-0.811), during rotations to the left (r=-0.906), after rotations to the left (r = -0.811), during rotations to the right (r = -0.829), after rotations to the right (r=-0.877). The fourth factor in this group was identified as physical fitness, with 8.9% of the total dispersion. The most significant factorial weight was obtained by indicators characterizing power and speed-power qualities (r=0.828-525). In addition, indicators of nystagmus reactions to a rotational load to the left (r=0.583) and to the right (r=0.822), as well as a sporting result in points (r=0.808) also have significant weight. The fifth factor in the group of girls is identified as sports-technical preparedness. The contribution of this factor was 6.3% of the total dispersion. Significant factorial weight was obtained by indicators of the sum of complexity factors and average ratings (r=0.959-0.8465) as well as technical improvement rate indices (r=0.953) and learning ability index (r=0.581).

Thus, at the age of 11, the factor of physical development is the most significant and common for boys and girls. Also common for both groups are the factors of autonomic reactions, sports-technical preparedness and speed of sensorimotor reactions; however, they differ in their contribution to the total dispersion and accordingly in significance for the motor activity of boys and girls. Therefore, physical fitness indicators for girls are combined in the fourth factor, while for boys only two indicators (characterizing power and speed-power capabilities) are included with significant factorial weight in the first factor. As can be seen from the data presented, at the age of 11, a certain restructuring of the factorial structure is observed and as well as significant differences in the factorial structures of boys and girls.

At the age of 12, the differentiation of factorial structures of boys and girls continues. Although individual factors are similar in identification, they differ in their contribution to the total dispersion. Thus, in the group of boys of this age, the first factor was interpreted as physical development, the contribution of the factor to the total dispersion was 16.7%. In 12-year-old girls, the first factor is identified as sports-technical preparedness. Factor 1 has absorbed a large amount of information about girls' motor activity; its contribution to the total dispersion was 21.6%.

The second factor in the group of 12-year-old boys is identified as a factor of physical and sports-technical preparedness. The contribution of the factor to the total dispersion was 14.2%. In girls, the second factor is interpreted as the ability to self-regulate sensorimotor activity. Its contribution to the total dispersion was 15.5%. The factor, also identified as self-regulation ability, was the third in the group of boys of this age. Its contribution to the total dispersion was 9.7%. In the girls' group, there was the third factor, interpreted as physical development. Its contribution was 13.6% of the total dispersion. The fourth factor in 12-year-old boys was identified as the rate of sensorimotor reactions; the contribution of the factor was 8.6% of the total dispersion. The fourth factor for the girls was the nystagmus response to the rotational load, whose contribution to the total dispersion was 10.8%. The fifth factor in girls was identified as the rate of sensorimotor reactions. The contribution of this factor was 9.5% of the total dispersion. In boys of this age, the fifth factor is interpreted as an autonomic reaction to a rotational load. The sixth factor in boys is identified as learning ability. Its contribution is 5.7% of the total dispersion. In the sixth factor in girls, the most significant factorial weight was obtained by indicators of physical fitness. The contribution of this factor to the total dispersion was 8.9%.

According to the data provided, it can be concluded that the differences in the factorial structure of girls and boys at the age of 13 are even more pronounced. Girls of this age have an increase in the integration of indicators in factors, making their identification difficult. In boys of this age, the factorial structure is similar to that of 12-year-olds, and indicators in factors stand out differentially. Perhaps the differences in the factorial structures of boys and girls aged 11–13 years old are associated with different periods of the onset of puberty, and the integration of indicators found in factors in girls is explained by the interdependence of indicators during intense puberty development.

Discussion

According to the data provided, it can be concluded that the differences in the factorial structure of girls and boys at the age of 13 are even more pronounced. Girls of this age have an increase in the integration of indicators in factors, making their identification difficult. In boys of this age, the factorial structure is similar to that of 12-year-olds, and indicators in factors stand out differentially. Perhaps the differences in the factorial structures of boys and girls aged 11–13 years old are associated with different periods of the onset of puberty, and the integration of indicators found in factors in girls is explained by the interdependence of indicators during intense puberty development.

In summary, we can say that the results of factor analysis showed changes in the factor structure of sports activity with age development in both boys and girls. Moreover, changes in the factorial structure of girls are more significant, which is associated with different dates of the onset of puberty for boys and girls.

The results of the factorial analysis also indicate that the sports activities of boys and girls aged 9–11 years are mostly similar. Thus, factors of physical development and sports-technical preparedness are similar in significance and contribution to the factorial structure in boys and girls. The factors of nystagmus reactions to rotational load in 10-year-olds are common to all groups but differ in their place in the factorial struc-

ture and the contribution to the total dispersion.

Changes in the factorial structure in the age aspect in boys are less pronounced than in girls. In particular, in boys, factors of physical development and sports-technical preparedness remain relevant throughout the study period, while girls aged 12–13 experience changes in the significance of the identified factors and the integration of indicators within factors, which makes their interpretation difficult.

The analysis provides the basis for a differentiated approach to assessing the athletic suitability of boys and girls.

Prospects for further research are to develop an integrated assessment of athletic suitability obtained by calculating the multiple regression equations, taking into account the rank correlation of the indicators of sports and technical preparedness at the beginning of the observation with the valid data on the success of sports activities by years of training.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

Correlation of Physical Fitness and Professional Military Training of Servicemen

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Abstract

This article demonstrates that physically trained military personnel are more skilful and perform professional military actions much faster than poorly trained soldiers do. We have shown that, regardless of the characteristics of the professional activity of any military experts, its effectiveness is closely linked to their level of physical fitness, which in turn plays a significant role in the formation of the professional skills and capabilities of military experts. To assess the military and applied skills of servicemen, we have researched them performing exercises and meeting combat training standards (shooting machine guns, loading tank ammunition, constructing a single trench for shooting, etc.). The results of the exercise and performance assessment enabled the determination that physical training of troops is closely linked to combat training and contributes to improving the professional skills of military personnel.

Keywords: *military, servicemen, troops, performance, physical qualities, professional skills*

Introduction

Currently, one of the major problems is the comprehensive reform of the process of training and education of cadets who will become the officers of the Armed Forces of Ukraine. Providing troops with sophisticated military equipment, their improvement, and the need to maintain constant combat readiness of units require thorough improvement of combat training. Modern military operations, which are currently underway, do not reduce but rather increase the value of professionally important qualities of each officer.

The use of physical exercise to improve professional training of military, as confirmed by the historic experience of combat training, began long ago. There have been changes in weapons, military equipment, methods and tactics of warfare, but the importance of the physical fitness of servicemen for their successful military combat activities, as studies of outstanding scientists show has not decreased but has constantly grown, requiring specific differentiation (Klymovych, Olkhovyi, & Romanchuk, 2016).

The importance of the physical condition for the effective execution of military-professional work was proved by many scientific studies and centuries of war experience, including fighting in "hot" spots. Many experts consider physical condition to be the foundation for other components of the combat readiness of military personnel. This is because the level of development of certain physical qualities determines the overall physical ability of servicemen to perform separate motor actions and complex motor activities of differing character.

Abundant evidence has accumulated that proves that the

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good physical condition of soldiers is an integral part of the successful implementation of their professional military duties, and the foundation of their combat effectiveness (Oderov et al., 2017).

During the reform of the Armed Forces of Ukraine, an opportunity appeared to abandon the outdated methods of verification and assessment of physical fitness and implement the most effective ways to assess and verify the organization of training for servicemen. Therefore, the analysis of research results allows us to insist on the need to develop programmes, standards and tests for the army that would determine the degree of basic physical abilities of soldiers of various specialities and the degree of a person's ability to perform tasks in accordance with the chosen speciality and the requirements of military service (Romanchuk, 2015).

The purpose of the article is to prove the interconnection between physical fitness and military-vocational training of servicemen.

Methods

In order to improve special physical training and find ways of intensification, to study the level of employability, and to define dependence on physical qualities of servicemen, we studied the relationship of physical fitness and military training of military personnel in the course of field training exercise of personnel of the Faculty of Combat Employment of Troops, the Faculty of Missile Troops and Artillery, and the Faculty of Combat (Operational) Support of the National Army Academy, named after Hetman Sahaidachny, on performing exercises of PT and standards of combat training with the use of personal protective equipment (body armour of "Le Corsaire" type, Kevlar or metal helmet and with a weapon). The methods of analysis, mathematical and statistical processing of the obtained data were used during the study. Execution of the obstacle exercise was carried out as part of the training groups. The result of the implementation of the practical component of exercising physical and vocational training was measured with a CASIO electronic stopwatch with an accuracy of 1 s. The investigation of the average result of firing from an automaton by soldiers was determined in case of a hit in two of three targets or in the third. The study was conducted during scheduled sessions on physical and military training at the range within three months of systematic training. We were formed by two groups of each military specialty, physically trained and less trained - 1st (n=32), 2nd (n=34) of artillery servicemen; 1st (n=29), 2nd (n=38) servicemen of tank units; 1st (n=35), 2nd (n=64) servicemen of mechanized units. This study involved 232 cadets of the departments of combat use of troops, rocket troops and artillery, all-military faculty, training specialists in combat (operational) support. Each training group was tested in scheduled training sessions in approximately one period.

The results of the research were processed using mathematical statistics methods of using the Statistica 5.5 software. We also applied the methods of parametric statistics. The level of reliability was determined using a dual two-way t-test for the average.

Results

We have shown that, regardless of the features of professional military activity of any military experts, its effectiveness is closely linked to the level of their physical fitness. This conclusion is confirmed by the survey results during the field training exercises (FTXs) (Table 1).

Table 1. Indicators of professional military training of artillery servicemen during FTXs, (n=66)

Groups of servicemen	Indicators	Before exercises	On the final day	p
		M±SD	M1±SD	
1st (n=32)	Time to complete obstacle course, sec	129±0.9	131±0.9	>0.05
	Results of machine gun firing, marks	68±2.6	67±2.7	>0.05
2nd (n=34)	Time to complete obstacle course, sec	138±1.2	166±1.4	<0.001
	Results of machine gun firing, marks	66±2.4	42±3.3	<0.001

The advantage, by the results of these tests, is held by physically better-prepared servicemen (n=32), and compared with less physically prepared soldiers (n=34) is significant. The results in overcoming obstacles of less prepared soldiers deteriorated by 28 seconds ($p<0.001$), while in the best group the results declined by only 2 seconds ($p>0.05$). The results of the research suggest the physical unpreparedness of most military servicemen to endure significant physical pressure for long periods of professional military activity. It should also be noted that training during the FTX was not always carried out with maximum load, which modern combat conditions offer.

The results of firing the Kalashnikov machinegun also showed the advantage of physically stronger servicemen over the personnel of the less prepared group ($p<0.001$). Servicemen of the weaker group hit the target fewer times at the end of the FTX, which confirms the lack of psychological readiness to endure significant physical and psychological pressure of combat conditions.

The importance of physical fitness affects modern professional military activity, accompanied by relatively low loads.

Thus, during lengthy FTXs and while performing tasks in hermetically sealed objects (energy spending ranged from 2,762 to 2,814 kcal/day), the servicemen from the better physically prepared group showed significantly higher results in professional military training than the soldiers from the group with the lower level of physical preparation (Table 2).

Discussion

In the course of our research during the FTXs, we found that physically well-prepared cadet of mechanized units perform actions related to the implementation of manoeuvre on the battlefield up to 20-35% faster than those with a low level of physical fitness. Thus the longer the fighting, the more substantial the difference. Actions related to boarding technique and leaving it, hiding in various shelters, performing speed runs, are performed by soldiers with good physical condition 15–20% faster than by the soldiers with a low level of physical fitness.

Compared to physically poorly prepared servicemen, physically-well trained military of artillery units perform

Table 2. Indicators of professional training of military servicemen of tank and mechanized units during FTXs, (n=166)

Servicemen of tank units									
Groups	Tank ammunition loading,%			Precision of shooting%			Time of fire task performing,%		
	Before FTX	After FTX	Changes	Before FTX	After FTX	Changes	Before FTX	After FTX	Changes
1st (n=29)	100	80	20	100	75	25	100	117	17
2nd (n=38)	100	40	60	100	55	45	100	237	137
Servicemen of mechanized units									
Groups	3 km paramilitary cross, min., sec			Machinegun shooting, marks			Making a single trench for shooting prone		
1st (n=35)	14.19±2.1	14.37±1.9	0.18	57±1.9	51±2.4	6	512±0.9	529±0.7	0.17
2nd (n=64)	14.28±2.6	15.21±2.8	0.53	53±2.3	29±3.8	24	518±0.6	534±1.1	0.5

the actions to bring guns in combat and marching position, to lay and charge, to deliver ammunition to a firing position and other activities faster, more precisely and more skilfully. Their advantage in implementing various professional military techniques is more pronounced the higher physical and mental pressures the soldiers experience. This leads to the fact that artillery squadrons whose personnel are better prepared physically are capable of performing the first sighting shot and to fire 20% faster than the squadrons with worse physically prepared personnel (Oderov, 2014).

The positive impact of the components of physical condition extends to the professional military careers of servicemen of other military specialities. Excellently physically prepared tankmen more quickly and more accurately than poorly physically prepared ones perform the techniques associated with firing from a tank gun. In long combat training, the speed and shooting accuracy of such troopers is reduced by half compared to those servicemen who are worse physically prepared. During a multi-day advance action, the significant advantage of physically well-prepared tankmen in their accuracy and speed of manoeuvring becomes evident. High levels of physical fitness allow the car drivers to perform actions associated with servicing machines quickly and more efficiently, as well as operating the machine in difficult conditions.

The positive impact of physical state indicators of servicemen on the components of their combat capability phenomenon is caused by the skills transfer (training, fitness, experience).

The physical condition of radar operators influences the speed of target search, identification their coordinates, situation assessment and decision making in difficult conditions, as well as the number of errors the operators make during duty. Therefore, soldiers with excellent physical condition make mistakes approximately 50% less than those with a low level of physical fitness and functional capacity do.

The degree of use of aircraft manoeuvring capabilities and the efficiency of air shooting largely depend on the physical condition of pilots. It is established that pilots with a good functional physical state can endure overload of 7.1–7.7 units, allowing full use of the manoeuvrable possibilities of fighter aircraft. At the same time, a pilot with a worse physical fitness state uses only 65% of manoeuvrable possibilities of an aircraft in similar conditions (Romanchuk, Popovich, & Krasota, 2011).

It is a fact that perfectly physically prepared sailors perform military and special techniques aboard their ship more quickly and accurately than weakly physically prepared ones do. In particular, they perform steps to prepare for torpedo firing much faster, which is especially important because in most cases the speed and precision of the personnel in performing such actions directly influence the speed of performing relevant manoeuvres or combat missions by the entire ship (Weidner-Dubrovin & Gamgarov, 1964)

In addition, the practice of military training proves that servicemen in excellent physical shape retain the speed and accuracy of fighting techniques longer and at a higher level under the influence of physical pressure and mental stress, and acquire knowledge, skills and abilities necessary to carry out these actions much faster. In other words, they master a military profession and adapt to unusual conditions of military life more quickly. The degree of interdependence between the level of the physical shape of military personnel and their level of military preparedness and education is greater the more complex the combat environment is. Common tasks of physical training reflect requirements for physical readiness of the whole personnel of the Armed Forces of Ukraine, and special tasks of physical training are identified by analysing the requirements for the physical shape of servicemen of different arms, services and branches of the armed forces.

This study shows that the vast majority of combat action is associated with different durations of movement by military equipment and vehicles both along the roads and over rough terrain. About 90% of respondents confirm the negative impact of motion sickness, action in specific conditions of high noise and air pollution while performing tasks related to the movement by vehicles on the fighting capacity of subordinate personnel, their physical, and physiological condition.

The results of the research aimed at understanding the nature of the methods and actions of military personnel in the performance of combat missions enabled clarifying the theory of special orientation of physical training, based on which the differentiation of evaluation standards was implemented in the exercises, reflecting the development of applied physical qualities of servicemen of different military specialities (Kyrpenko, V. Romanchuk, S. Romanchuk, & Fedak, 2015).

Therefore, when certain requirements of military activity by physical and mental activities, mode of physical motion activity, as well as current conditions are identified, the combat activities of servicemen of different military specialities are different. This significantly affects the requirements applied to

the physical and mental state of soldiers.

Having analysed the test results of the exercises performed and the standards of combat training, materials of special research, and methodological literature, we can state that the use of personal protective equipment and weapons (total fixed weight is approximately 25–30 kg) when performing motor actions will allow determining further the dependence of professional employability on the level of physical qualities of military servicemen, and in a short period will accelerate the training of servicemen for possible military action in protective combat gear and preforming actions similar to combat fighting.

Thus, the importance of various indicators of the physical condition of soldiers in the structure of their readiness for combat activities is undisputedly proven. Physical fitness and the functional condition of the body positively affect all combat effectiveness of personnel, and significantly influence the overall effectiveness of military-professional work and commitment of troops to perform assigned tasks according to their positions.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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SportMont

ORIGINAL SCIENTIFIC PAPER

Effect of β-Alanine Supplementation on Repeated Sprint Ability and Responses of Blood Lactate and Bicarbonate in Male Soccer Players

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Abstract

This study was designed to investigate the effect of β-alanine supplementation on sprint time during repeated sprint ability test and blood lactate and bicarbonate responses to the test. Eighteen male soccer players were randomly divided into two groups (β-alanine, n=9 (24.31±2.14 yrs) or placebo, n=9 (23.98±2.07)). We conducted a randomized, double-blind, parallel-group, placebo-controlled study in which participants ingested 4.8 g/day for four weeks of a β-alanine supplement or a placebo. Athletes completed seven repetitions of 30 m interspersed with 30 s recovery intervals. The test was performed before and after four weeks of supplementation. Blood samples were collected from each participant in both groups before and after the test, pre- and post-supplementation to measure lactate and bicarbonate levels. Data showed that the sixth and seventh repetitions were significantly faster after β-alanine supplementation than the placebo (sixth repetition: 3.74±0.04 s vs 3.91±0.09 s, seventh repetition: 3.91±0.07 s vs 4.12±0.14 s, p=0.001, p=0.002, respectively). Before supplementation, however, no differences existed between groups for any sprint time in all repetitions (p>0.05). Data revealed significantly higher lactate concentration in the β-alanine than the placebo after the finish of the test at both pre-supplementation (p=0.022), and post-supplementation (p=0.017). No differences noted between groups in bicarbonate at all measured points. In conclusion, β-alanine supplementation has a beneficial effect on repeated sprint performance in soccer players, probably due to effective vasodilatation mechanism.

Keywords: *carnosine, fatigue, hydrogen ion, fast-twitch fiber, glycolysis*

Introduction

Soccer players complete a competitive game with substantial high numbers of explosive powers, duels, accelerations, and repeated sprints (Varley & Aughey, 2013). These activities are performed with high-intensity effort that may be associated with the accumulation of muscle metabolites, such as adenosine diphosphate (ADP), inorganic phosphate (Smith et al., 2009), and hydrogen ion (H^+) (Hobson, Saunders, Ball, Harris, & Sale., 2012) contributing to muscle fatigue. Excessive amounts of H^+ impair the activity of calcium ions on the troponin-binding site (Lancha Junior, de Salles Painelli, Saunders, & Artioli, 2015) affecting excitation-contraction coupling. In addition, the accumulation of intramyocellular H^+ represents the major cause of muscle fatigue during high-intensity exercise (de Salles Painelli et al., 2013) and has been shown to inhibit the resynthesis of phosphocreatine (PCr) (Hobson et al., 2012), glycolysis (Lancha Junior et al., 2015), and disrupt the buffering system (de Salles Painelli et al., 2013). Of importance, the muscle pH buffers are supported by the physicochemical buffering system (Smith et al., 2009) that includes free inorganic phosphate (Baguet, Koppo, Pottier, & Derave 2010), creatine phosphate (Baguet et al., 2010) bicarbonate (de Salles Painelli et al., 2013), and histidine residues, such as carnosine (Baguet et al., 2010; Hobson et al., 2012).

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Carnosine (β-alanyl-L-histidine) is a cytoplasmic dipeptide and one of the first lines of defence system against muscle acidosis (Hill et al., 2007) due to its imidazole that has an optimal pka value of 6.83 (Bate-Smith, 1938; Brisola, Artioli, Papoti, & Zagatto, 2016; Harris et al., 2006); high concentrations of it are found in human skeletal muscle (16 - 29.2 mmol/kg dry muscle) (Harris et al., 2006; Hobson et al., 2012; Smith et al., 2009). Additionally, carnosine functions are mostly associated with antioxidants, anti-ageing (Gallant, Semyonova, & Yuneva, 2000), protein glycosylation inhibition, and wound healing (Baguet et al., 2010). Since soccer players perform several changes of directions, with an average change of movements every 4 to 6 seconds (Devrnja & Matkovic, 2018), which may induce muscle acidosis, carnosine supplementation is likely to be beneficial.

β-alanine (BA), a non-essential amino acid, is the rate-limiting precursor of the carnosine synthesis in muscle cells (Glenn et al., 2015). It has been demonstrated that BA supplementation is used by athletes to delay fatigue and improve performance (Baguet et al., 2010) through increased non-bicarbonate myocyte buffering capacity (Baguet et al., 2010; Suzuki, Ito, Mukai, Takahashi, & Takamatsu, 2002) and increased vasodilatation (Ririe, Roberts, Shouse, & Zaloga, 2000). Previous studies have shown that intake of BA supplement with a dose of 3.2–6.4 g/day for 4–10 weeks (Hoffman, 2010; Kendrick et al., 2008) could increase intramyocellular carnosine content by 40–80% (Hill et al., 2007). Also, irrespective of different exercise modes, some studies have revealed that BA supplementation resulted in improved physical performance in high-intensity exercise (Claus et al., 2017), repeated maximal contractions (Derave et al., 2007), and during time-to-exhaustion (Glenn et al., 2015). In contrast, the others have failed to find a beneficial effect on strength exercise (Kendrick et al., 2008), repeated treadmill sprint test (Sweeney, Wight, Brice, & Doberstein, 2010), Wingate anaerobic testing (Al-horani & Alzoubi, 2017), and oxygen deficit (Baguet et al., 2010).

It is plausible that the increase in muscle carnosine content brought about by BA might be of benefit to soccer players. Although some studies have examined the effect of BA in repeated sprint modes (Brisola et al., 2016; Danaher, Gerber, Wellard, & Stathis, 2014; Sweeney et al., 2010), no studies have examined BA supplementation effect on treadmill repeated sprint ability (RSA) test in soccer players or on the field. Consequently, the present study aimed to investigate the effect of BA supplementation on RSA test and blood lactate and bicarbonate responses to the test in soccer players. We speculate that BA supplementation may improve performance by the features of physicochemical buffers.

Methods

Subjects

Eighteen well-trained male soccer players from a premier Jordan division team participated in the study. All athletes trained once a day (approximately 110–120 min), six times per week. The study was done during the early period of the participants' off-season. Before signing the informed consent form, the athletes were informed about the potential risks and benefits involved in participation. Informed consent was obtained from all participants involved in the study. This study was approved in advance by the Local Scientific Research Committee (protocol no. 09/2019 M A)

Experimental design

A randomized, double-blind, parallel-group placebo-controlled design was used in this study. Participants were randomly divided into two groups: β-alanine (BA) group (n=9) and dextrose as the placebo (Pla) group (n=9). Participants' demographic data in both groups are presented in Table 1. Before beginning the study, each athlete visited the laboratory on two separate days. Day one consisted of fill-out and signing an informed consent form and completion of a background health information form to ensure that all participants met the inclusion criteria (normal vital signs). Day Two consisted of the measurements of characteristics of participants as well as information about possible risks and benefits related to participation. Before beginning the supplementation period, each athlete in both groups performed the RSA test. After that, athletes were instructed to ingest BA in the BA group and dextrose in the Pla group, both for four weeks. After one day of the completion of supplementation, the test was performed in the same order for all athletes in both groups. The test was performed at the same time of the day (9.30 am) in both groups. Randomization was equalized by skills, position, and experience to ensure the homogeneity between groups. The homogeneity of the demographic variables of participants between groups was equal (p>0.05) (Table 1).

Table 1. Subjects demographic data

variable	Pla	BA	p
	M±SD	M±SD	
Age (years)	23.98±2.07	24.31±2.14	0.741
Height (cm)	178.11±3.33	180.00±2.55	0.196
Mass (kg)	71.89±3.18	72.33±2.78	0.756
BMI (kg/m^2)	22.65±0.44	22.30±0.82	0.281
resting HR (bpm)	61.89±2.67	60.67±2.45	0.326
VO2max (ml/kg/min)	54.70±2.00	55.52±2.26	0.426
Training experience (years)	9.56±2.24	8.89±1.96	0.512

Legend: M-mean; SD-standard deviation; Pla-placebo, BA-β-alanine; p<0.05

No differences existed between groups for any demographic variable.

Control of pre-experimental status

The authors did not interfere with the athletes' training sessions throughout the study. Athletes were asked to maintain their routine training sessions and were instructed to refrain from strenuous exercise 48 hours prior to each test. None of the athletes had ever consumed BA supplements. They were not permitted to ingest any nutritional and/or ergogenic sup-

plementation throughout the study. They were also requested to maintain their normal diet throughout the supplementation period and were instructed to fast three hours prior to the test for not to affect final analyses. Athletes wore the same attire for each test and wore the T-shirt and shoes in which they normally train.

Supplementation protocol

During the supplementation period, athletes in the BA group received 4.8 g/day of BA (CarnoSyn®, Capsule, Beta-alanine, BioSteel, Canada) taken three times per day throughout the supplementation. Athletes in the Pla group received 8 g dextrose in the same order. The selected dose was utilized to avoid the potential incidence of paraesthesia (Kendrick et al., 2008). The supplementation period was determined to ensure the increased content of muscle carnosine (Smith et al., 2009). The dose of BA supplement was taken after meal or snack interspersed minimally by three hours to circumvent paraesthesia. Similar opaque capsules were used by participants in both groups to preserve the design and participants' inability to distinguish between the two types. None of the athletes were affected by paraesthesia.

Repeated sprint ability test

Familiarization for the RSA test was done once in the study due to the fact the athletes are already adapted to short sprinting. The test was performed in the track (arena). Athletes performed a sprint test before and after four weeks of the supplementation period. It consisted of seven maximal sprint repetitions of 30 m (7×30 m) interspersed by a 30 s recovery. It was performed after a standardized warm-up of 10 min that had already been used by athletes before every training session. The distance of 30 m was measured electronically (30M Laser Digital Tape, Germany). A digital clock (Infrared Control System, Clock Counter, 63501IR, USA) was utilized to record the time of each repetition during the test. All participants were performed in the standing position beginning. During the 30 s recovery intervals between repetitions, athletes were asked to rest passively. Verbal encouragement was given to each athlete to achieve the maximal speed of every repetition.

Blood sample analysis

The blood samples were collected from each participant in the BA and Pla groups to measure lactate and bicarbonate before and after five minutes of the RSA test. Venepuncture was used to obtain blood samples (5 ml). Lactate concentration was analysed using (Integral 400, Switzerland). A gas analyser (Cobas b 221 - Roche Diagnostics, Switzerland) was utilized to analyse bicarbonate. The period of five minutes was specified to ensure sufficient lactate clearance and bicarbonate buffering and, therefore, supposed the explanation for ingested BA effect. The reference ranges of variables were as follows: 0.63–2.44 mmol/L for lactate, 22.0–29.0 mmol/L for serum bicarbonate.

Statistical analysis

The Shapiro-Wilk test was applied to check for normal distribution. The variables were normally distributed ($p>0.05$). A paired sample t-test was used to analyse the differences in blood lactate and bicarbonate within a group (between pre- and post-RSA test, and between before and after supplementation). Paired sample t-test was also used to analyse the differences between repetitions within a group. An independent t-test was utilized to analyse the differences in blood lactate and bicarbonate between groups. Two-way ANOVA with repeated measures on (pre vs post) was used to determine if any significant main effects were present between groups (BA and Pla). Statistical analyses were carried out by SPSS version 23.0. All data are reported as mean±SD. The level of statistical significance was set at $p<0.05$.

Results

Table 2 illustrates the sprint time of each repetition during the RSA test before and after supplementation within a group.

Table 2. Sprint time of the 7 repetitions during repeated sprint ability test within a group before and after supplementation

RSA test	Pla group		p	BA group		p
	Pre-suppl M±SD	Post-suppl M±SD		Pre-suppl M±SD	Post-suppl M±SD	
Rep. 1	3.51±0.01	3.52±0.01	0.088	3.52±0.02	3.51±0.02	0.154
Rep. 2	3.54±0.02	3.53±0.01	0.316	3.55±0.03	3.53±0.02	0.070
Rep. 3	3.57±0.02	3.56±0.01	0.212	3.58±0.02	3.55±0.02	0.052
Rep. 4	3.62±0.03	3.61±0.02	0. 056	3.63±0.03	3.59±0.02	0.010*
Rep. 5	3.66±0.04	3.65±0.02	0.738	3.67±0.03	3.63±0.03	0.002*
Rep. 6	3.89±0.10	3.91±0.09	0.009*	3.90±0.09	3.74±0.04	0.001*
Rep. 7	4.11±0.14	4.12±0.14	0.028*	4.10±0.13	3.90±0.06	0.001*

Legend: * - $p<0.05$; RSA - repeated sprint ability; Pre - before, Post - after, suppl - supplementation, Rep - repetition

Two-way ANOVA showed that the sprint time of sixth and seventh repetitions were significantly ($p<0.05$) faster before than after dextrose supplementation. Data also revealed that BA supplementation had a significantly beneficial ($p<0.05$) effect in the sprint times of the fourth to seventh repetitions compared to pre-supplementation. In addition, the sixth and seventh repetitions were significantly faster ($p<0.05$) after BA supplementation than the Pla (Table 3). Before supplementation, however, no differences existed between groups for any sprint time in all repetitions.

The paired sample t-test showed that lactate concentration was significantly higher after the finish of the RSA test compared to pre-test before and after supplementation in both the BA and Pla groups ($p<0.05$). These were measured pre- and post-sprint test before and after supplementation (BA: 2.30±0.12 vs 9.01±0.14 mmol/L, $t=190.45$, $p=0.001$; 2.40±0.07 vs 9.15±0.22 mmol/L, $t=105.89$, $p=0.001$; Pla: 2.37±0.30 vs 9.23±0.21 mmol/L, $t=51.41$, $p=0.001$; 2.38±0.05 vs 8.89±0.17

Table 3. Sprint time of the 7 repetitions during repeated sprint test before and after supplementation between groups

RSA test	Pre-suppl		p	Post-suppl		p
	Pla (M±SD)	BA (M±SD)		Pla (M±SD)	BA (M±SD)	
Rep. 1	3.51±0.01	3.52±0.02	0.395	3.52±0.01	3.51±0.02	0.468
Rep. 2	3.54±0.02	3.55±0.03	0.464	3.53±0.01	3.53±0.02	0.920
Rep. 3	3.57±0.02	3.58±0.02	0.593	3.56±0.01	3.55±0.02	0.325
Rep. 4	3.62±0.03	3.63±0.03	0.748	3.61±0.02	3.59±0.02	0.067
Rep. 5	3.66±0.04	3.67±0.03	0.562	3.65±0.02	3.63±0.03	0.186
Rep. 6	3.89±0.10	3.90±0.09	0.818	3.91±0.09	3.74±0.04	0.001*
Rep. 7	4.11±0.14	4.10±0.13	0.882	4.12±0.14	3.90±0.06	0.002*

mmol/L, t=80.97, p=0.001, for pre- and post-RSA before supplementation, pre- and post-RSA after supplementation, respectively). The values of bicarbonate were significantly (p<0.05) decreased within a group after the finish of the test compared to pre-test before and after supplementation (BA: 26.09±0.42 vs 19.91±0.24 mmol/L, t=72.810, p=0.001; 26.31±0.20 vs 20.17±0.23 mmol/L, t=194.705, p=0.001; Pla: 26.14±0.29 vs 19.93±0.24 mmol/L, t=73.566, p=0.001; 26.23±0.23 vs 19.96±0.27 mmol/L, t=71.568, p=0.001, for pre- and post-RSA before supplementation, pre- and post-RSA after supplementation, respectively). The independent t test demonstrated significantly higher lactate concentration in BA than Pla after the sprint test, before (p=0.022), and after supplementation (p=0.017) (Figure 1).

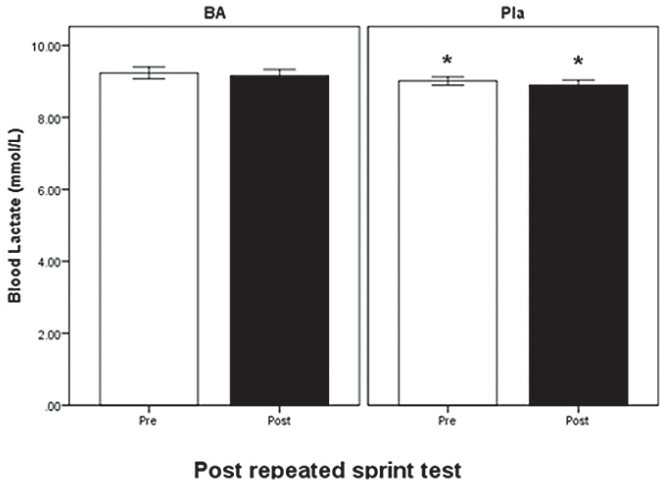

FIGURE 1. Lactate response to repeated sprint test between trials pre- and post-supplementation (p<0.05)

Figure 2 illustrates the insignificant (p>0.05) differences between groups in bicarbonate following sprint test, before and after supplementation.

No differences existed between groups (p=0.894, p=0.104 for pre and post supplementation, respectively). Significance level was set at p<0.05

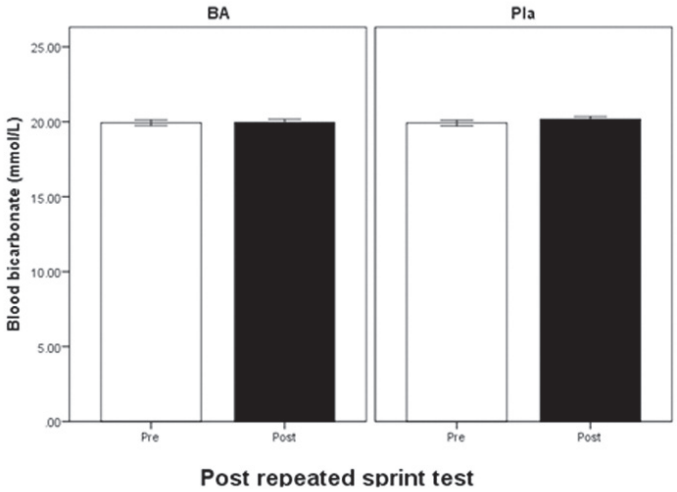

FIGURE 2. Bicarbonate response to repeated sprint test between trials pre- and post-supplementation.

Discussion

Our main finding is that the sprint times in the sixth and seventh repetitions during the RSA test were performed faster after BA supplementation than by the Pla group. This result could be explained by the beneficial effects of BA for improving performance by eliciting calcium release from the sarcoplasmic reticulum (Dutka & Lamb, 2004), by increasing calcium sensitivity of the contractile apparatus (de Salles Painelli et a., 2013), and by vasodilatation (Ririe et al., 2000). These mechanisms can occur as a result of increased muscle carnosine levels, making the muscle contractile force operate effectively (Hobson et al., 2012) and the subsequently delayed onset of fatigue (Hill et al., 2007). Significantly, a typical content of muscle carnosine is 17–25 mmol/kg dry muscle (Baguet et al., 2010). This amount has been proposed to elevate muscle carnosine content by about 60–80% (Lancha Junior et al., 2015).

Although we were unable to measure muscle carnosine content, the supplementation period and dosage utilized in our study (4.8 g/ day for 4 weeks) are approximately equal in previous studies that have shown increase muscle carnosine levels. In line with this, Baguet et al. (2010) found, using proton magnetic resonance spectroscopy (1H-MRS), increased muscle carnosine content by 45.3% in the soleus and 28.2% in gastrocnemius after BA supplementation (5 g/ day for 7 weeks) and showed the high correlation between speed and carnosine content as 4.3 s faster than the placebo after the completion of a 2000 m ergometer test in rowers. Derave et al. (2007) also observed significantly increased carnosine content in the soleus (+47%) and gastrocnemius (+37%) following BA supplementation (4.8 g/day for 4 weeks) and diminished fatigue during five bouts of 30 maximal voluntary leg extension in sprinters. Danaher and colleagues (2014) found elevated carnosine concentration in the gastrocnemius (+62%) and soleus (+88%) after supplementation period (4.8–6.4 g/day for 6 weeks) compared to placebo (7.42 mM, 6.33 mM, respectively).

In regard with repeated sprint performance, Brisola et al. (2016) demonstrated no significant group-time interaction for RSA test interspersed by 30-min swimming test after 28 days of BA supplementation (4.8–6.4 g/day) in water polo players. Danaher et al. (2014) showed that the performance during RSA test (5 × 6 s) separated by 24 s was not different between beta-alanine and placebo groups, although intramuscular carnosine levels were increased after supplementation. In a study conducted on physically active college men, BA supplementation (4–6 g per/day for 4 weeks) had no beneficial effect on repeated sprint protocol that consisted of 2 sets × 5 five-second sprints separated by 45 s between sprints and 2 min between sets (Sweeney et al., 2010). In the same study, they suggested that the recovery period was inadequate to resynthesize PCr. In contrast, Claus et al. (2017) showed that BA supplementation (6.4 g/day for 6 weeks) improved ball velocity shooting during RSA test in water polo players. Regarding endurance capacity, Glenn et al. (2015) showed that BA supplementation (3.2 g/day for 28 days) improved time to exhaustion compared to placebo in female cyclists. Surprisingly, one study revealed no existed difference in rating of perceived exertion between a BA and placebo, although the time to exhaustion during supra-maximal cycling test (120% VO2 peak) was significantly increased following BA supplementation (6.4 g/day for 4 weeks) in cyclists (Bellinger & Minahan, 2016).

In the present study, lactate concentration at the end of the RSA test pre- and post-supplementation was significantly higher in the BA than the Pla group. This could be explained by the fastest sprint time achieved by athletes in the BA group, specifically in the last two repetitions. Importantly, during repeated sprint bouts, fast-twitch fibers' reliance on both PCr and glycolysis (Sweeney et al., 2010), resulting in elevated lactate concentration. In the study of Derave et al. (2007), lactate concentration was not different between BA (16.3±0.8 mmol/L) and placebo (15.9±0.7 mmol/L) that was measured after 180 s from completion of a 400-m run. Sweeney et al. (2010) found no difference in lactate response to repeated sprint protocol before and after supplementation between a BA and placebo (12 mmol/L, 13 mmol/L, respectively). In the present study, after supplementation, lactate concentrations reached 9.15 mmol/L in the BA group compared to 8.89 mmol/L in the Pla group after the completion of the RSA test. We suggest that the measured lactate levels after 5 min might not allow for lactate clearance. Tobias et al. (2013) reported increased lactate levels (~13 mmol/L) after BA supplementation compared to placebo (~ 12 mmol/L) after 5-min recovery of four 30 s upper-body Wingate tests, separated by 3 min. The supplementation period in that study was 6.4 g/day for four weeks. Glenn et al. (2015) concluded that adequate recovery to determine a typical lactate concentration would be more than five minutes after the completion of the exercise. Sale et al. (2011) showed that lactate concentration remained elevated after five minutes of exercise in BA compared to the placebo. According to the lactate values in previous studies, we suggest that our athletes did not reach the point of "lactate-induced fatigue".

BA supplementation was likely to decrease bicarbonate after finishing the RSA test compared to Pla, though that was not statistically significant (p=0.104). The explanation of this result might be attributed to the effective buffering system in which the carbonic acid catalyses bicarbonate to H^+. Basically, when lactic acid accumulates inside muscle fibers due to glycolysis and disassociates to lactate overcome the buffering capacity (Hobson et al., 2012), excessive production of H^+ will occur (de Salles Painelli et al., 2013), the muscle pH declines, and subsequent, bicarbonate decreases. Intramuscular H^+ can increase to 10-fold during intensive exercise, in which the muscle pH drops from 7.1 to 6.3 (Tobias et al., 2013). In addition, muscle acidosis is increased during activation of fast-twitch fibers rather than slow-twitch fibers (Zhen-He, Botinelli, Pellegrino, & Reggani, 2000). Therefore, in our design, the repeated sprinting bouts might be depending on fast-twitch fibers that may result in decreased bicarbonate (Derave et al., 2007).

These are the first data investigating the beneficial effects of β-alanine on repeated sprint performance in soccer players. Our main data indicate that β-alanine supplementation (4.8 g/day, 3 times per day for 4 weeks) can improve sprinting performance during RSA test (7 × 30 m) in soccer players. After the supplementation period, however, lactate response to the test was higher in BA than in the placebo group, though the bicarbonate concentration was not different.

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Conflict of interests
The authors declare that there is no conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

Indonesian Air Force Physical Tester Reliability in Assessing One-Minute Push-Up, Pull-Up, and Sit-Up Tests

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Abstract

The physical fitness test is a form of assessment to determine the level of physical fitness of a person, both general and specific (muscle). The purpose of this study was to assess the correlation among testers on pull-ups, sit-ups, and push-ups for one minute, and to determine the lowest reliability of the three tests. This study uses a sample of five people who are physical fitness testers of the Indonesian Air Force (TNI AU) who are experienced and active in conducting tests. The subjects were 25 males 18–22 years old. All testers assessed each subject by recording the results of the repetition of movements on all three tests. The data obtained were then converted based on the Indonesian Air Force physical fitness technical guidelines book. After analysis with Anova and ICC, it was found that the data produced by the five different testers had the ICC coefficient values that varied the least on the push-up test. Increased reliability of the testers can be accomplished through practice, tester selection, and paying attention to the ability of the tester. Also, the development of assessment tools and the development of alternative forms of testing are needed.

Keywords: *reliability, tester, push up test, pull up, sit up*

Introduction

Physical fitness has an essential role in supporting one's physical activities so that they can carry out their duties optimally. The degree of physical fitness has a linear relationship with the level of achievement, work success, and other physical activities (Widiyanto & Hartono, 2018). Many institutions require a certain level of fitness, so systems and tools that can measure and assess someone's fitness level ae needed. Harsono (2015) argues that physical fitness components that can be measured and assessed include strength, endurance, muscular power, speed, flexibility, agility, coordination, balance, accuracy, and reaction. In measuring physical fitness, the aspects that must be measured are the basic motor skills, which include strength, endurance, speed, flexibility, and coordination (Bompa & Haff, 2009).

Muscle strength and endurance are essential components of physical fitness (McManis, Baumgartner, & Wuest, 2000). The level of strength and endurance of muscles affects the ability of individuals to perform daily functions and various physical activities. A physical fitness test is needed to produce data about physical abilities, both in monitoring the physical development of coaching and in the context of selection. In the Indonesian Air Force, one-minute model pull-ups, push-ups, and sit-ups are part of a form of physical fitness test conducted to determine the strength and endurance of muscles without using assistive devices (Hartono, Widodo, Wismanadi, & Hikmatyar, 2019). Pull-up and push-up tests are used to assess and develop the strength of the shoulders, arms, and upper body, while sit-up tests are used to measure the strength and endurance of the abdominal muscles (Fox, 1988; Piscopo &

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Baley, 1981; TNI AU, 2011; TNI AU, 2013).

The results of these three tests are based on the results of the tester, who interprets the pull-ups, sit-ups, and push-ups. Based on the technical guidance of the Indonesian Air Force soldiers' physical safety test, the pull-up movement is done by lifting the body with the strength of the arm so that the chin passes above the bar and then drops off to the starting posture followed by lifting the body; this is repeated as much as possible without resting for a maximum of one minute. In the sit-up test, in the initial stance, participants lie on their backs with their legs bent 90 degrees, their feet flat against the floor and knees approximately 20 cm apart, hands placed behind the head, fingers placed with legs held in place to keep them from moving.

The movement starts with rising and sitting and bending down until the nose touches the right or left knee, and one of the elbows is between the knees; the subjects then quickly goes down, lying on his back as in the starting posture, and then repeats the motion for a maximum of one minute.

In the push-up test, the starting position is with both hands under the shoulders, arms bent at the side of the body, legs straight with toes resting on the floor and the distance between the hands as wide as the body. The subject straightens his arms to lift the body so that it is raised with the legs and body straight; He then bends his arms so that the body lowers; his chest touches the floor while his stomach should not; the head turned to the right or left, and the movement is repeated for one minute.

In connection with a test, according to Miller (2002), some physical ability test requirements are valid, reliable, objective, economical, attractive, and should be implemented. The study of McManis et al. (2000) reveals some problems that are often encountered in the pull-up test when test participants take a down position, and it is difficult to make an assessment. Likewise, in the push-up test, many assessors have difficulty in determining the movements, so the measurement results differ between assessors. According to Barnett et al. (2009), their research showed some problematic motor skills to be assessed, which result in a low-reliability score; they highlighted some obstacles in determining the reliability values in field-based research with direct observation rather than research that uses assistive devices and is more controlled.

In contrast, Baumgartner and Gaunt (2005), in their research on push-up movements, stated that the problem in push-up tests was to determine the position so that the tester could assess accurately. The tester must decide on an assessment of whether the movement of the tester is the correct movement and results in getting a score. The position of the part of the body determines the movements performed, including the number of times the movement can be repeated. This is consistent with what was stated by Cogley et al. (2005) in their research on free movement that different hand positions in push-ups affect the results -ups.

It is crucial that the tester can carry out measurements to produce accurate test data. In tests, errors in measurement are difficult to avoid, so what the tester can do is to anticipate the smallest possible error. The implementation of a mass test with a large number of participants requires many testers to be involved so that there may be no similarities between the measurement and assessment data. Tests involving a large number of testers must pay attention to the agreement between the testers (Putranta & Supahar, 2019). Putranta and Supahar's research (2019), shows that when the total score resulting from inter-assessor measurements and the results of the appraiser's agreement is examined, the scores are almost always not identical.

Kozlowski and Hattrup (1992) define agreement as interrater consensus and reliability as interrater consistency. One way to determine the ability of a tester to take measurements and assessments compared to other testers is called reliability inter-rater. There are many ways to obtain the value of the reliability coefficient inter-rater (ICC), but the basic technique is based on analysis of variance and estimation of various components of variance (Bartko, 1966). The ICC approach is used to assess the consistency of measurements made by several testers on test-takers. Various indices to measure the agreement between several assessors regarding the presence or absence of different measurement results can be interpreted as an intra-class correlation coefficient (Rae, 1984).

Fielitz, Coelho, Horne, and Brechue (2016) found that the coefficient among raters on a two-minute push-up test was small, which is also in line with Mathews' (2013) research on the reliability of rater in pull-up and push-up tests, which states that the results of this experiment illustrate the fact that the ability of the rater to measure physical fitness index is not better when carried out alternately or simultaneously. Also, the learning factor certainly helps to calculate a more valid score, so measurement needs to be preceded by training.

This study aims to obtain the level of reliability of the Indonesian Air Force physical testers among testers one-minute push-up, pull-up, and sit-up tests, and to determine the lowest reliability of three tests. Futhermore, the aims of this study also was used material for correction, training, and guidance in testing in the future.

Methods

Respondents in this study consisted of 25 young male civilians and 18–25-year-old male students who were part of the physical fitness development group at Adi Sucipto Air Force Base, Yogyakarta, Indonesia. As many as five randomly selected testers came from the Air Force Physical Development unit and were experienced and often involved in physical fitness testing. An assessor is an active military member who is male and aged 25-50 years and is still actively involved in physical fitness testing in the Indonesian Air Force.

All procedures for carrying out a pull-up, sit-up, and push-up are guided by technical guidelines for physical fitness tests issued by the Indonesian Air Force Headquarters. Participants carry out pull-up for one minute alternately in the order given by the assessor. During the test, each subject is rated by five testers. The tester only assesses the correct movements performed by the subject for one minute. If the participant stops even though one minute has not expired, the test is considered complete, and the tester records the results obtained. The same procedure is also done on sit-ups and push-ups, with the same subject, but before carrying out the next test, the subject is given sufficient rest time.

The data generated in the form of the results achieved by the subject for one minute of each type of test based on the results of the number of times able to make the correct movements in each test that has been recorded by the tester is then converted to the value of the ability to perform the exercises according to the assessment table contained in the manual for physical fitness test of the Indonesian Air Force on a scale of 0-100. Then the converted value is processed by Anova and

ICC analysis with the SPSS software.

Results

Descriptive data analysis results obtained that the five testers have different ratings on the results of the pull-up, sit-up, and push-up assessment. The results of the assessment by the five testers are in the form of the average value and the complete standard deviation in Table 1.

Table 1. Results of Pull Up, Sit Up and Push Up Tests

	Pull up	Sit up	Push up
	Mean±SD	**Mean±SD**	**Mean±SD**
Tester 1	39.40±21.75	79.04±16.23	47.36±15.44
Tester 2	35.04±22.79	69.80±18.07	39.16±27.55
Tester 3	47.76±26.12	81.68±14.97	35.76±19.59
Tester 4	49.04±24.94	79.84±15.86	32.64±25.96
Tester 5	59.00±23.25	86.20±11.99	53.56±22.74

In the pull-up test, the fifth tester has the most substantial average rating with an average value 59.00±23.255. The smallest assessment results, with an average 35.04±22.79, were obtained from the second tester. The results of the sit-up assessment also show almost the same results, namely the five testers have a diversity of test results for which the largest average is obtained from the fifth tester rating with an average of 86.20±11.99 while the smallest assessment with an average of 69.80±18.07 obtained from the second tester. In the push-up test, the most significant average rating is obtained from the fifth tester with an average 53.56±22.74, while the smallest assessment with an average 32.64±25.96 obtained from the fourth tester. From these data, it appears that the fifth tester tends to give a high rating compared to other testers, and the second tester tends to give a low rating. Differences in the results from the four testers above can also be proven through Anova analysis, as presented in the following Table 2.

Table 2. ANOVA Analysis Results for Differences in Assessment

	F critical	F hit	Sig
Pull up		17.407	.000
Sit up	2.87	28.174	.000
Push up		12.239	.000

Table 2 shows that all the results of the assessment of the five testers through three types of tests differ significantly with the calculated F value greater than the F critical and the significance value p=0.0000. In the pull-up test, F count=17.407, the sit-up test F value=28.174 and push-up test F value=12.239 all of which showed a value greater than F critical=2.87. Relating to the level of reliability of the tester in noncritical assessments on a pull-up, sit-up, and push-up tests, the magnitude of the correlation values among testers through the Inter Correlation Class analysis can be seen in Table 3.

Table 3. Correlation Values Inter-Raters (ICC)

	Intra Class Correlation	95% Confidence Interval	
		Lower limit	**Upper limit**
Pull up	0.782	0.657	0.882
Sit up	0.868	0.782	0.931
Push up	0.706	0.556	0.835

The results of the calculation of correlations among testers in Table 3 use the ICC type of consistency approach, which emphasizes the similarity of ratings between testers. This type of approach is suitable if used to measure abilities that emphasize the differences in each subject and the achievement of predetermined criteria. Table 3 data shows that in the three types of tests, between testers have varying correlation coefficient values: the pull-up test with the ICC coefficient = 0.782 with the correlation range 0.657-0.882, the sit-up test ICC coefficient = 0.868 with the correlation range 0.782-0.931 and the push-up test with the ICC coefficient = 0.706 with a correlation range of 0.556-0.835.

Discussion

Pull up, sit-up, and push-up tests are essential components of physical fitness, especially muscle strength and endurance. The equipment that is used is as simple as a crossbar for pull-up tests while none is needed for the sit-up and push-up tests. Another consideration is that it can be used to test many participants within a limited period, such as tests at military institutions with many test subjects. This component is important for someone who engages in many physical activities, especially muscle strength and endurance, such as athletes and soldiers. According to D'Isanto et al. (2019), the assessments produced through tests serve to define the anthropometric and psychomotor profiles of a person who is used to help determine the goals needed to set a training programme.

Accurately assessing the three tests is difficult because the focus is to obtain as many results as possible with a one-minute repetition of movements. Circumstances with rapid repetition of such movements would certainly make it difficult for the tester to be able to judge carefully and produce accurate data.

The assessment results from several testers appear to vary, including within the same test. Analysis based on the variance values of the above results leads to the conclusion that there are differences in the assessment made by the five testers who have a high significance value with p=0.0000.

While the variation in the value of the inter-rater correlation coefficient shows that the inter-rater correlation value on the push-up test has the smallest value with the value of ICC = 0.687, but the ICC value of pull-up and sit-up tests has values > 0.8. This study also obtained that the range of correlation coefficient values of the five testers in each test has a fairly long range, so the reliability of the tester can be concluded not yet fully adequate. Koo and Li (2015) stated that the ICC coefficient value below 0.50 is bad, between 0.50 and 0.75 in the medium category, between 0.75 and 0.90 the good category and above 0.90 is excellent.

Meanwhile, Artero, España-Romero, and Castro-Piñero (2011) suggested that the ICC between 0.70-0.80 is still questionable or doubtful, and 0.90 is considered high. Thus the reliability between testers on the pull-up, sit up and push up tests needs to be improved. Bajpai, Bajpai, and Chaturvedi (2015) state that it is essential to realize that it is not possible to reach a perfect agreement between testers and that a professional tester and experience are needed to obtain high coefficient values between them. There are many concrete steps to improve the consistency of the assessment by the tester and increase the value of the ICC coefficients of multiple testers, namely through the training of assessors, the selection of appraisers, and the ability to judge. Several studies have been carried out to improve the reliability of testers in carrying out physical tests.

In the study of McCunn et al. (2017), it is stated that filming aids in realizing a better agreement among the judges. A similar study by Mischiati et. Al. (2015) shows that the reliability value between assessors is acceptable. Rogers et al. (2017) demonstrated that ICC scores are better produced by assessors who use video assistance compared to direct measurement.

Further research needs to be done to develop tester tools in assessing pull-up, sit-up and push-up tests, such as the use of infrared motion sensors and cameras. Alternative forms of testing to measure muscle strength and power while still paying attention to practicality in the implementation of tests with a large number of participants are needed. Tester training, the selection or selection of testers involved in the test and paying attention to the ability of the tester are ways of improving the reliability of the tester. It is necessary to develop assistive devices used to pull up, sit up, and push tests to assist the tester in making decisions in assessing the correct movements, especially for tests with a large number of subjects.

Assessments made by multiple testers on a pull-up, sit-up, and push-up tests that rely on humans in their measurements are prone to differences in measurement. This can be seen from the test results data that are varied or significantly different with a significance of P = 0.000. This study also shows the differences in the level of reliability of the tester value of the correlation coefficient among tester (ICC), for which the reliability of the tester on the exercises are all in the medium range; therefore, for use in military institutions, it is necessary to make efforts to improve reliability. In addition to these, other alternatives are needed, such as the use of other forms of testing, as well as the use of assistive devices to facilitate measurement and training for the tester.

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Conflict of Interest

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ORIGINAL SCIENTIFIC PAPER

Performance Evaluation of Basketball Referees with an Integrated MCDM Approach

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Abstract

Basketball referees have to make decisions quickly and accurately under pressure and stress within a limited time. Their decisions affect the results of the match. Therefore, it is necessary to evaluate the performances of the referees and give them feedback. This study aims to propose an MCDM (Multi-Criteria Decision Making) approach to evaluate the performances of basketball referees for the observers and instructors who evaluate officials' performance. AHP (Analytic Hierarchy Process) and WASPAS (Weighted Aggregated Sum Product Assessment) methods are integrated to evaluate the performance of basketball referees. Criteria weights are considered as equal in the current performance evaluation system of the basketball referees. In this study, the weights of the performance evaluation criteria were determined with the help of the AHP (Analytic Hierarchy Process) method, taking into consideration the fact that the criteria will have different importance degrees. Then, the ranking of the basketball referees according to their performances was obtained using the WASPAS method. The obtained rankings of referees by the help of the proposed integrated approach is different from the ranking obtained with the existing basketball referee evaluation system. This is done because, in the proposed approach, weights of different importance are given to the criteria with the AHP method; also, for ranking the referees, the WASPAS method is used. The proposed approach will improve the referee evaluation process and quality. In this manner, the referees' performance can be discussed more objectively. Objective evaluation criteria will also improve the performance of referees by strengthening the trust of the referees in the system.

Keywords: *performance evaluation, basketball referee, MCDM, AHP, WASPAS*

Introduction

Referees have different places and roles in sport, working diligently in the field to apply the rules. They have different roles including being a leader, manager, rule maker, or mediator. Quick decision making, impartiality, control of the game, good communication skills, applying the rules, and using physical and mental abilities are other essential features for referees.

In addition to these, another important feature of the referees is problem-solving. While Heppner and Krauskopf (1987) defines problem-solving skills as complex internal and external demands and desires for the integration of cognitive and behavioural processes, Bingham (1998) describe it as the process of reaching a specific goal to eliminate difficulties that require a series of efforts. Making a quick decision and solving the problem in the right way is a complex procedure under stress. As we know, officiating is a stressful job; it is imperative to understand their role and give to the referees' feedback to have a good result. Stress in referees occurs when players, coaches, or spectators misperceive the referee's whistle, improperly applying the rules or partiality (Mark, Bryant, & Lehman, 1983). If the referees cannot effectively deal with stress and stressful events, this will adversely affect the performance of both the referee and the athlete. The result of weak, ineffective coping is

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slower information processing, less accurate decision-making, improper performance mechanics, burnout and, eventually, quitting (Anshel, 2012; Anshel, Sutarso, Ekmekçi, & Sarasati, 2014). Referees received their feedback the context of various criteria's for performing coping with stressful moment on the court.

In the literature, many studies examine the factors that influence the decision-making process of referees because of their complex decision-making process (MacMahon, Starkes, & Deakin, 2007). These factors include live broadcast pressures (Solomon, Paik, Alhauli, & Pan, 2011); being observed by hundreds or thousands of fans in each match/game, and many other people, such as athletes, coaches, managers, and fans, trying to influence referee's decision (Guillén & Feltz, 2011), and sports involving combat contact, and game change within seconds. Even the relationship of the crowd with the number of yellow cards (Downward & Jones, 2007) referees' decision communication skills (Mellick, Fleming, Bull, & Laugharne, 2005), and the effects of nutritional interventions on cognitive performance for referees (Reilly & Gregson, 2006) were examined. Especially in sports with physical contact, referees are focusing on foul or no foul situations (Plessner, Schweizer, Brand, & O'Hare, 2009). Johnson (2006) suggests the use of sequential sampling models over other approaches to decision-making. Their gaze behaviours are examined, and although referees do not differ in such behaviours, higher-level referees have superior decision-making accuracy and decision sensitivity than lower-level referees do (Hancock & Ste-Marie, 2013). After giving the decisions, feedbacks on their accuracy can be useful for correcting intuitive decisions (Schweizer & Plessner, 2011). To explain biases in referees' judgments a combination of social and embodied cognition is needed, because referees' motor experience influenced perceptual judgments and interacted with contextual factors (Dosseville, Laborde, & Raab, 2011).

Factors influencing referees when making decisions are grouped at four themes; accuracy-error, regulations, professionalism, ideal-decision making (Lane, Nevil, Ahmad, & Balmer, 2006). Factors that ensure referees' efficacy are role specificity, years of officiating, hours of practice per week, number of matches officiated, mastery experiences, referee knowledge/education, support from significant others, physical/mental preparedness, environmental comfort, and perceived anxiety (Catteeuw, Helsen, Gilis, & Wagemans, 2009; Guillén & Feltz, 2011).

All of these studies focused on the psychological, biological, physical and environmental factors needed for referees to be more effective in making decisions. However, although all these elements have been improved, the evaluation criteria of the observer/evaluator should be ideal. This study addresses this issue to enable the referees to perform more effectively as a whole.

The evaluation system of the referees' performance in the world is quite similar. An observer for the organization makes a report with some numerical results according to evaluation criteria, but none of them is including weighted criteria process. Referees complain about this kind of evaluation frequently, because of its subjective nature and incorrect results. According to the assumption of this study, there should be priority differences between the evaluation criteria. The first of the actors who can define the weight of the evaluation criteria may be the referees themselves. Thus, awareness can be created about the values and points of view given by the referees according to these evaluation criteria.

In addition, the primary purpose of the referees' evaluation process is to direct the referees to manage better competitions. Therefore, the referees need to know the weighted priorities of these evaluation criteria. In this manner, the referees' self-development will have a positive impact on the quality of the competition. From this point of view, the opinions of the referees were consulted in determining the priorities of the evaluation criteria in this study and a new integrated approach is proposed based on the AHP and WASPAS methods for referee performance evaluation.

In the first section of this study, a brief introduction is given. In the second section, the AHP method is introduced and described. In the third section, WASPAS method is explained, a literature review is given, and the method is summarized. In the fourth section, the application of the performance evaluation of basketball referees with the integrated method is given. Finally, in the fifth section, the results of the application are discussed, and recommendations for future studies are given.

Methods

AHP method

The Analytic Hierarchy Process (AHP) was first proposed by Saaty (1980). Later, it was widely used as an efficient MCDM method for determining the weights of the criteria and ranking the alternatives. The AHP method allows decision makers to model the complex problems in a hierarchical structure that shows the relationship between criteria, sub-criteria and alternatives. The most important feature of the AHP method is that the decision-makers can include both objective and subjective judgements in the decision process, and they can also capably handle both qualitative and quantitative data. However, the use of AHP requires cumbersome calculations due to pairwise comparisons and consistency checking.

In the literature, the AHP method has been widely used in the studies both in determining the criteria weights and ranking the alternatives. It has been applied in various fields, such as selecting the best alternative, planning, optimization, resolving conflict, resource allocations, among others (Vaidya & Kumar, 2006). A detailed literature review for AHP method has been done by Vaidya and Kumar (2006) and Russo and Camanho (2015).

The steps of the AHP method can be summarized as:

Step 1. Decision criteria and alternatives to the problem are determined by the decision-makers. A hierarchical structure of the decision problem is constructed. The goal of the decision problem takes place at the highest level of the hierarchy, and the alternatives are at the lowest level. Between goal and alternatives, criteria and sub-criteria are placed (Wang, Chu, & Wu, 2007).

Step 2. Pairwise comparisons for n criteria are made by the decision-makers using Saaty's 1-9 scale. Based on these pairwise comparisons, matrix A is obtained, as given in Eq. 1.

$$A = \left[a_{ij}\right] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \; ; \; {}_{i,j} = 1,2,\ldots,n \qquad (1)$$

In this matrix, $a_{ij}>0$, $a_{ji}=1/a_{ij}$, $a_{ii}=1$ and a_{ij} is the decision

maker's rating of the relative importance of criterion i respect to criterion j. If criteria i and j have equal relative importance for the decision-maker, then $a_{ij} = a_{ji} = 1$ (Caputo, Pelagagge, & Salini, 2013).

Step 3. From the pairwise comparison matrices, local weights and priorities of elements in the same level are calculated, and weight vector is obtained as in Eq. 2.

$$W = [w_1, w_2, \ldots, w_n]^T \qquad i=1,2,\ldots,n \quad (2)$$

This vector is the normalized principal eigenvector of matrix A. The elements of the weight vector are calculated from the normalized pairwise comparison matrix A by taking the average value of the rows as given in Eq. 3,

$$w_i = \frac{1}{n}\sum_j \left(\frac{a_{ij}}{\sum_i a_{ij}} \right) \qquad i,j = 1,2,\ldots,n \quad (3)$$

Step 4. Pairwise comparison matrices of alternatives under each criterion are built by following the procedure in Step 2. Then, normalized relative rating b_{ij} is computed for each ith alternative respect to any judgment criterion Cj, in comparison with the other alternatives.

Step 5. In this step, firstly the consistency indices (CI) of the pairwise comparison matrices are checked by using the Eq. 4, then the consistency ratio (CR) is calculated via Eq. 5.

$$CI = (\lambda_{\max} - n)/(n-1) \quad (4)$$

$$CR = CI / RI \quad (5)$$

λ_{max} seen in Eq. 4, is the largest eigenvalue of A. In Eq. 5, RI is the average value of CI one would obtain were the entries in A chosen at random, subject that all diagonal entries must equal 1.

For different n values, RI values can be found in the article by Saaty (2013).

In the case of CR <0.10, the decision matrix is said to be consistent. In the case of CR> 0.10, the comparison matrix is reviewed, and necessary changes are made by the decision-makers to bring the matrix into a consistent form.

Step 6. In the last step, global priorities, including global weights and global scores, are obtained by aggregating all local priorities with the application of a simple weighted sum. A ranking score R_i is calculated for the ith alternative as seen in Equation (6);

$$R_i = \sum_j b_{ij} w_j \quad (6)$$

In the end, the final ranking of the alternatives is determined based on these global priorities.

WASPAS method

The WASPAS (Weighted Aggregated Sum Product Assessment) method was developed by Zavadskas, Turskis, Antucheviciene, and Zakarevicius (2012); it is an MCDM method that combines the results of Weighted Sum Model (WSM) and Weighted Product Model (WPM). According to the joint generalized criterion of weighted aggregation of additive and multiplicative methods, the ranking of the alternatives is determined. This method can control the consistency of the alternative rankings by conducting sensitivity analysis within its process (Chakraborty & Zavadskas, 2014).

The literature shows that WASPAS method has been applied in different fields. Zavadskas et al. (2012) assessed building design alternatives with WASPAS and MULTIMOORA methods. Chakraborty and Zavadskas (2014), proposed using it for solving manufacturing decision-making problems. They concluded that the WASPAS method could accurately rank the alternatives in such problems. Chakraborty, Bhattacharyya, Zavadskas and Antucheviciene (2015) applied the WASPAS method to parametric optimization of five non-traditional machining processes, concluding that it can be used as a useful tool for both single response and multi-response optimization of the non-traditional machining processes. Karabašević, Stanujkić, Urošević, and Maksimović (2016) proposed using an approach based on SWARA and WASPAS methods for personnel selection. Urosevic, Karabasevic, Stanujkic, and Maksimovic (2017) applied the SWARA and WASPAS methods to personnel selection in the tourism industry. Stojic, Stevic, Antucheviciene, Pamucar, and Vasiljevic (2018), proposed a new rough WASPAS approach to select a supplier in a PVC carpentry product manufacturing company.

In this paper, WASPAS method is used to evaluate the performances of basketball referees. While determining the criteria weights, the AHP method is used, and the ranking of the referees are determined with the help of WASPAS method.

The steps of the WASPAS can be given as (Zavadskas et al. 2012; Chakraborty & Zavadskas, 2014; Chakraborty et al., 2015):

Step 1. Alternatives *A*i (*i*=1,…,) and criteria C*j* (*j*=1,…,*n*) are determined by the decision-makers.

Step 2. Weights of the criteria are determined with the help of an MCDM method such as AHP, SWARA and similar or decision-makers can determine these weights by intuition.

Step 3. After determining the weights of the criteria, a decision matrix is constructed.

$$X = [X_{ij}]_{mxn} = \begin{bmatrix} X_{11} & \cdots & X_{1n} \\ \vdots & \ddots & \vdots \\ X_{m1} & \cdots & X_{mn} \end{bmatrix} \quad (7)$$

Step 4. The decision matrix is normalized via Eq. 8 or 9 according to the type of the criterion.

For benefit criteria;

$$r_{ij} = \frac{x_{ij}}{max_i x_{ij}} \quad (8)$$

For cost criteria;

$$r_{ij} = \frac{min_i x_{ij}}{x_{ij}} \quad (9)$$

Step 5. For each alternative, the total relative importance $Q_i^{(1)}$ is calculated based on the Weighted Sum Model (WSM) with the help of Eq. 10.

$$Q_i^{(1)} = \sum_{j=1}^{n} w_j . r_{ij} \quad (10)$$

Here; w_j indicates the weight of the j^{th} -criterion.

Step 6. Then, for each alternative, the total relative importance $Q_i^{(2)}$ is calculated based on the Weighted Product Model

(WPM) by using Eq. 11.

$$Q_i^{(2)} = \prod_{j=1}^{n} (r_{ij})^{w_j} \quad (11)$$

Step 7. Finally, the total relative importance of i[th] alternative is calculated via Eq. 12. This more generalized equation is developed to increase the ranking accuracy and effectiveness of the decision-making process (Chakraborty et al., 2015).

$$Q_i = \lambda Q_i^{(1)} + (1-\lambda) Q_i^{(2)} \quad (12)$$

Here; λ= coefficient of joint optimality and $\in$ [0,1].

If WSM and WPM have the same importance degree, then the coefficient of combined optimality is taken as λ=0.5. When λ=0 WASPAS method becomes WPM, and when λ=1 it transformed into WSM (28).

Step 8. Alternatives are ranked according to their Qi values. The best alternative would be that one having the highest Qi value.

Application

In this part, performances of the basketball referees are evaluated with an integrated approach based on AHP and WASPAS methods. In the current performance evaluation system of the basketball referees, criteria weights are considered as equal. Because the criteria will have different importance degrees in the evaluation process, the AHP method is used for determining the weights of the criteria. Then, basketball referees are ranked according to their performances with the help of WASPAS method.

In the proposed integrated approach, the AHP method is applied to determine the weights of the criteria. In the first step, a committee of decision-maker is formed from four decision-maker DM1, DM2, DM3, DM4. The first decision-makers is an FIBA instructor; the second is a Euroleague referee; the third one is a Euroleague delegate and referee observer; and the fourth decision-makers is a high-level basketball coach. Then, these decision-makers evaluated 10 decision criteria used in the current evaluation system. These evaluation criteria are; Competition and self-esteem (C1), Physical state (C2), Foul assessment (C3), Violation assessment (C4), Mechanical (C5), Standard (C6), Teamwork (C7), Game control (C8), Disciplinary implementation (C9), Overall performance (C10).

Pairwise comparisons of criteria are made firstly, and then pairwise comparisons are made for alternatives under each criterion. The consistency of each comparison matrix is checked; they were found to be consistent. Later, these four matrices are reduced into one matrix by the help of geometric mean. This obtained matrix is shown in Table 1. Then, this comparison matrix is normalized by using Eq. 3.

Table 1. Pairwise comparison matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
C_1	1.00	4.28	2.51	6.00	5.96	1.00	2.00	1.97	4.61	5.58
C_2	0.23	1.00	0.71	2.11	2.45	0.24	0.43	0.64	1.19	1.73
C_3	0.40	1.41	1.00	3.25	3.22	0.29	0.54	0.79	1.97	2.40
C_4	0.17	0.47	0.31	1.00	0.84	0.16	0.21	0.34	0.70	0.84
C_5	0.17	0.41	0.31	1.19	1.00	0.16	0.23	0.35	0.74	0.93
C_6	1.00	4.16	3.46	6.40	6.19	1.00	1.86	1.63	4.92	5.79
C_7	0.50	2.34	1.86	4.74	4.36	0.54	1.00	1.09	2.38	3.03
C_8	0.51	1.57	1.27	2.91	2.83	0.61	0.91	1.00	2.99	3.94
C_9	0.22	0.84	0.51	1.43	1.35	0.20	0.42	0.33	1.00	1.68
C_{10}	0.18	0.58	0.42	1.19	1.07	0.17	0.33	0.25	0.59	1.00

Finally, the weights of the criteria are calculated by taking the averages of each row of the normalized matrix. The weights for each criterion is obtained as; Standard (C6) 0.23, Competition and self-esteem (C1) 0.22, Teamwork (C7) 0.13, Game control (C8) 0.12, Foul assessment (C3) 0.09, Physical state (C2) 0.06, Disciplinary implementation (C9) 0.05, Overall performance (C10) 0.04.

After determining the criteria weights with the AHP method, the steps of WASPAS method are followed to determine the ranking of the basketball referees. A decision matrix is formed, as given in Table 2. This matrix includes the performance values of basketball referees.

Table 2. Decision Matrix

Referees	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
R_1	8.88	8.75	7.75	8.00	7.88	8.13	8.13	7.88	8.25	8.25
R_2	8.50	7.75	7.13	7.63	6.75	7.63	7.13	7.63	7.63	7.38
R_3	8.60	8.40	7.00	7.80	7.00	7.20	7.60	7.60	7.80	7.40
R_4	9.00	8.25	7.50	8.13	8.00	7.88	8.38	7.88	8.13	7.75
R_5	8.75	8.25	6.75	7.25	7.25	7.00	7.00	7.75	7.25	7.25
R_6	8.67	8.67	7.00	7.33	7.67	7.33	7.67	6.83	7.00	7.00
R_7	9.29	9.14	7.86	7.86	7.86	8.14	8.43	8.14	8.29	8.14
R_8	8.67	7.83	6.83	7.00	7.00	7.17	7.00	6.83	7.00	7.00

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Referees	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
R_9	8.63	8.75	6.88	7.00	7.00	6.88	7.13	7.38	7.00	7.13
R_{10}	8.75	8.25	7.13	7.25	7.25	6.88	7.13	7.13	7.13	7.00
R_{11}	8.71	8.71	6.71	7.43	7.43	7.29	7.57	7.43	7.43	7.43
R_{12}	9.00	8.50	7.50	7.63	7.63	7.50	8.13	7.75	7.88	7.88
R_{13}	9.00	7.57	8.00	7.71	8.00	7.57	7.71	7.57	7.57	7.86
R_{14}	9.29	8.71	7.71	8.14	8.00	7.71	8.29	8.00	8.29	8.00
R_{15}	8.50	8.25	7.25	7.25	7.25	7.50	7.75	7.25	7.50	7.25
R_{16}	8.88	9.00	7.25	7.50	7.75	7.25	7.63	7.63	7.38	7.63
R_{17}	9.67	9.33	7.67	8.33	8.00	8.33	8.00	8.00	8.17	8.00
R_{18}	9.25	9.13	7.50	7.88	7.88	7.50	7.88	7.63	7.88	7.88
R_{19}	9.00	9.44	7.89	8.22	7.78	7.78	7.89	8.33	8.33	8.00
R_{20}	8.88	6.63	7.63	7.50	7.25	7.88	8.25	8.13	8.25	7.88
R_{21}	8.50	8.25	7.00	7.25	7.50	7.50	7.75	7.50	7.25	7.25
R_{22}	8.71	8.29	8.14	7.86	8.29	8.14	8.29	8.57	8.57	8.29
R_{23}	9.00	8.20	7.40	7.40	7.60	7.60	7.80	7.60	7.40	7.60
R_{24}	9.00	8.83	7.33	7.83	7.50	7.17	7.50	7.67	7.83	7.50
R_{25}	8.88	7.88	7.38	7.63	7.50	7.38	7.88	7.63	8.00	7.63
R_{26}	8.80	8.20	7.40	7.20	7.60	7.60	7.60	7.20	7.80	7.60
R_{27}	8.83	8.33	7.00	7.67	7.67	7.33	8.33	7.50	7.67	7.50
R_{28}	9.13	8.88	8.13	7.88	8.38	8.13	8.25	8.00	8.13	8.13
R_{29}	9.00	8.50	6.50	7.50	7.25	6.25	7.25	6.75	7.00	7.00
R_{30}	8.50	7.50	7.33	7.17	7.17	7.17	7.50	7.50	8.00	7.50

The decision matrix is normalized by using Eq. 8 as all the criteria are benefit criteria. Then, the normalized decision matrix is formed. Later, the total relative importance $Q_i^{(1)}$ is calculated with the help of Eq. 10 for all referees. In this equation, the weight values obtained with the AHP method are considered. These total relative importance values for the referees are given in Table 3.

Table 3. Weighed normalized decision matrix and total relative importance $Q_i^{(1)}$

Referees	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	$Q_i^{(1)}$
R_1	0.202	0.056	0.086	0.029	0.028	0.224	0.125	0.110	0.048	0.040	0.948
R_2	0.193	0.049	0.079	0.027	0.024	0.210	0.110	0.107	0.044	0.036	0.880
R_3	0.196	0.053	0.077	0.028	0.025	0.199	0.117	0.106	0.046	0.036	0.883
R_4	0.205	0.052	0.083	0.029	0.029	0.217	0.129	0.110	0.047	0.037	0.940
R_5	0.199	0.052	0.075	0.026	0.026	0.193	0.108	0.109	0.042	0.035	0.865
R_6	0.197	0.055	0.077	0.026	0.027	0.202	0.118	0.096	0.041	0.034	0.874
R_7	0.211	0.058	0.087	0.028	0.028	0.225	0.130	0.114	0.048	0.039	0.969
R_8	0.197	0.050	0.076	0.025	0.025	0.198	0.108	0.096	0.041	0.034	0.849
R_9	0.196	0.056	0.076	0.025	0.025	0.190	0.110	0.103	0.041	0.034	0.856
R_{10}	0.199	0.052	0.079	0.026	0.026	0.190	0.110	0.100	0.042	0.034	0.857
R_{11}	0.198	0.055	0.074	0.027	0.027	0.201	0.117	0.104	0.043	0.036	0.882
R_{12}	0.205	0.054	0.083	0.027	0.027	0.207	0.125	0.109	0.046	0.038	0.921
R_{13}	0.205	0.048	0.088	0.028	0.029	0.209	0.119	0.106	0.044	0.038	0.914
R_{14}	0.211	0.055	0.085	0.029	0.029	0.213	0.128	0.112	0.048	0.039	0.950
R_{15}	0.193	0.052	0.080	0.026	0.026	0.207	0.120	0.102	0.044	0.035	0.885
R_{16}	0.202	0.057	0.080	0.027	0.028	0.200	0.118	0.107	0.043	0.037	0.898
R_{17}	0.220	0.059	0.085	0.030	0.029	0.230	0.123	0.112	0.048	0.039	0.974
R_{18}	0.211	0.058	0.083	0.028	0.028	0.207	0.121	0.107	0.046	0.038	0.927

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Referees	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	$Q_i^{(1)}$
R_{19}	0.205	0.060	0.087	0.030	0.028	0.215	0.122	0.117	0.049	0.039	0.950
R_{20}	0.202	0.042	0.084	0.027	0.026	0.217	0.127	0.114	0.048	0.038	0.926
R_{21}	0.193	0.052	0.077	0.026	0.027	0.207	0.120	0.105	0.042	0.035	0.885
R_{22}	0.198	0.053	0.090	0.028	0.030	0.225	0.128	0.120	0.050	0.040	0.961
R_{23}	0.205	0.052	0.082	0.027	0.027	0.210	0.120	0.106	0.043	0.037	0.909
R_{24}	0.205	0.056	0.081	0.028	0.027	0.198	0.116	0.107	0.046	0.036	0.900
R_{25}	0.202	0.050	0.082	0.027	0.027	0.204	0.121	0.107	0.047	0.037	0.903
R_{26}	0.200	0.052	0.082	0.026	0.027	0.210	0.117	0.101	0.046	0.037	0.897
R_{27}	0.201	0.053	0.077	0.028	0.027	0.202	0.129	0.105	0.045	0.036	0.903
R_{28}	0.208	0.056	0.090	0.028	0.030	0.224	0.127	0.112	0.047	0.039	0.962
R_{29}	0.205	0.054	0.072	0.027	0.026	0.173	0.112	0.095	0.041	0.034	0.837
R_{30}	0.193	0.048	0.081	0.026	0.026	0.198	0.116	0.105	0.047	0.036	0.875

Later, the total relative importance $Q_i^{(2)}$ for each alternative are calculated by using Eq. 11 and given in Table 4.

Table 4. Weighed normalized decision matrix and total relative importance $Q_i^{(2)}$

Referees	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	$Q_i^{(2)}$
R_1	0.981	0.995	0.996	0.999	0.998	0.994	0.995	0.990	0.998	1.000	0.948
R_2	0.972	0.988	0.988	0.997	0.994	0.980	0.978	0.986	0.994	0.995	0.880
R_3	0.975	0.993	0.986	0.998	0.995	0.967	0.987	0.986	0.995	0.995	0.883
R_4	0.984	0.992	0.993	0.999	0.999	0.987	0.999	0.990	0.997	0.997	0.939
R_5	0.978	0.992	0.983	0.996	0.996	0.961	0.976	0.988	0.992	0.995	0.865
R_6	0.976	0.995	0.986	0.996	0.997	0.971	0.988	0.973	0.990	0.993	0.874
R_7	0.991	0.998	0.997	0.998	0.998	0.995	1.000	0.994	0.998	0.999	0.969
R_8	0.976	0.989	0.984	0.995	0.995	0.966	0.976	0.973	0.990	0.993	0.848
R_9	0.975	0.995	0.985	0.995	0.995	0.957	0.978	0.982	0.990	0.994	0.856
R_{10}	0.978	0.992	0.988	0.996	0.996	0.957	0.978	0.978	0.991	0.993	0.857
R_{11}	0.977	0.995	0.983	0.997	0.996	0.970	0.986	0.983	0.993	0.996	0.882
R_{12}	0.984	0.994	0.993	0.997	0.997	0.976	0.995	0.988	0.996	0.998	0.921
R_{13}	0.984	0.987	0.998	0.998	0.999	0.978	0.989	0.985	0.994	0.998	0.913
R_{14}	0.991	0.995	0.995	0.999	0.999	0.982	0.998	0.992	0.998	0.999	0.949
R_{15}	0.972	0.992	0.990	0.996	0.996	0.976	0.989	0.980	0.993	0.995	0.885
R_{16}	0.981	0.997	0.990	0.997	0.998	0.968	0.987	0.986	0.993	0.997	0.898
R_{17}	1.000	0.999	0.995	1.000	0.999	1.000	0.993	0.992	0.998	0.999	0.974
R_{18}	0.990	0.998	0.993	0.998	0.998	0.976	0.991	0.986	0.996	0.998	0.927
R_{19}	0.984	1.000	0.997	1.000	0.998	0.984	0.991	0.997	0.999	0.999	0.949
R_{20}	0.981	0.979	0.994	0.997	0.996	0.987	0.997	0.994	0.998	0.998	0.923
R_{21}	0.972	0.992	0.986	0.996	0.997	0.976	0.989	0.984	0.992	0.995	0.885
R_{22}	0.977	0.992	1.000	0.998	1.000	0.995	0.998	1.000	1.000	1.000	0.961
R_{23}	0.984	0.992	0.991	0.996	0.997	0.979	0.990	0.986	0.993	0.997	0.909
R_{24}	0.984	0.996	0.991	0.998	0.997	0.966	0.985	0.987	0.996	0.996	0.899
R_{25}	0.981	0.989	0.991	0.997	0.997	0.972	0.991	0.986	0.997	0.997	0.903
R_{26}	0.980	0.992	0.991	0.996	0.997	0.979	0.987	0.979	0.995	0.997	0.897
R_{27}	0.980	0.993	0.986	0.998	0.997	0.971	0.999	0.984	0.994	0.996	0.903
R_{28}	0.987	0.996	1.000	0.998	1.000	0.994	0.997	0.992	0.997	0.999	0.962
R_{29}	0.984	0.994	0.980	0.997	0.996	0.936	0.981	0.972	0.990	0.993	0.834
R_{30}	0.972	0.986	0.991	0.995	0.995	0.966	0.985	0.984	0.997	0.996	0.875

Finally, the total relative importance of the referees is calculated with the help of Eq. 12. Here the coefficient of combined optimality is taken as λ=0.5. The total relative importance values (Q_i) of referees are obtained. In the end, basketball referees are ranked according to their Q_i values in descending order, as seen in Table 5.

Table 5. Ranking results of basketball referees

Referees	Q_i	Referees	Q_i	Referees	Q_i
R_{17}	0.974	R_{12}	0.921	R_3	0.883
R_7	0.969	R_{13}	0.913	R_{11}	0.882
R_{28}	0.962	R_{23}	0.909	R_2	0.880
R_{22}	0.961	R_{25}	0.903	R_{30}	0.875
R_{19}	0.950	R_{27}	0.903	R_6	0.874
R_{14}	0.949	R_{24}	0.900	R_5	0.865
R_1	0.948	R_{16}	0.898	R_{10}	0.857
R_4	0.939	R_{26}	0.897	R_9	0.856
R_{18}	0.927	R_{21}	0.885	R_8	0.849
R_{20}	0.925	R_{15}	0.885	R_{29}	0.836

The rankings obtained of referees in Table 5 by the help of the proposed integrated approach is different from the ranking obtained with the existing basketball referee evaluation system. The reason for this is, in the proposed approach's different importance weights given to the criteria with the AHP method and because the WASPAS method is used for ranking the referees.

Conclusion

The starting point of this study was that the importance of the criteria of referee evaluation was not determined in the current evaluation system. First to eliminate this deficiency, by taking the opinions of the referees, the weights of the evaluation criteria were determined with the help of AHP method and the ranking of the criteria according to their weight is obtained as follows: Standard, Competition and self-esteem, Teamwork, Game control, Foul assessment, Physical state, Disciplinary implementation, Overall performance, Mechanical, Violation assessment.

In addition, in the current evaluation system, a ranking is obtained by considering the total number of points received by the referees based on the criteria. In this study, the WASPAS method, which is an MCDM method that combines the results of Weighted Sum Model (WSM) and Weighted Product Model (WPM), is proposed for determining the ranking of basketball referees. In this manner, a more precise and accurate ranking is obtained. This approach guides the decision-makers in the basketball referees' performance evaluation process. In future studies, criteria can be evaluated by different decision-makers in the field. Also, other MCDM can be applied both in determining the weights of the criteria and ranking of the basketball referees. In the end the obtained results can be compared.

Referees are considered one of the most critical factor for evaluating athletes' performance; therefore, their performance on the court or field is essential. Classical methods of evaluating referees' performance are sometimes not objective and suitable, because the evaluating criteria are not examined detailed. The model presented by this study will improve referee evaluation process and quality. Therefore, if the quality of evaluation improves, the referees' performance can be discussed more objectively. In addition, objective evaluation criteria will improve the performance of referees by strengthening the trust of the referees in the system.

The referee's role specificity may be taken into consideration while evaluating the evaluation criteria of the performance of the referees in further studies.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

Various Aspects of the Scientific Development of Beach Handball over Three Decades - from "Keep It Simple" to the Olympic Games

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Abstract

The study aims to present the analyses of the scientific and historical development of beach handball over three-decades. The purpose is to identify future development trends through a broad analysis. The primary methods used were description, comparison and constructive analysis. The available scientific publications were analysed, and the quantitative and qualitative analyses using the deductive method is present. To 2019, the literature on beach handball in Europe consisted of three doctoral theses (all written in Spain), 81 quantitative analyses, a wide range of promotional material to an extensive amount of video (teaching and promotional) material. The changes in philosophy were also analysed. In the first articles, the philosophy revolved around "fair play", "keep it simple", and "sport for the future", with a focus on "simple structure", "very few restrictions", "little administration", "easy rules", "a lot of sun and fun", and "beach lifestyle", while the more recent studies adopted a systematic approach, in many cases using high-tech measurement technology and the most modern approaches (performance analysis, time-motion analysis, Global Positioning System (GPS), load intensity, elite, technology, rotator cuff, peak torque, etc.) Based on this overview and according to ongoing rapid and dynamic developments, it is safe to predict further intensive development, as well as the possibility of it becoming an Olympic sport.

Keywords: *beach handball, analyses, development, philosophy, scientific approach*

Introduction

Although beach handball has experienced rapid growth and increasing interest over the previous two decades, it is still considered a "sport of the future." Among the specific beach handball rules, which were created for the game to be more dramatic than indoor handball, there double points for goals scored in-flight, spin (360-degree) shots, and the goalkeeper's scoring. Beach handball is played with four players per side, one of whom is the goalkeeper, on a 27-metre long and 12-metre wide sandy rectangular court. The match consists of two 10-minute sets with a shoot-out to determine the winning team in case of a tie. Beach handball is therefore characterized by a combination of high-intensity efforts, such as sudden accelerations with short recoveries, heterogeneously distributed across a match. As a result, players are exposed to both high- and low-level work rates which demand appropriate speed, sprint ability, strength, and power (Cobos, 2011).

As mentioned by several authors (Hatzimanouil et al., 2017; Póvoas et al., 2012; Bon, Kuburović, & Šibila, 2018), for a many years beach handball was the sport without appropriate high-level scientific data and studies; and this has changed with intensive scientific researches, with modern methodologies in the recent years. Similar to handball, beach handball has been studied through notational analyses (Gruić, Vuleta, Bazzo, & Ohnjec, 2011; Morillo-Baro, Reigal, & Hernández-Mendo, 2015: Zapardiel, 2017a) and psychology (Morillo Baro, Reigal Garrido, & Hernández-Mendo, 2016; Zapardiel, 2017b) and in recent years also from playing positions per-

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spective (Zapardil & Asin- Izquierdo, 2020). We are also following intensive development in some other areas of beach handball, possibly psychological and sociological aspect, public relations and similar.

This study aims to present some characteristics of beach handball; to analyse all available scientific and expert literature, to generalize all scientific data, and predict the further development of beach handball.

Methods

The primary methods used were description and comparison. Constructive analyses were used; the available scientific publications in Europe and the quantitative and qualitative analyses that were completed within the frame of the EHF using the deductive methods were analysed. Keywords from the analysed articles were coded and generalized. Some of the data in the study were based on the author's personal observations and practical experiences (from the positions of a player and a national team coach).

Results and discussion

This chapter presents aspects of professional, scientific, and historical elements of beach handball in general, as well as some particular features of the game. We analysed the available scientific and professional articles and other publications, with a focus on more complex contributions including the theses that represent specific milestones in the development of beach handball.

The Historical Overview

The first records of beach handball date back three decades. Some earlier, amateur attempts at playing handball on the beach are known, but the first organized competitions were acknowledged in the early 1990s. The detailed and most complete set of rules and features of the game are presented in the book published by the International Handball Federation (IHF): Beach handball from A to Z (Bebetsos, 2012).

Beach handball began as a discipline targeted towards tourists, as a leisurely, fun sport, but has now a clear structure and regulations. The natural conditions (sand beaches) have had a significant influence. The first official international beach handball competition was organized by Buttarelli in Rome in 1993 (Van Linder, Gehrer, & Trespidi, 2004: Zapardie, 2017a). The first national team tournament was held in 1995 and the first National Championship in 1997, both in Spain. The first European Championship was organized in 2000 (and then each second year).

A strategical change in the structure of the game occurred in 2002 in Cádiz, Spain (the second European beach handball Championship). That was the first championship in which the spin-shot, in addition to the in-flight, also won two points (Zapardiel, 2018).

At the third European championship in Alanya (Turkey), the importance of the shoot-out was highlighted since 25% of the matches ended with this tie-break system (Zapardiel, 2018). Another aspect highlighted in another subsequent analysis (Van Linder et al, 2004) was that the teams' performance improvement was based more on individual technical improvement than on the improvement of common tactics (Zapardiel, 2018). The fourth European Championship took place in Cuxhaven (Germany) in 2006; the fifth was played in Misano Adriatico (Italy) in 2007 (Gehrer & Trespidi, 2007); then in Larvik (Norway) 2009, Umag (Croatia) 2011, Randers (Denmark) 2013 Lloret de Mar (Spain) 2015 and Zagreb (Croatia) 2017 (Zapardiel, 2018).

After the introduction of the official beach handball rules in 2002, the sport gained global popularity. After the first World Championship (as a part of the World Games) in 2005, there was a systematic improvement of the organization of competitions, which also included young age categories. Apart from national and international championships, beach handball leagues were established in many countries. The European Beach Handball Tour (EBT), a club competition has been organized since the 2009/10 season (Zapardiel, 2017a).

The Structure of Beach Handball; Physical Demands -Motion Analysis and Injuries

One of the latest studies (Navarro, Morillo, Reigal, & Hernández-Mendo, 2018) was conducted to identify the relationships between the various behaviours of the positional attack. The data obtained were subjected to a polar coordinate analysis from the perspective of genuine retrospectivity. Related to how the attack ends and to the player who finishes it, seven focal behaviours were chosen. The results revealed differences by gender (Navarro et al., 2018).

Applying the median test for each variable referring to the victory/defeat criterion, a statistically significant difference between winning and defeated teams was found in the following variables: successful in-flight shots (INF-U), spin shots (SPS), blocking (BLO), and technical errors (TEC) (Gruić et al., 2011). The analyses of defence tactics in high-level teams were made by Greek researchers (Gkagkanas et al., 2018) with use of video- analyses.

The analysis of positional attack in male and female beach handball with polar coordinates (Morillo-Baro et al., 2015) aims to provide a new perspective on understanding and differentiation of play behaviour in the phase of the positional attack. The observation design used was nomothetic, monitoring, and multidimensional. The results showed differences in mating behaviour in the male and female categories (Morillo-Baro et al., 2015).

The analysis of time-motion and heart rate in elite male and female beach handball (Pueo, Jimenez-Olmedo, Penichet, Ortega, & Espina, 2017) concludes that beach handball is a high-intensity mixed-metabolism sport; with numerous moderate-to-high intensity displacements, distributed intermittently throughout the game: long periods of low-intensity activity interspersed by short bursts of high intensity (Pueo et al., 2017).

It was also defined (Cobos, 2011) as a vigorous activity and 26.1±26.5% as very vigorous, while during the second half the percentage of moderate activity was reduced, as the percentage of very vigorous activity increased to 40.8±25.5%. The results suggest that the practice is a vigorous and very vigorous activity during 70% of the total activity time. Heart rates were maintained between 150 and 157 bpm, representing the 80–83% reference HRmax (Cobos, 2011).

The aim of the study (Zapardiel, 2018) was to analyse the differences in the behaviour of the rotator muscles in the shoulder joint complex and athletes in non-ball throwing disciplines (ANTD). Using a System 3 Biodex isokinetic dynamometer, the researchers found significant differences ($p>0.01$) between the two study groups (26 male BHP and 70 male ANTD) in the sub-variable time-to-peak torque-internal

rotation at 180°/s. BHP takes less time than ANTD to reach the peak torque at high speeds on the internal rotation of the dominant arm (Zapardiel, 2018). In a previous study, Zapardiel (2014) also reports a strength evaluation of the shoulder joint rotator muscles through isokinetic dynamometry.

Among the results obtained, points out that while higher strength values were found in beach handball players' shoulder joint internal rotator muscles, along with the presence of an agonist/antagonist muscle imbalance in the shoulder joint rotator muscles, there is less correlation between the isokinetic variables of the shoulder joint rotator muscles in beach handball players and specific anthropometric measures, compared to the other groups (non-throwing athletes) under study.

As is typical in handball, also in beach handball, we followed increase amount of injuries studies and the study of Achenbach et al. (2018) investigate the injury pattern and conclude that, in general, beach handball seems to have a lower incidence of time-loss injuries than that reported for indoor team handball. (Achenbach et al., 2018). The aim of one of the latest studies (Hotzaminouil et al., 2017) showed that injuries in beach handball are similar to those of team handball, rather than other "sand" sports (Hotzaminouil et al., 2017).

Sports Psychological Profile; Recreation

The subject of the sports psychological research was to examine the relationship between the sports psychological profile and competitive anxiety in a group of beach handball players (Morillo et al., 2015) and also relationships between autonomy support and perception motivational climate with the sport psychological profile in beach handball (Zapardiel, 2016b). The Psychological Inventory of Sports Performance (IPED) and the State Anxiety Inventory in Competition-2 (CSAI-2) were used to evaluate the state of anxiety and self-confidence. The correlation of the analysis and linear regression revealed significant relations between the studied construct. The negative coping control sample and the motivational level were the best predictors of anxiety, and the control of negative and positive coping were the most important predictors of confidence. Some difference existed by gender in all models (Morillo et al., 2015). Further research in the field of sports psychology and sociology would be needed and would probably answer such and similar questions.

There are some other aspects -outdoor sports are a risk activity for skin cancer, especially if adequate sun protection measures are not used. Beach handball players are highly exposed to the effects of ultraviolet radiation and often take insufficient measures of sun protection (De Castro-Maqueda et al, 2019).

A pilot study (Bělka, Hůlka, Šafář, Weisser and Chadimova, 2015) was prepared to investigate beach handball (and beach volleyball) as a means of encouraging people to increase their physical activity and increase the possibility of (beach) handball on the recreational level. It is important to involve beach handball in curriculum of physical education hours in elementary and high school (Zapardiel, Serrano, 2016) one one hand, and on other - to continue with studies with high- level methodology (e.g. Vázquez-Diz, Morillo-Baro, Reigal, Morales-Sánchez, & Hernández-Mendo, 2019) and with several modern technologies (e.g. Zapardiel & Asín-Izquierdo, 2020).

Conclusions

From the contributions in the first decade of beach handball research (Van Linder et al., 2004; Gehrer, & Trespidi, 2007; etc.), it is evident that at the beginning the vision of beach handball was directed towards "sport for recreation and fun", "sport for tourism", "summer sport (only)", and similar. According to studies in the previous decade, one of the aims was to predict the further development of beach handball. Constructive analysis was used to evaluate the state and further trends in development in sport society till really complex studies – e.-g. about contextual factors and decision-making in the behaviour of finalization in the positional attack in beach handball (Vázquez-Diz et al., 2019). Development means a different philosophy of the game and revolved around "keep it simple", "sport for the future", while the latest research studies adopted a systematic scientific approach. In the first articles, the philosophy of the game revolved around "fair play", "keep it simple", "sport for the future", while the latest research studies adopted a systematic approach in increasingly complex scientific studies. Keywords in the first decade were focused on "a simple structure", "very few restrictions", "little administration", "easy rules", "a lot of sun and fun" and "beach lifestyle"; whereas in the most recent decade common keywords included "performance analysis", "time-motion analysis", "Global Positioning System (GPS)", "load intensity", "elite", "technology", "rotator cuff", "peak torque" among others. From the above-mentioned studies, it is evident that beach handball has been scientifically observed from different points of view and while those studies are part of ongoing research, there are still many areas that have not been examined (e.g., beach handball and sociology, the theory of sports training, management, media presence, PR, pedagogical aspects, special methodology, strategical planning etc.).

Summarizing our analyses, we can conclude that beach handball is becoming a modern, fully structured sport discipline; with a defined structure, with clear philosophy; and it seems that beach handball is maybe to becoming in-depended sport discipline - not being part of handball in the future), if its efforts to become an Olympic discipline are any indication.

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Conflict of Interest
The authors declare that there are no conflicts of interest.

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SportMont

REVIEW PAPER

The Difference between Male and Female Sport Participation in Turkey: "Determination Always Finds a Way"

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Abstract

The fight for gender equality throughout the world should be acknowledged and properly represented in society. This is all the more important in the sporting world with a further emphasis on the everyday Turkish woman. The rapid rise in female participation in sport in Turkey over the last ten years indicates a rise in the status of women in sport as well as several other areas. However, it should be acknowledged that there is a clear gap with regards to how men and women participate in sport. The varying physical composition of women in comparison to their male counterparts and also the varying level of expectations society places on both male and female participation in sport limits the level of success women derive from actively participating in sport activities. This paper will examine the origin, concepts, and historical background of women in sport in Turkey. At the same time, it will evaluate the current situation while also taking into consideration future developments relating to female participation, leadership, and sport media.

Keywords: *sport, women, female athletes, gender discrimination*

Introduction

With the evolution of technology worldwide, the phrase "the world is a global village" seems to be casually mentioned quite often. Just like different work environments, the areas of sport and physical education have become an international phenomenon. There seems to be an interaction between people from different walks of life, ethnicities, religions, cultures, and lifestyles to mention a few factors (Edginton, Chin, Geadelmann, & Ahrabi-Fard). As a result of the rising number of different working environments, there is a need for sport professionals and physical education experts to comprehend and assimilate how social and cultural factors of varying groups and nationalities influence the physical activities of participants. Several schools of thought have carried out studies about the reasons that promote female involvement in sport and physical activities in several groups, although there is scant literature that has discussed the problems that influence female involvement in sporting activities. This paper will examine the challenges and opportunities for female participation in sport in Turkey.

In times past, sport was mainly a male-dominated world, and women were considered outsiders to it. Initially, women were perceived to be the other sex; they were not the main insiders and were mainly considered to be latecomers or "newbies" who were only given permission to participate in friendly games or sports. This belief that women were only suitable to partake in certain kinds of sport was prevalent for several years, while men were allowed to take part in specific games and sports. For instance, it has always been perceived that women are more suited to gymnastics and dancing while

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men were footballers. This assumption has held sway from the early 19th century and was based not only on gender differences and convictions but also on scientific knowledge. Famous philosopher Buytendijk in 1953 discussed female football, referencing it as "a game is essentially a demonstration of masculinity as we understand it from our traditional view of things and as produced in part by our physical constitution (through hormonal irritation). No one has ever been successful in getting women to play football" (Pfister, 2006).

The situation in Turkey is almost the same. Therefore, this paper tries to present the initial zoning of women in Turkey according to their involvement in sport. Turkey possesses a special position with regards to geography; this is all the more evident as it shares a common history with some Islamic countries. Its distinct features include its modernisation movement and also its secular system, especially with regards to the development of women's liberation. The evolving roles of women, their behavioural pattern, and activities has provided Turkish women with new opportunities and also plays a significant role in female representation in Turkey.

As a result, the involvement of women in public life, in addition to their involvement in sport, reflects the evolution of the young country. The goal of this research is to examine the different roles women have to play in reforming the Turkish government, with emphasis on explaining the relationship between sport and politics as a means of modernization. Conversely, if one does not fully grasp the socio-cultural composition of Turkey, one will not be able to comprehensively grasp the factors that are in play with regards to female representation in sport in Turkey.

The Involvement of Women in Turkish sport

The Turkish National Physical Education Curriculum has been applied in schools since 2007; the programme is standard for all free and tuition-based schools. This new educational plan changed the concentration from customary sport-based exercises (e.g., gymnastics, Olympic-style events, and wrestling), to physical exercises that improve everyday health (e.g. dance, games and open-air activities). It has two fundamental learning zones: development information and abilities.

The previous physical training project is, by and large, still utilised in numerous schools. Indeed, even as the national PE rules are standard for all schools, there are significant deviations related to the execution of these rules. Physical instruction is obligatory in all schools from ages 6-18 years; primary schools are relied upon to seek to give one-hour physical training every week for the grades and two hours for sixth grades. There are no distinctions for young girls and boys as far as physical instruction exercises and condition. As per the principle of Turkish Secularism, coeducation in PE is a standard for all evaluations. Be that as it may, in many, particularly in non-public schools, boys and girls are separated in 6-8 grade. The most popular sports all through school for boys are soccer, basketball, and wrestling; for the girls, they are volleyball, aerobatics, and badminton. Schools are the key institute in giving physical instruction to every single child with the extra chances to take part in extra-curricular exercises. Moreover, girl's physical activities investment levels all through school are lower than boys (girls had a mean of 50 METs, and young men had a mean of 66), which results in more negative dispositions in girls toward physical sports and game in contrast with men. This prompts a lack of interest and moral support for girls.

Interest in Women Global Sport

In Turkey, as a mainstream Muslim nation, women have a cutting edge, contemporary way of life but, in contrast, are attached to their conventions and traditions. Despite the fact that the sport world in Turkey is empowered and upheld by the state through the Directorate General of Youth and Sports (DGYS), the Turkish Football Federation, and sport clubs, the gap between the offices and number of sports accommodating male and female athletes is entirely apparent. This is because women and girls have to accept the invisible and unwritten rules of the society which separates them off from men whose level of education and socioeconomic status are different. The families' perspective is also a significant factor influencing girls' sports. In the previous two decades, there has been an expansion in interest among women and girls in competitive and recreational sports.

As indicated by the Turkish Civil Law that was first given in 1926 soon after the Turkish Republic was established, "people [have] equivalent rights in all parts of life" (The Constitution of Republic of Turkey, 2010). Subsequently, women had equal opportunities as men in education, in the workplace, and in family life, and they additionally had similar rights regarding their children and their training. In 2001, a few changes were made to the Turkish Civil Law to give better security to women and children. As indicated by these changes, the head of the family is not the father (as determined previously), but rather both father and mother have equivalent rights to settle on family issues.

Despite the fact that this has been written in the law, the patriarchal way of life still dominates in the eastern and rural parts of the nation, where the training level is lower, In specific locales, men still settle on the choices with respect to family issues independent from anyone else, since they hold the power, and the women do their job of dealing with the family unit and children. This originates from conventions and traditions that we accept could be decreased as the instruction level of the two sexes increments. A similar circumstance can be found in sport opportunities for women, which are not at all homogeneous in all parts of the country either. Furthermore, social and religious desires may urge women and girls to practice sport with a scarf covering the hair and with specific types of clothing rather than customary sport uniforms, especially in the schools and in the legislative zones open to the general population. Be that as it may, private focuses, clubs, and open regions now and again enable women to practice sport in any way they wish. These distinctions are related to the social variety of the nation. The study of Hosper, Nierkens, van Valkengoed, and Stronks (2008) with respect to the impact of cultural assimilation on game interest among youthful Turkish and Moroccan women in the Netherlands revealed that cultural assimilation had a positive impact among Turkish women, yet not among Moroccan women. Their discoveries suggest that socially explicit attitudes among Turkish women were powerful at expanding their cooperation in sport. We accept that the relation between socially explicit mentalities or convictions and the participation in physical exercise and sport among Turkish women living in the Western world is additionally influenced by the solid influence of their experience in Turkey.

Turkey in the 2012 Olympics

Although Turkey has been competing in the Olympics since 1932, the iconic appearance at the Olympics was made in 2012 when 50% of the participants of the Olympics were women. Held in the London, England from 27 July to 12 August, the Olympic Games welcomed the participation of 204 nations. Contending in 16 branches with 114 athletes, Turkey won two gold, two silver, and one bronze medal. Turkey's first gold decoration was granted to Servet Tazegul in men's Taekwondo and the second gold award was granted to Asli Cakir Alptekin-a female mid-distance runner for the 1500 metre-run which is Turkey's first track & field gold medal in its Olympics history. Within the extent of "Sakip Sabanci Sports Awards", Asli Cakir Alptekin and Servet Tazegul got what might be compared to 40 Turkish Republic gold coins from Guler Sabanci, Chairman of the Board of Trustees of Sabanci Foundation on September 4, 2012, at of a function held at Sabanci Centre.

Sports Have Sex-based Characteristics

From the 1950s onwards, sportswomen in Turkey have gained access to different sporting events and activities that were previously dominated by men. The question now is whether this evolution has had any effect on the sport, The human body and physical attributes are the forefronts of sporting activities as sport largely depends and ranks are based on one's physical performance. Sport, to a large extent, is a system that involves competition and elite forms, and it is a widely accepted form of gender segregation that is rarely found in other areas of society. This has led to the standard practice of separating sporting activities based on sex, and females are not permitted to participate in male events and vice versa.

There are many publications that discuss gender composition. Taking a constructivist perspective, gender represents a structural class as well as an individual routine carried out in interaction. This approach places emphasis on our actions and not on attributes we possess. Actions are made up of gendered images and identities and gender representation in social circles, where we have to identify with (out) gender, either male or female. Therefore, sport is a typical example of this.

Gender is not only a societal issue. According to Butler's proposal in 1990, we should view gender as a process; however, actions and discussion have gained many reviews in various media. Discussions on inter-, trans-, and homosexuality raise questions regarding the model of two genders; phenomena such as gender-bending and gender play also show how gender is created and represented (Pfister, 2010). Playing around with different gender characteristics is now a global trend, and this is more evident in global sporting icons like David Beckham and his constant experimentation with different hairstyles and looks. He is perceived to be the idol of both heterosexuals and homosexuals and is the pacesetter of the "metrosexual" trend.

Signs that seems to be different in views as regards to the public perception of gender can be found in the men's health concepts that portray men as the stronger sex. For example, Natalie Angier's book titled "Woman: An Intimate Geography" portrays women as the exact opposite of the weaker sex. The constructivist perspective also emphasises the demand for women to be included in "men's sport" and vice versa. These demands that tend to raise the issues of dismantling the gender bias in sport is leading to a new gender direction.

Comparisons across different cultures, either when comparing different sport traditions in recent times, or when looking at previous generations show that it is more of the meaning attached to sport together with the social compositions of masculinity and femininity. So, this leads to defining sport activities as either female or male activities.

How is this important for the analysis of gender relations, and what does the future hold for women in sport? What does the future hold for the inclusion of men and women in sports that are typically stereotyped for the opposite sex? First things first; it should be stated that merely allowing a particular gender to participate in a particular sport does not actually mean that we have been able to remove gender or sexual differences successfully. On the other hand, there are several sports where this may be seen as a step to new and subtle methods of gender representation. For instance, figure skating continues to be seen as an area of sport that has been tailored to be women-friendly. Gender differences are captured quite clearly in ice dancing and pair skating (Pfister, 2010). Unlike sports in which the outcomes are defined and measurable, figure skating aesthetics and presentation form are a huge part of the evaluation process. Performing gender is an essential part of figure skating, and the different moves and creative freedom allowed in the sport gives room for athletes, both male and female, to carry out gender in different forms.

Turkish Women's Volleyball

The Turkey women's national volleyball team is part of the Turkish Volleyball Federation (TVF) and has gained a reputation around the world with its unbeatable performance. In the Olympics, World Championship, FIVB World cup, and in other famous volleyball tournaments, the women's national team of Turkey has been ranked Top 10. The team is considered to be the best in the country and has been named as "Filenin Sultanları" since 2003 Women's European Volleyball Championship facilitated in Ankara, Turkey. It is positioned tenth in the FIVB World Rankings as of October 2015. This team won bronze medals at both the 2011 Women's European Volleyball Championship and the 2012 FIVB World Grand Prix.

Turkish National Basketball Team

The Turkey national basketball team gained its reputation in international basket- competitions. They are represented by the Turkish Basketball Federation. Their nickname is "12 Dev Adam", which means 12 Giant Men. Turkey has contended at each significant international ball competition. Their most prominent accomplishments are winning two silver medals on home soil at the EuroBasket (2001), and FIBA World Cup (2010) individually. Turkey has likewise won two gold (1987, 2013), one silver (1971), and three bronze (1967, 1983, 2009) awards at the Mediterranean Games. Currently, Turkey stands fifteenth in the FIBA World Rankings.

How Does Religion Prove to be a Hurdle for Turkish Women in Sport?

When considering how women's participation in sport is impacted by Islam, it must be expressed as a matter of first importance that there is no broad prohibition of sport in Islam, and this includes girls and women. Numerous Islamic researchers have emphasized that wellbeing and wellness are similarly significant for both sexes and must be maintained by standard physical movement. Attention is given to the fact that the Prophet Mohammed himself suggested horseback-riding,

swimming, and archery. Leila Sfeir and others have derived from this that Islam initially demonstrated a positive mentality towards women's sport, yet certain religious components, for example, Islamic acquiescence and Hinduism's supernatural quality, have effectively affected general access.

In recent decades, female competitors have progressively begun partaking in sports that have been customarily viewed as manly (e.g., wrestling, weight-lifting, kick-boxing). Notwithstanding, numerous sports have been viewed as unseemly for women, and women who take part in "the wrong sorts of sports" are regularly seen as acting outside of their sex role. Thus, they are treated as carrying on improperly. It very well may be accepted that the nearby relationship between the traits required for the sport and the customary ideas of sexual orientation add to this frame of mind. The participation of women and men in the social establishment of sports and the very state of the established organization of sport are incompletely controlled by the significations of what people should be in the public view. Turkey is a unique nation, and the participation in sport, just as the general practice and experience of physical action, shift significantly in the different locales of Turkey. The quantity of female competitors' in martial sports, for example, taekwondo, karate, and judo, is developing rapidly, which demonstrates that an expanding number of women are taking an interest in sports customarily dominated by men. It is likewise a reality that society is changing, and younger people are increasingly interested in sport, and families have to support their youngsters', particularly girls, to appreciate sport. This phenomenon has driven scientists to explore the organization of sport as a significant field of gendered social practices in Turkish society [43]. As per the insights taken from General Directorate of Sport of the Turkish Ministry of Youth and Sport, before the finish of 2017, only 33% of the official competitors are females (1,469,314 female competitors and 2,959,521 male competitors).

Sport in the Early Republican Era

In every modern society, there are similar missions and goals for sport, which are basically to improve the health and fitness level of the general population and create visibility for the country worldwide. These were relevant goals and objectives for Turkey as a country, which had been adversely affected by the ending of the Ottoman Empire and associated conflicts between different countries.

Nationalism centres on men being the subject of a country and, as such, the sport policies of a country aimed at national representation should be developed for and meant for men (Hobsbawm, 1992). In 1937, Prime Minister Celal Bayar stressed the importance of sport in his speech, which can be found inside the Journal of Turkish Sports Administration. In his speech, he asserted, "Sport is the guide of our national culture. The ultimate aim is to raise the Turkish citizens […] to have a healthy body and an excellent character." Founder of the Republic, Mustafa Kemal Ataturk, also shed more light on the concept of developing the new man, which was to promote a powerful and virtuous generation with the sole aim of increasing and developing people's talent with the help of physical education and also developing the human mind.

Sport in the 1920s was generally influenced by these ideas and under the control of official policies and politics. By 1922, the Turkish Training Association Union (TICI) was established. The union aimed to bring together and organize physical education and sport in general. TICI ran as an autonomous organization representing sport clubs, and its responsibilities included championships, record keeping, and representing the country in international sport activities. In addition to the aforementioned, the organization was also responsible for supervising the creation of sports legislation and regulation, and also promoting the development of modern sport activities (Senol-Cantek, and Yarar).

The TICI maintained autonomous status right until 1924; however, in terms of changing sport policies, the state began to assert more influence. By the 1930s, sport was a national phenomenon, and it became imperative to hand over the control and administration of physical education and sport to a state-owned institution. This led to the birth of the Turkish Sports Administration (TSK), established in 1933, and the Physical Education General Directory (BTGM), which came in five years later in 1938 (Turkish National Assembly, 1938). The 1930s saw the evolution of sport and physical education as a means to training soldiers to the level where it was adopted as a way to condition the body and provide education for the citizens of the country. This led to the passing of the Physical Education Law in 1938, mandating participation in sport and physical education for all citizens of Turkey. The law mandated men and boys between the ages of 12 and 45 years and also women and girls between the ages of 12 and 30 years to take part in sport and physical education. The original plan was to develop and construct sporting facilities all over the country to train instructors and staff who would, in turn, teach and train the people. Sadly, this law could not be enforced fully due to the harsh economic conditions of the country at that time (Tarakçığlu, 2014).

In the Media

The media throws more light on gender-related views and also plays a part in the spread and adoption of these views. The majority of the citizenry are not exposed to sporting activities; however, they have easy access to the media, and as a result, they have access to information with different media outlets. Female athletes' coverage is about 5% of the total media coverage, and this lays credence to the fact the media has played a very small role in the progression of female sport over the years (Orta, 2012). The media has an important role to play, both in the current circumstances, and also to promote the ideas and practices as regards to gender. Critics of the media say it fosters patriarchy and also the exclusion of women, and this contributes to gender inequality and promotes discrimination between males and females (Hardin & Greer, 2009). For instance, about 50% of women shown in sport magazines in Turkey are not female athletes but rather wives and girlfriends of male athletes.

When we get to see actual female athletes in a magazine, the focus is mainly on their appearance (T.C. Aile ve Sosyal Politikalar Bakanlığı, 2018). The commentators that present them as people with marginal accomplishments are also not helping these athletes, portraying them as pretty, dependent, and young (Ugur-Tanriover, Vitrinel, & Sözeri, 2009). They tend to be radical in the separation and marginalization of sex-based roles of women only in the social circle. A close look at the media in Turkey shows patriarchal views, identifying women as emotional beings that lack the ability to think rationally (Menevse & Albay, 2018).

When an athlete representing Turkey excels in an inter-

national competition, the pride of the nation eliminates the gender gap that is predominant in Turkish media. Typical examples include the case of Yasemin Dalkilic, a World and European free diving champion; Yasemin Adar and Lena Erdil, gold medallist in wrestling and a champion in windsurfing, respectively. Otherwise, the standard routine for women is to get minimal coverage at most. This means there are basically two levels to rating success for male and female athletes (Koca & Hacisoftaoglu, 2011).

The most detailed analysis and research on Turkish women's involvement in sport and in sport media reveal that women are generally overlooked in the media; 21% of news headlines involve women; 2% of regular columnists are women; 0% of political programmes on TV are headlined by women; in addition, 0% of headline news presenters are women (Women for Women's Human Rights, 2016).

Researchers have raised concerns as to the under-representation of women in the media in Turkey to the fact that even when women are discussed, the coverage usually centres around existing stereotypes, such as women being mothers or housewives or objects of sexual pleasure (Gencel-Bek & Binark, 2000; Gencel-Bek, 2001; Hortaçsu & Ertürk, 2003). However, these studies reveal that media views did not differ after the introduction of women into sport media, and women's coverage remains negligible. In the case of sport columns in newspapers, the views are much more singular in dimension, and it is very difficult to see a woman as a member of staff in the newspaper office (Davidson & Burke, 2011).

Currently, the leading claim is that the media does not reflect the progress that has been made in women's participation in sport over the years. The focus still centres on male participants. There is very minimal interaction with female sport events, which plays a part in promoting the perception that female participation in sport is less significant than their male counterparts (Fullagar & Toohey, 2009). In the world today, there is much focus on financial and commercial considerations and, as such, it is very difficult to expect the emphasis to be placed on cultural and educational values. Based on this assumption, it is quite easy to understand that emphasis would be placed more on scandalous and aggressive elements in sport, which can sell more (Halbert & Latimer, 1994). While it is a fact that the media alone does not have the ability to change the differences currently experienced in sport today, it has the power to contribute positively to the evolution of female participation in sport.

The Power That Men Wield: Foundations of Leadership and Control

Sport is perceived to be a micro-representation of a larger society (Wolfe et al., 2005), in which dominant concepts are actualised and represented as well as contested and challenged (Messner, 2002). Sport, compared to any other ideology, comes with a special side that allows the ideology of male superiority (Messner & Sabo, 1990; Hall, 1999). According to Cunningham (2008), gender inequality is an institutionalised practise within sport organizations and the varying degree of gender inequality. This cuts across having access to mid- and upper-level of management positions, career progression, and opportunities in general, which are largely considered to be male-dominated sporting circles (Aitchison, 2005).

If the decision-making process in sport organization are examined, it will be found that the degree to which female exclusion occurs in leadership and management positions in countries such as Canada (Hall, 1999), Sweden (Ottesen, Skirstad, Pfister, & Habermann, 2010), Denmark, the US (Whisenant, Miller, & Pedersen, 2012), and Germany (Pfister & Radtke, 2009) means that almost 50% of all entry-level positions were occupied by women, 28% and 23% were occupied by executive and technical directors, respectively, while less than 10% of national coaches were women.

The culture in sport establishments of defining the skills, ideals, behaviours, and qualities of its employees based on masculinity puts women in a difficult situation in terms of the value they bring to the organization (Hovden, 2010). For instance, the views typically associated with leadership and management in sport are intertwined with male characteristics and traits like toughness and prior sport participation background (Knoppers & Anthonissen, 2008). Shaw and Hoeber (2003) discovered that upper management positions were strongly dominated by discussions centred on masculinity (with English words like "chairman" and "businessmen"). While in female circles, the discussion centres on femininity (with words like "loyal", "kind", and "feminine"), and these are typically associated with lower-level roles within an organization. Unfortunately, there are not enough articles, papers, and studies that focus on the low representation of women in sport circles in other countries apart from the West. Like Chen and Henry (2012) pointed out, it is essential that Muslim-dominated communities look beyond Islam as the main origin of female segregation and focus attention on the different patriarchal kinds of domination within their communities. As such, the socio-cultural perception of Turkey as a predominantly Muslim country should not be seen as a surprise.

Due to the socio-cultural composition of Turkey, men predominantly occupy high-level management positions in sport organizations in Turkey. The percentage of women in top management positions in sport organizations in Turkey is 7%. In comparison to this, the percentages of several other European nations, like Denmark (25%) (Ottesen et al., 2010), Sweden (33%), Finland (27%), Germany (15%), and Norway (37%) (European Commission, 2014), show that the Turkish rates are very low. This is mainly due to the perception of women in Islam and the increasing levels of patriarchal domination, in addition to the complex cultural, historical, and political factors all contributing to increasing the inequality gap between men and women in society.

Conclusion

Turkey is a rather complicated society in which religion, economic, social, and cultural forces interfere in the life of an average woman. As a result, female participation in sport is simply a reflection of the wider Turkish society. To promote female participation in sport, different actions need to be investigated; a constant engagement with government and public institutions to pass laws that encourage gender equality in terms of funding and representation is required. Sporting organizations also need to encourage the creation of sport teams that promote sport experience in the lives of young girls and women by interacting and cooperating with families, schools, and their communities.

Budgets should be split equally amongst men and women, and there should be an increase in the number of women given employment opportunities as coaches and also in sport associations and committees. This, in turn, will create an atmosphere

that promotes female participation in sport; it will also purge society of the stereotypes and bias that currently exists against women. Women have been fighting for equal rights and representation in various aspects of life, and this fight has yielded positive results in different areas of public life. The fundamental political and social position with respect to sport should be put out in the open. Also, the Olympic movement motto "international freedom and equal rights" is not being practised.

Legislation and affirmative action are not enough to help the fight for gender equality. These solutions only provide opportunities, and the opportunities provided need to be followed up with challenges, criticism, and questions centred around the social discussion as regards to the processes and actions on stereotypes and prejudice. Given all these, there is a belief that women's participation in sport and sport activities will gather momentum in the future. The programmes, initiatives, and budgets to promote female participation and equal representation in sport should be at the forefront of the Turkish sport policy. Also, there is a need to promote special ideas that will include health advancement and improve the image of young women and girls. There is also the need to develop quality social values and prevent sexual harassment and violence in sport. Previously, sport was a male-dominated world; however, the future is in the hands of all. The chances of this happening are not clear right now, although it would be very good if it does.

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SportMont

SHORT REPORT

Comparative Analysis of Peripheral Blood Circulation Parameters in Long-Distance Swimmers at Middle Altitude and Under the Conditions of a Hypoxic Gas Environment

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Abstract

Competitive activity at middle altitude creates increased demand on the cardiovascular system of long-distance swimmers. The state of their cardiovascular system and its readiness for such activities at middle altitude can be evaluated according to haemodynamic parameters. At the same time, state-of-the-art strategies for cardiovascular disorder prevention in long-distance swimmers during training for competitive activity at middle altitude are mostly based on the assessment of systemic haemodynamics, with no reference to microcirculation. The process of adaptation and changes in the functional parameters of long-distance swimmers that characterize their physical performance and the function of external respiration mainly occurs by broadening the range of training tools and methods. The unrestricted broadening of these tools and methods can cause severe disturbances in the functioning of the cardiovascular system. At the same time, existing methods for assessing the state of the cardiovascular system in long-distance swimmers do not allow performing a qualitative evaluation of the peripheral circulation haemodynamic parameters. The studies conducted have shown that microcirculation parameters in long-distance swimmers at different training loads have similar dynamics at middle altitude and under the conditions of a hypoxic gas environment, which allows for higher quality assessment of the cardiovascular system state in athletes and for the more accurate evaluation of their bodily reaction to different training loads at middle altitude.

Keywords: *long-distance swimmers, peripheral blood circulation, haemodynamic parameters, conditions of a hypoxic gas environment and at middle altitude*

Introduction

Expanding the conditions of competitive activity and conducting it at middle altitude creates increased demand on the cardiovascular system of athletes (Bakayev, Bolotin, & You, 2018; Bakaev, Bolotin, & Aganov, 2016; Bohuslavska, Furman, Pityn, Galan, & Nakonechnyi, 2017; Radovic, & Kasum, 2008; Leko, Siljeg, & Greguranic, 2019). The state of their cardiovascular system and its readiness for such activities at middle altitude can be evaluated by haemodynamic parameters (Bolotin, & Bakayev, 2017; Bunevicius et al., 2016; Vogiatzis et al., 2007). At the same time, state-of-the-art strategies for the prevention of cardiovascular disorders in long-distance swimmers during training for competitive activity at middle altitude are mostly based on the assessment of systemic haemodynamics, with reference to the micro-circulation of the working muscles (Murray, & Horscroft, 2016;

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Bakayev, Vasilyeva, Kalmykova, & Razinkina, 2018; Bolotin, Bakayev, & You, 2018).

Broadening of these training tools and methods can cause severe disturbances in the functioning of the cardiovascular system and the body in general. At the same time, existing methods for assessing the state of the cardiovascular system in long-distance swimmers do not allow performing the qualitative evaluation of the peripheral circulation haemodynamic parameters (Dempsey, Amann, Harms, & Wetter, 2012; Martin et al., 2009).

The studies conducted have shown that microcirculation parameters in long-distance swimmers at different training loads have similar dynamics at middle altitude and under the conditions of a hypoxic gas environment (Bolotin, & Bakayev, 2017). This phenomenon allows for higher quality assessment of the cardiovascular system state in athletes and for the more accurate evaluation of their bodily reaction to different training loads at middle altitude.

Study objectives:

1) To assess the dynamics of microcirculation in long-distance swimmers after ten hours of staying in a hypoxic gas environment;

2) To evaluate the peripheral circulation in long-distance swimmers at middle altitude;

3) To reveal the differences in the dynamics of microcirculation in long-distance swimmers at middle altitude and under the conditions of a hypoxic gas environment.

Methods

Eight long-distance swimmers from the Russian swimming team, in the age group of 17 to 23, were examined at middle altitude. The athletes underwent competition preparation and competed at the altitude of 1,300 m above sea level. For six weeks, the group swam for 17 to 19 km daily with a total weekly distance of 115 to 120 km. Balanced and repeated training methods were used.

The same subjects were examined in a hypoxic gas environment before the start of the training process at middle altitude. For that, they stayed in a hypoxic chamber with 16% oxygen content for 720 min. The conditions similar to those of the middle altitude were created in the hypoxic chamber. The air temperature was +24 degrees; the air humidity was 70%. The subjects in the hypoxic chamber were at rest. Peripheral blood circulation was studied using Laser-Doppler flowmetry at the distal phalanx of the second finger of the right hand. The microcirculation parameter (M) and the root-mean-square deviation of the fluctuation of red blood cells flow (b) (in peripheral units (p.u.)) were measured in all subjects. The coefficient of variation (CV) was used to assess the intensity of the microvessels' vasomotor reactions.

Results

A reduction in microcirculation during short-term exposure (360 min), followed by its compensatory increase (720 min) was determined in swimmers under the conditions of a hypoxic gas environment (Figure 1).

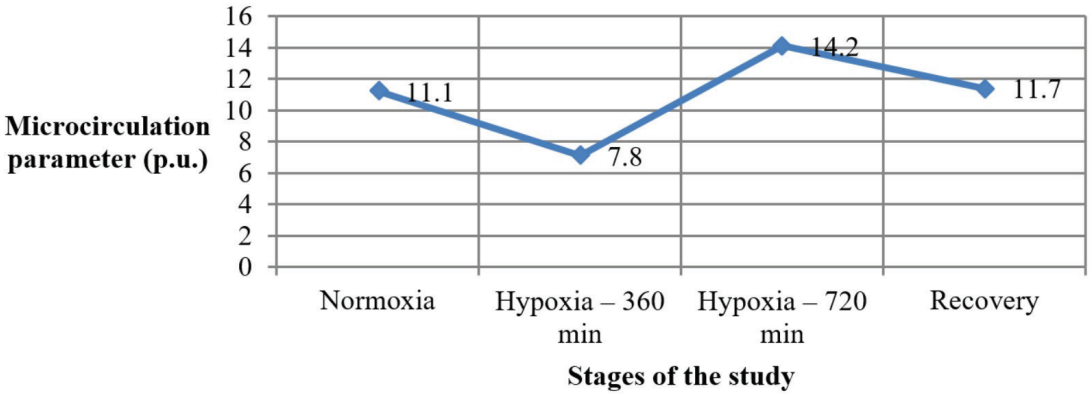

FIGURE 1. Microcirculation parameters in long-distance swimmers under the conditions of a hypoxic gas environment

Baseline data that characterize the reduction of peripheral blood circulation were obtained using biomicroscopy in athletes at middle altitude (Table 1).

With that, the coefficient of variation showed reverse dynamics in the form of an increase in the vasomotor activity of microvessels from 12.5 to 18.3% at the stage of performing the maximum training load for a month at middle altitude under the conditions of exposure to a hypoxic environment, which was then followed by a reduction at the stage of preparation for the start.

Table 1. Dynamics of Microcirculation Parameters in Long-Distance Swimmers at Middle Altitude

Microcirculation	Stage of the study		
	Baseline level	Stage of performing training load at middle altitude	Stage of competition preparation
Microcirculation parameter (p.u.)	11.3±1.1	8.1±1.2*	14.3±1.1*
Coefficient of variation %	12.5±0.84	18.3±0.91*	12.4±0.83

Legend: * – p<0.05

Discussion

In the course of this research, it was established that the peripheral vascular resistance of the arterial bed is determined by arterioles. Depending on the diameter of these vessels, it was revealed that various regulatory mechanisms might predominate (Martin et al., 2009). Arterioles of a larger diameter

(70 to 100 μm) are characterized by pronounced endothelium-dependent vasoreactivity. This type of reactivity is characterized by a direct relationship between changes in the vascular lumen in response to changes in the blood flow. Arterioles with a diameter of 40 to 70 μm are largely regulated by smooth muscle cells' stretch receptors. This regulation is determined by the narrowing of the arteriolar lumen at an increase in pressure, as well as the expansion of microvessels at a decrease in pressure. The tone of arterioles with a diameter of less than 40 μm is characterized by the metabolic activity of tissues, which undergo specific changes in swimmers under the influence of the training load at middle altitude. It was determined that the expansion of arterioles is caused by an insufficient amount of incoming oxygen following a decrease in metabolic activity and short-term suppression of microcirculation. This occurs against the background of the accumulation of under-oxidized metabolic products, which causes a decrease in pressure in arterioles. We have revealed an increase in the coefficient of variation, which characterizes the enhancement of the vasomotor reactions of microvessels. This discovery confirms the above-described mechanisms.

Under the conditions of a hypoxic gas environment, two-step change dynamics of microcirculation parameters in athletes were recorded: an initial reduction with a subsequent increase to the baseline level. Similar results were recorded in swimmers during competitions at middle altitude. This suggests that the assessment of peripheral circulation in a hypoxic gas environment may be critical in evaluating the degree of readiness of the cardiovascular system in long-distance swimmers for competitions at middle altitude.

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SportMont

SHORT REPORT

Assessing Health-Related Quality of Life in Older Adults: EuroQol Five-Dimensional Questionnaire vs the Short Form Health Survey

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Abstract

This study analyses the association between EuroQol five-dimensional questionnaire indexes (utility index and visual analogue scale) and the physical and mental components of the Short Form Health Survey, considering the impact of some variables that may influence both questionnaires (i.e., age, BMI, physical fitness and cognitive function). Bivariate and partial correlation analysis between EuroQol five-dimensional questionnaire indexes and summary components of the Short Form Health Survey, including the mentioned covariates, were conducted in 58 older adults (71.03±4.32 years). The large to small correlations found between utility index and the physical component (0.647), as well as the utility index and the visual analogue scale (0.441), persisted by adjusting physical condition, cognitive function, BMI and age, while mental components showed no association at all. The utility index and physical component were confirmed to correlate with physical fitness, although moderately (0.294; 0.284). BMI was negatively associated, but only to the utility index (-0.322). These results reinforce the concurrent validity only for the utility index and physical components and highlight the importance of physical fitness in a comprehensive geriatric assessment. The indexes of the Short Form Health Survey seem to provide diverse information regarding those of the EuroQol five-dimensional questionnaire in terms of the HRQL construct.

Keywords: *aging, body mass index, executive function; health status; perceived quality of life; physical fitness*

Introduction

The study of Health-Related Quality of Life (HRQL) emerges as an important objective of health promotion and disease prevention policies for older adults (OA) (Buchcik, Westenhöfer, Fleming, & Martin, 2017) arousing great interest for administrations and professionals in this field (Luthy, Cedraschi, Allaz, Herrmann, & Ludwig, 2015). As an example, the development of two common questionnaires: The Short Form Health Survey (SF-36) and the EuroQol five-dimensional questionnaire (EQ-5D); or more recently, the short version of the former (SF-12) and the subsequent update of the latter (EQ-5D-5L). These two questionnaires, designed to measure HRQL regardless of the presence or absence of diseases¸ have become popular in OA studies (Hart, Kang, Weatherby, Lee, & Brinthaupt, 2015). In addition, they have shown good reliability and validity in this population (Haywood, Garratt, & Fitzpatrick, 2005), despite its high heterogeneity and the many variables that influence the HRQL.

In recent years, it has been observed that people with better physical fitness (PF) are usually in higher percentiles in terms of perceived HRQL as assessed employing the EQ-5D (Wanderley et al., 2011), giving increasing importance to this domain. Other studies have confirmed that HRQL decreases as the Body Mass Index (BMI) and/or age increases (König et

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al., 2010; Korhonen, Seppälä, Järvenpää, & Kautiainen, 2014), using both the EQ-5D and the SF-12. It has even been found that cognitive function (CF), and more specifically executive functions, such as inhibition and cognitive flexibility, also influence the responses obtained in these questionnaires (Forte, Boreham, De Vito, & Pesce, 2015).

In this context, if PF, CF, age, and BMI confirm to modify the HRQL scores (utility index; visual analogue scale, physical components, and mental components), it seems useful to deepen in the concurrent analysis of these scores controlling the influence of each of the above-cited covariates. To the best of our knowledge, no studies have performed this type of analysis between the SF-12 and the EQ-5D-5L among a population of older adults. Thus, the aim of this study is to analyse the association between EQ-5D-5L and SF-12, considering the impact of some variables that may influence both questionnaires (i.e. age, BMI, physical fitness and cognitive function).

Methods

Participants

Fifty-eight elderly people (30 women) participated in this cross-sectional study. Inclusion criteria were: 1) to be over 60 years of age; 2) refer a score less than or equal to 2 in the fragility questionnaire of Fried et al. (2001); 3) not to participate in any supervised physical activity prior to the evaluation.

HRQL Questionnaires

The EQ-5D-5L questionnaire (Herdman et al., 2011) has two parts: the EQindex (utility index), a descriptive profile that can be converted into an index-summary which defines health in terms of five dimensions (Mobility, Self-care, Daily Activities, Pain/Discomfort, and Anxiety/Depression); and the EQVAS, in which respondents rate their overall health using a vertical visual analogue scale from 0 to 100.

The SF-12 (Ware, 2002) is a reduced and updated version of the SF-36 questionnaire, designed for quick administration. It answers 12 questions (on a Likert scale of 2 or 6 points) that add up to eight dimensions, in which two summary components are obtained: the physical component (PCS) and the mental component (MCS) (Ware, 2002).

Covariates

PF was obtained from the average of the standardized values of three well-known tests: the Five-Times-Sit-to-Stand Test (5STS), as a measure of lower-limb strength (Whitney et al., 2005); the 6-minute walk (6MWT), as a measure of the cardiovascular fitness; the six-metre Gait-Speed (GS_6m), to assess the overall functional capacity. The 6MWT was conducted following the recommendations of the American Thoracic Society (2002). The GS_6m was evaluated using Cronojump Bosco System electric photocells (Velleman PEM10D photocells, 5-100ms response time) and the Chronojump Software.

In contrast, after assessing weight (BC-545 scale; TANITA; Tokyo, Japan) and height (SECA 222 stadiometer), BMI was calculated as body weight divided by the squared value of body height (kg/m^2). CF was assessed with the Stroop Test, in which the interference score was calculated as a representative value of the Executive Function (Rivera et al., 2015).

Experimental procedure and ethical aspects

Data collection was carried out on two alternate days to control the contaminating effect of some tests. On the first day, we assessed body composition, SF-12, EQ-5D-5L, and the 5STS test; on the second day, Stroop Test, 6-metre Gait-Speed, and the 6MWT were assessed. Food intake was halted two hours prior to the assessments. All individuals were previously informed and signed their written consent to participate in this study approved by the ethic committee of the University of Valencia.

Statistical analysis

Data were analyzed with the Statistical Package for the Social Sciences, SPSS v24 for Windows (IBM Inc. Chicago, USA). After testing for normality, non-parametric correlation analysis (Spearman's Rho) were conducted between the main HRQL indices (EQindex, EQVAS (visual analogue scale), PCS (physical components) and MCS (mental components), followed by partial correlation analysis controlling the covariates PF, EF, Age and BMI. It was considered: r<0.1, trivial; 0.1–0.3, small; 0.3–.5, moderate; 0.5–0.7, large; 0.7–0.9, very large; >0.9, almost perfect; and 1 perfect.

Results

The sample was relatively homogeneous in terms of age (71.03±4.32 years; 6.1% CV), with a larger coefficient of variation in weight (71.15±14.27 kg, 20% CV), BMI (29.10±4.21; 14.5% CV) and the interference score of executive function (-6.02±7.90; CV=130.8%).

Bivariate correlations

Our results confirm a positive and moderate correlation between the components of the EQ-5D-5L (EQindex vs EQVAS; r=0.441, p<0.05), not found between the summary components of the SF-12 (PCS vs MCS; r=0.036; p>0.10). Moreover, when analysing the concurrence between questionnaires (figure 1), the PCS confirmed a large and positive concurrence with EQindex, and a trend regarding the EQVAS (small), while the MCS failed to associate with any index of the EQ-5D-5L.

Partial correlations

Regarding the influence of PF, CF, age, and BMI on these relationships, once checked whether there were changes in partial correlations for each covariate or groups of covariates, Figure 1 shows these results both independently as when controlling the four covariates together. PF correlates significantly and positively with EQindex and PCS, while BMI only affects EQindex. Partial correlation coefficient decreases slightly in comparison to the previous analysis, with no difference in levels of significance. Significantly, MCS again failed to relate with any covariate. Neither age nor CF showed any association at all.

Discussion

The present study aimed to highlight similarities and differences between two questionnaires widely used in the assessment of the health-related quality of life among the elderly, sorting out the influence of physical and mental conditions related to age. As the main finding, both questionnaires share and properly highlight the importance of the PF in elderly people's HRQL. PF is highly associated with the EQIndex and PCS, which are also largely associated with each other. Conversely, EQVAS and MCS fail in these associations, which indicates their complementarity and need in the assessment of this construct (HRQL).

Similar to previous studies (Dritsaki, Petrou, Williams, &

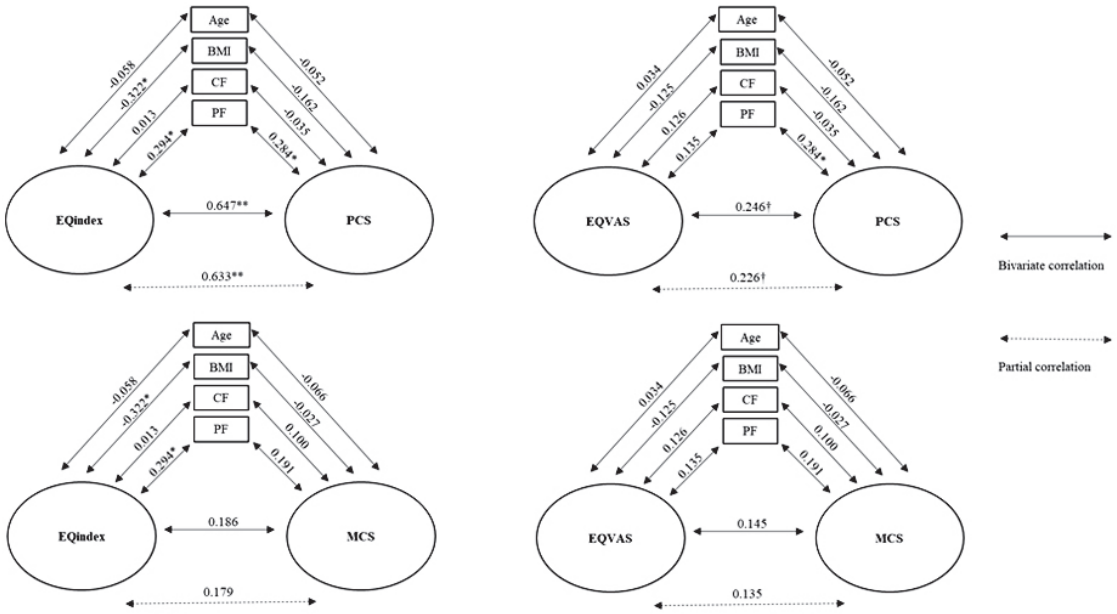

FIGURE 1. Bivariate and partial correlations (Spearman) between the different HRQL indices when controlling physical fitness, cognitive function, body mass index and age together, **p<0.010; *p<0.050; †p=0.100.

Lamb, 2017), our results reinforce the concurrent validity of both questionnaires in terms of perceived physical health and its influence on the quality of life (EQindex and PCS), qualifying them in relation to a population of older adults. However, data also confirm the need for both instruments and the influence of other factors different from the physical health in the HRQL. The summary components of the SF-12 do not correlate between each other, and the within correlation in the two EQ-5D-5L indexes decreases. In addition, the EQVAS-PCS correlation is only a trend, and the MCS does not correlate with any of the EQ-5D-5L indices. Indeed MCS seems to provide information about a different theoric construct to which the rest of the indices, not even affected by the age and Execute Function of the participants.

On the one hand, the association of PF and the components EQindex and PCS in both questionnaires reinforces the idea of a higher fitness leading to higher HRQL, as previously reported in older adults (Takata et al., 2010), PF should be included in the comprehensive geriatric assessment (Sánchez, Formiga, & Cruz-Jentoft, 2018) and taken into account in the assessment of HRQL. On the other hand, our data suggest that PF might influence this HRQL more than other factors such as BMI, age or the cognitive function in healthy older adults, at least in a sample quite homogeneous in terms of age.

With regard to BMI, only the EQIndex has been sensitive to this factor, reporting a small and negative association (Figure 1). Significantly, the use of the BMI may not fully reflect changes in body composition with ageing, as it does not distinguish between muscle mass and fat mass (Kahn & Cheng, 2018). Nevertheless, the EQindex may offer additional information related to been overweight by including some emotional issues (i.e., pain and anxiety), becoming a more comprehensive HRQL index.

Sample size and homogeneous age can be the major limitations of this study. Similarly, future studies should replicate this analysis by using, for example, the waist/hip ratio index, or more accurate tests for the cognitive domain. They should also investigate whether PF is best expressed by a unified set of variables under a single indicator, or by the isolated study of the different capacities of the OA, since the use of a single indicator could be hiding the relevance of some specific capacity.

In conclusion, our results indicate that only EQindex and PCS have moderate concurrent validity. However, controlling certain aspects such as PF, age or BMI is important due to their possible influence on certain indexes and their relationship.

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Conflict of interest

The authors declare that there is no conflict of interest.

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Number (Arabic numerals) the pages consecutively (centering at the bottom of each page), beginning with the title page as page 1 and ending with the Figure legend page.

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Abstract word count: 236

Number of Tables: 3

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All authors are required to provide word count (excluding title page, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References), the Abstract word count, the number of Tables, and the number of Figures.

2.2. Abstract

The second page of the manuscripts should be the abstract and key words. It should be placed on second page of the manuscripts after the standard title written in upper and lower case letters, bold.

Since abstract is independent part of your paper, all abbreviations used in the abstract should also be explained in it. If an abbreviation is used, the term should always be first written in full with the abbreviation in parentheses immediately after it. Abstract should not have any special headings (e.g., Aim, Results…).

Authors should provide up to six key words that capture the main topics of the article. Terms from the Medical Subject Headings (MeSH) list of Index Medicus are recommended to be used.

Key words should be placed on the second page of the manuscript right below the abstract, written in italic. Separate each key word by a comma (and a space). Do not put a full stop after the last key word. *See* example:

Abstract

Results of the analysis of

Key words: *spatial memory, blind, transfer of learning, feedback*

2.3. Main Chapters

Starting from the third page of the manuscripts, it should be the main chapters. Depending on the type of publication main manuscript chapters may vary. The general outline is: Introduction, Methods, Results, Discussion, Acknowledgements

(optional), Conflict of Interest (optional). However, this scheme may not be suitable for reviews or publications from some areas and authors should then adjust their chapters accordingly but use the general outline as much as possible.

2.3.1. Headings

Main chapter headings: written in bold and in Title Case. *See* example:

- ✓ **Methods**

Sub-headings: written in italic and in normal sentence case. Do not put a full stop or any other sign at the end of the title. Do not create more than one level of sub-heading. *See* example:

- ✓ *Table position of the research football team*

2.3.2 Ethics

When reporting experiments on human subjects, there must be a declaration of Ethics compliance. Inclusion of a statement such as follow in Methods section will be understood by the Editor as authors' affirmation of compliance: "This study was approved in advance by [name of committee and/or its institutional sponsor]. Each participant voluntarily provided written informed consent before participating." Authors that fail to submit an Ethics statement will be asked to resubmit the manuscripts, which may delay publication.

2.3.3 Statistics reporting

SM encourages authors to report precise p-values. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Use normal text (i.e., non-capitalized, non-italic) for statistical term "p".

2.3.4. 'Acknowledgements' and 'Conflict of Interest' (optional)

All contributors who do not meet the criteria for authorship should be listed in the 'Acknowledgements' section. If applicable, in 'Conflict of Interest' section, authors must clearly disclose any grants, financial or material supports, or any sort of technical assistances from an institution, organization, group or an individual that might be perceived as leading to a conflict of interest.

2.4. References

References should be placed on a new page after the standard title written in upper and lower case letters, bold.

All information needed for each type of must be present as specified in guidelines. Authors are solely responsible for accuracy of each reference. Use authoritative source for information such as Web of Science, Medline, or PubMed to check the validity of citations.

2.4.1. References style

SM adheres to the American Psychological Association 6th Edition reference style. Check "American Psychological Association. (2009). Concise rules of APA style. American Psychological Association." to ensure the manuscripts conform to this reference style. Authors using EndNote® to organize the references must convert the citations and bibliography to plain text before submission.

2.4.2. Examples for Reference citations

One work by one author

- ✓ In one study (Reilly, 1997), soccer players
- ✓ In the study by Reilly (1997), soccer players
- ✓ In 1997, Reilly's study of soccer players

Works by two authors

- ✓ Duffield and Marino (2007) studied
- ✓ In one study (Duffield & Marino, 2007), soccer players
- ✓ In 2007, Duffield and Marino's study of soccer players

Works by three to five authors: cite all the author names the first time the reference occurs and then subsequently include only the first author followed by et al.

- ✓ First citation: Bangsbo, Iaia, and Krustrup (2008) stated that
- ✓ Subséquent citation: Bangsbo et al. (2008) stated that

Works by six or more authors: cite only the name of the first author followed by et al. and the year

- ✓ Krustrup et al. (2003) studied
- ✓ In one study (Krustrup et al., 2003), soccer players

Two or more works in the same parenthetical citation: Citation of two or more works in the same parentheses should be listed in the order they appear in the reference list (i.e., alphabetically, then chronologically)

- ✓ Several studies (Bangsbo et al., 2008; Duffield & Marino, 2007; Reilly, 1997) suggest that

2.4.3. Examples for Reference list

Journal article (print):

Nepocatych, S., Balilionis, G., & O'Neal, E. K. (2017). Analysis of dietary intake and body composition of female athletes over a competitive season. *Montenegrin Journal of Sports Science and Medicine, 6*(2), 57-65. doi: 10.26773/mjssm.2017.09.008

Duffield, R., & Marino, F. E. (2007). Effects of pre-cooling procedures on intermittent-sprint exercise performance in warm conditions. *European Journal of Applied Physiology, 100*(6), 727-735. doi: 10.1007/s00421-007-0468-x

Krustrup, 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

Journal article (online; electronic version of print source):

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

Journal article (online; electronic only):

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

Conference paper:

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.

Encyclopedia entry (online, no author):

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

2.5. Tables

All tables should be included in the main manuscript file, each on a separate page right after the Reference section.

Tables should be presented as standard MS Word tables.

Number (Arabic) tables consecutively in the order of their first citation in the text.

Tables and table headings should be completely intelligible without reference to the text. Give each column a short or abbreviated heading. Authors should place explanatory matter in footnotes, not in the heading. All abbreviations appearing in a table and not considered standard must be explained in a footnote of that table. Avoid any shading or coloring in your tables and be sure that each table is cited in the text.

If you use data from another published or unpublished source, it is the authors' responsibility to obtain permission and acknowledge them fully.

2.5.1. Table heading

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}.

- ✓ ^{a}One participant was diagnosed with heat illness and n = 19.^{b}n =20.

Probability notes provide the reader with the results of the texts 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 bellow 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%	✓ 10º	✓ 10 kg	✓ 12:2	✓ 0.056
× 10 %	× 10 º	× 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 eISSN 2337-0351
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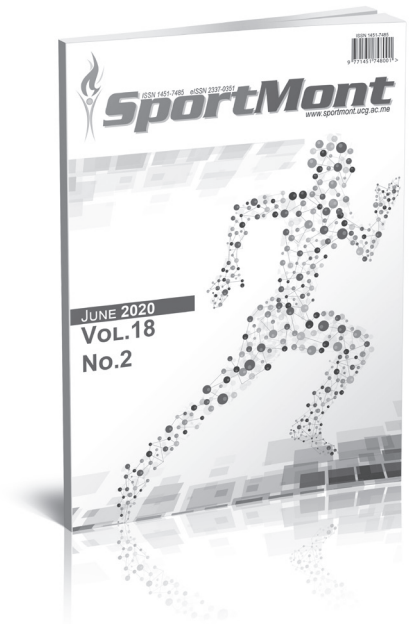
www.sportmont.ucg.ac.me



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- Open-access and freely accessible online;
- Fast publication time;
- Peer review by expert, practicing researchers;
- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
- Worldwide media coverage.

SM is published three times a year, in February, June and October of each year. SM 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.

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.

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 SM website: http://www.sportmont.ucg.ac.me/?sekcija=page&p=51. Contributors are urged to read SM's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to sportmont@ucg.ac.me or contact following Editors:

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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 programes 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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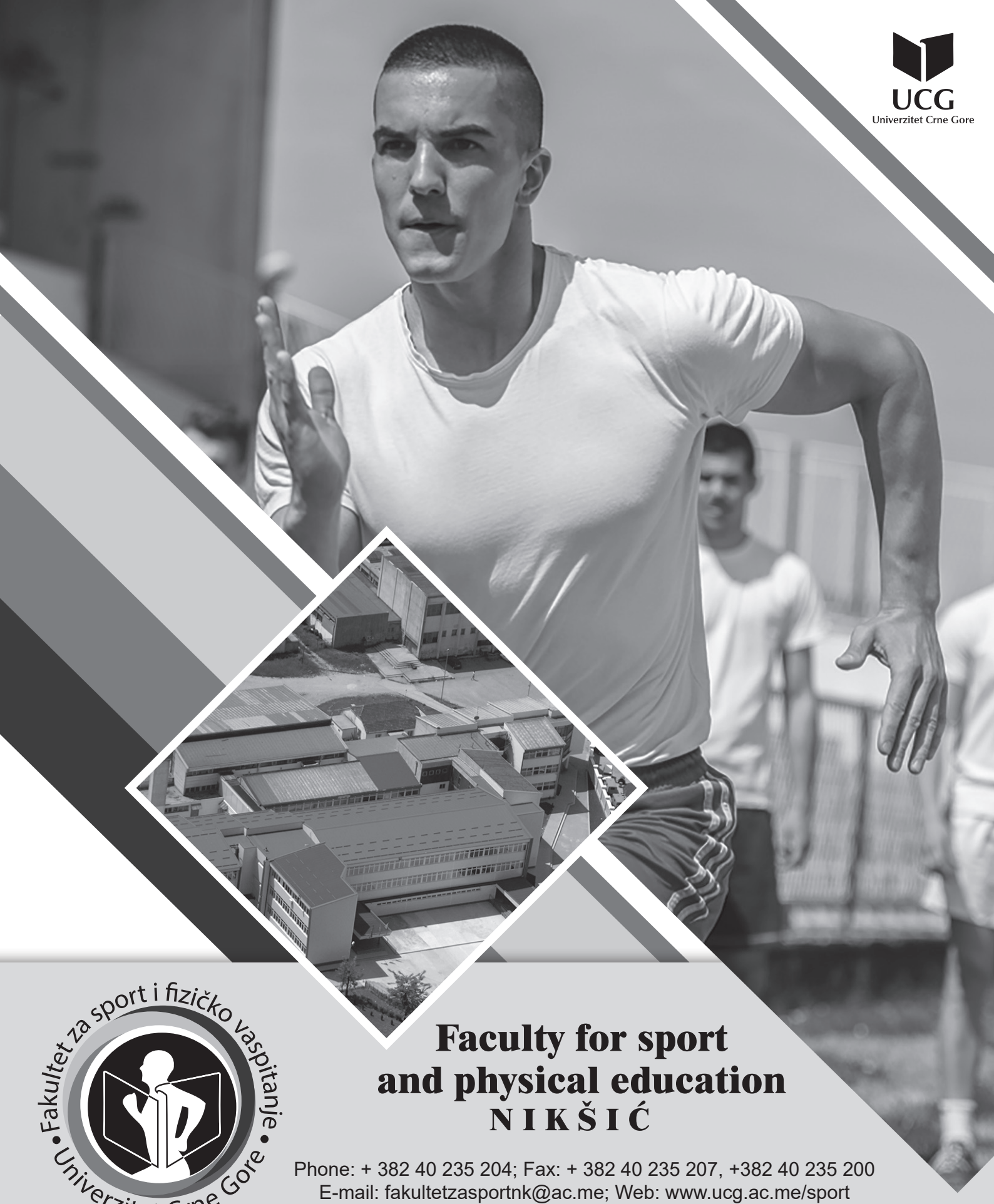

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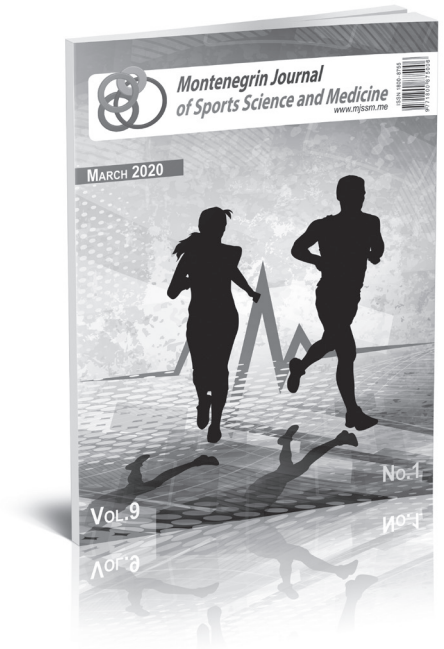
Montenegrin Journal of Sports Science and Medicine

MONTENEGRIN JOURNAL OF SPORTS SCIENCE AND MEDICINE



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- Post-publication tools to indicate quality and impact;
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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.

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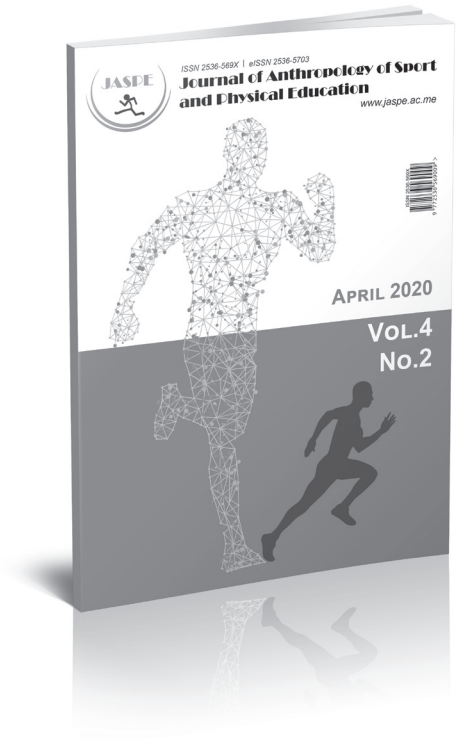
Publication date: Autumn issue – September 2020
Spring issue – March 2021

Journal of Anthropology of Sport and Physical Education



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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:

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- Peer review by expert, practicing researchers;
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- 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*

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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 Socialistic 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 soulutions for many important questions of cadre organization, technical and material problems. With the help of the University of Montenegro, faculty largely develops the international coorporation 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 founnded because of expression of need to reach the neccessary 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 implementatation of modern European trends .

The faculty is a complex organization and managing institution nowadays.

University of Montenegro
FACULTY of ECONOMICS PODGORICA

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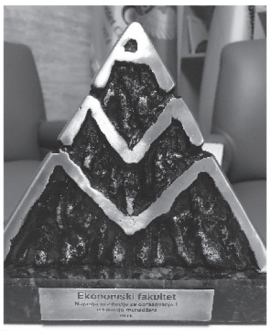
Faculty of Economics
University of Montenegro

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.

Jovana Tomaševića 37
81000 Podgorica, Montenegro

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INSTITUT ZA BIOLOGIJU MORA

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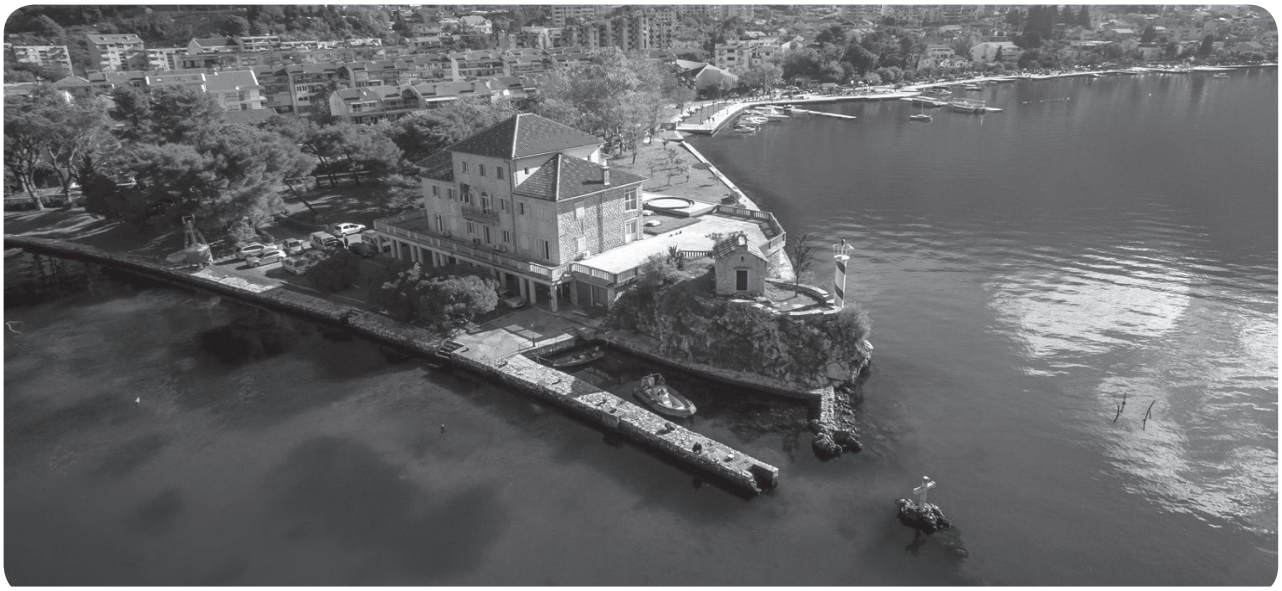

University of Montenegro – Institute for marine biology is located in Kotor, Montenegro. Since its establishment in 1961, the Institute performed comprehensive research of the marine and coastal area, which has its wide impact to the environmental protection, pollution-prevention and practical application. 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 trough 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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