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SportMont

ORIGINAL SCIENTIFIC PAPER

# Determining Factors of Physical Performance in an Exercise Stress Test in Women Practicing Nordic Walking

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**Abstract**

The goal of this research is the Analyse the influence of age, experience and relative fat mass (RFM) on physical performance in women practising Nordic Walking during maximal treadmill exercise testing. The population was formed of 20 women, who underwent a maximum stress test with continuous electrocardiographic recording. The Bruce protocol on the ramp was modified with progressive increases in speed and incline. In addition, we measured their height, weight, and waist. A study of exhaled gases was carried out. Our population has an average RFM of 39.8±2.9. Experience subjects reach higher levels of intensity during the exercise, with a variable speed of 6.4±0.9 km/h, compared to newcomers at 5.6±0.7 km/h ($p<0.05$). We observe that with higher RFM, higher body mass index (BMI) and waist size index, there is a lower oxygen consumption (VO2) and metabolic equivalent (METS) ($p<0.05$). Likewise, a longer time increases both VO2 and METS ($p<0.05$). The results suggest that the indexes and anthropometric relationships RFM, BMI, and waist-size index (WSI) influence performance in women practising Nordic Walking. In addition, previous experience in this discipline is also an influential factor in the intensity of the exercise.

***Keywords:*** *ergospirometry, nordic walking, aerobic resistance, older women*

## Introduction

Nordic Walking (NW) is a relatively new activity, which originated in Finland in 1930; since then, different investigations have been carried out on its characteristics and benefits (Jódar-Reverte, 2019).

This activity consists of walking with canes specifically designed for this activity; it involves working both the upper and lower part of the body, respecting the joint alignment and reducing the impact on the joints (Padulo et al., 2018). Unlike the usual gait, in NW, the gait of an upright position is adopted; the individual is tilted slightly forward, also requiring counter-lateral hand/foot coordination (Pérez-Soriano et al., 2014). Likewise, it involves the active participation of the upper limbs that exert the necessary force to contribute to the displacement, in this way, the movement ranges of the joints are much greater than in conventional walking (Song, Yoo, Choi, & Kim, 2012).

The Spanish Federation of Mountain and Climbing Sports (FEDME) states that it is a dynamic and rhythmic activity that can be suitable for everyone. According to the regulations of the FEDME, competitions are usually made on routes with a length between 10 and 42 km (FEDME, 2019). Thus, due to the type of exercise that is performed, the duration of its sessions and the predominant metabolic characteristics, it can be considered an aerobic endurance sport (Tschentscher, Niederseer, & Niebauer, 2013).

Therefore, the performance of a stress test in laboratory conditions is adequate for the objective assessment of its participants regarding both health and performance (Geevar-Zachariah & Anoop, 2017). This test examines the

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response of the heart to physical exercise; electrocardiographic analysis (Balady et al., 2010) is used for the diagnosis, monitoring and prevention of ischemic heart disease (McSweeney et al., 2016) and monitoring the performance of athletes (Ronconi & Alvero-Cruz, 2011). In addition, by incorporating spirometric analysis, through the study of respiratory gases, these practitioners will obtain information on the adaptation to exercise that can be evaluated regarding the performance and planning of training (Arós et al., 2000). In this manner, the data obtained in performing the ergospirometric test can be modified in order to develop or adapt the training plans to the physical capabilities of each individual (Mezzani, 2017).

In the literature referring to Nordic walking, studies that evaluate the influence of training programmes in NW in order to improve health stand out. These have been performed in specific populations, such as people with diabetes (B. Gram, R. Christensen, C. Christiansen, & J. Gram, 2010), hypertension (Launois et al., 2018), overweight or obesity (Hagner-Derengowska et al., 2015) or Parkinson's disease (Monteiro et al., 2017), among others. Most authors agree that NW is a relatively easy activity and that it can be used to counteract the negative aspects associated with inactivity, thus helping to maintain subjects' optimal performance (Mansour, Gorce, & Rezzoug, 2018). Among the subjects, we do not find references that separate the population according to age, experience (experienced and novices) and relative fat mass that could be useful for adapting different training plans according to the responses of these athletes to exercise.

The purpose of this research is to analyse the influence of age, experience and relative fat mass (RFM) on physical performance in women practising Nordic Walking during maximal treadmill exercise testing.

## Methods

*Subjects*

The population was formed of 20 women with a mean age of 50.6±5.1 years. Participants voluntarily registered through an agreement with the Mountaineering Federation of the Region of Murcia. Women over 40 years were included, excluding those who, due to illness, alteration and/or injury, were unable to perform the stress test. Prior to the data collection, participants were informed of the objectives and procedures of the study, all of them signed the corresponding informed consent document. The study was conducted in accordance with the Declaration of Helsinki and also has the approval of the Research Ethics Commission.

*Design*

This is an observational, descriptive study. Each participant had the following evaluation. After anthropometric measurements (weight, height and waist and hip contours) and baseline cardiovascular examination (history, auscultation, blood pressure and resting electrocardiogram), each woman underwent a maximum stress test on a Run model treadmill 7411 (Runner®) with the continuous recording of the 12 standard electrocardiogram leads (Cardioline® electrocardiograph, Click ECG model) and blood pressure every two minutes (Metronik BL-6®). The study of exhaled gases, maximum oxygen consumption, respiratory ratio and maximum ventilation was carried out using the Cortex Metalyzer® 3 B gas analyser.

A modified Bruce protocol was used on the ramp; the test began with a speed of 1.9 km/hour, and the slope and/or speed were progressively increased (Will et al., 1999). During this, the heart rate was recorded every minute and the blood pressure every two minutes, and at 1, 3 and 5 minutes of recovery. The test ended when each woman reached the maximum capacity and indicated this by raising her arm; at that time, the recovery period began. Similarly, the reason for the end of the test was noted. To establish the maximality of the test, it is verified that 1.1 is exceeded in the respiratory exchange ratio and 85% of the maximum expected heart rate for the age of the subject.

*Statistical analysis*

The SPSS version 24 software was used. Quantitative variables are presented using their mean and standard deviation and qualitative variables with their absolute frequencies and percentages. Furthermore, the normality of the distributions with the Shapiro Wilk test was determined, and the Wilcoxon traits test was used to establish the differences between related samples. Likewise, the Mann Whitney U test has been used for two independent samples. The relationship between quantitative variables was made with the Pearson correlation. The analyses were performed with a 95% confidence interval and $p \leq 0.05$. The body mass index (BMI) has been obtained from the classic formula (body mass/squared size), the waist-size index (WSI) (waist circumference/height) and the relative fat mass (RFM) by the procedure of Woolcott and Bergman (2018), from the height and waist circumference, using the equation adjusted according to gender.

## Results

The following table shows the general characteristics of the population (Table 1).

**Table 1.** General characteristics of the population

| | |
|---|---|
| Age (years) | 50.6±5.1 |
| Previous experience in NW (years) | 3.25±3.95 |
| Height (cm) | 163.87±5.02 |
| Weight (Kg) | 67.49±10.19 |
| Waist (cm) | 91.12±9.54 |
| Hip (cm) | 103.02±7.93 |
| BMI (Kg/m$^2$) | 25.11±3.24 |
| WSI | 0.55±0.05 |
| RFM (%) | 39.72±3.40 |

Legend: NW - Nordic Walking; BMI – Body Mass Index; WSI - Waist-Size index; RFM - Relative Fat Mass

Likewise, we divided women according to previous experience in Nordic Walking, considering experienced subjects those who had a year or more of experience. Table 2 shows the anthropometric characteristics according to the level of experience.

**Table 2.** Anthropometric characteristics according to experience

| | | Veterans (n=8) | Newcomers (n=12) | p |
|---|---|---|---|---|
| Age (years) | 49.7±6.2 | 51.1±4.3 | 0.057 | 0.057 |
| Height (cm) | 162.60±4.33 | 164.71±5.43 | 0.369 | 0.369 |
| Weight (Kg) | 67.66±6.71 | 67.38±12.26 | 0.954 | 0.954 |
| Waist (cm) | 91.93±6.21 | 90.58±11.47 | 0.765 | 0.765 |
| Hip (cm) | 102.68±4.57 | 103.25±9.75 | 0.881 | 0.881 |
| BMI (Kg/m$^2$) | 25.60±2.28 | 24.79±3.80 | 0.598 | 0.598 |
| WSI | 0.53±0.04 | 0.55±0.05 | 0.254 | 0.254 |
| RFM (%) | 40.48±2.60 | 39.20±3.85 | 0.424 | 0.424 |

The clinical, electrical, and hemodynamic responses during the stress test were normal in all participants. Likewise, resting electrocardiographic traces showed no alterations. Table 3 details the ergospirometric values obtained in the maximum effort of veteran and novice women. We note that experienced women had slightly higher intensity, yet still show no significant differences.

**Table 3.** Ergospirometric characteristics according to experience

| | Veterans | Newcomers | t | Sig. | U |
|---|---|---|---|---|---|
| Speed (Km/h) | 6.48±0.93 | 5.66±0.75 | 2.11 | 0.05 | 75.00 |
| Duration (min) | 10.94±2.15 | 9.18±1.62 | 2.04 | 0.057 | 109.00 |
| VO2 (ml/kg/min) | 27.13±2.59 | 24.91±3.67 | 1.46 | 0.163 | 177.00 |
| METS | 9.52±0.87 | 9.81±1.43 | 1.68 | 0.341 | 103.00 |

Table 4 shows the correlation between the different anthropometric variables and ergospirometric variables. In this way, we observe a significant relationship between the relative fat mass and the body mass indexes and waist size index, these being higher when the relative fat mass is higher. Likewise, we observe that the higher the relative fat mass, the lower the consumption of oxygen and metabolic index.

**Table 4.** Anthropometric and ergospirometric data correlation

| | | Age | BMI | WSI | RFM | Duration | VO2 | METS |
|---|---|---|---|---|---|---|---|---|
| BMI | Pearson correlation | -0.076 | 1.000 | 0.871** | 0.847** | -0.088 | -0.740** | -0.740** |
| | p | 0.749 | | 0.000 | 0.000 | 0.721 | 0.000 | 0.000 |
| WSI | Pearson correlation | 0.191 | 0.871** | 1.000 | 0.992** | -0.237 | -0.708** | -0.708** |
| | p | 0.420 | 0.000 | | 0.000 | 0.329 | 0.001 | 0.001 |
| RFM | Pearson correlation | 0.232 | 0.847** | 0.992** | 1.000 | -0.232 | -0.697** | -0.697** |
| | p | 0.325 | 0.000 | 0.000 | | 0.339 | 0.001 | 0.001 |

## Discussion

The objective of this study was to analyse the influence of age, experience and relative fat mass (RFM) on physical performance in women who practice Nordic Walking during the maximum treadmill exercise test. The results indicated that experienced women reached slightly greater intensity during the stress test without showing specific differences. In addition, we observe that the different anthropometric indices affect the performance of the participants.

Previous studies analysed aspects related to Nordic walking on populations similar to ours: middle-aged women (Cebula et al., 2017; Pilch et al., 2018) and with a number of similar or lower subjects (Sprod, Drum, Bentz, Carter, & Schneider, 2005; Strombeck, Theander, & Jacobsson, 2007). In our study, we only consider the participation of those who have the characteristic profile of the Nordic walking practitioner and who are middle-aged women (Martínez-Lemos, 2013).

Regarding the anthropometric characteristics of our population, they correspond to the data obtained from the Spanish population in recent years (Rodríguez-Rodríguez, López-Plaza, López-Sobaler, & Ortega, 2011; Jiménez-Talamantes, Rizk-Hernández, & Quiles-Izquierdo, 2017). In relation to the calculation of relative fat mass, the values provided by their researchers are consistent with those obtained in our population (Woolcott & Bergman, 2018).

We have taken into account previous experience in the practice of Nordic walking by dividing our population into veterans and newcomers; this separation has not been seen in the literature cited referring to the practice of this discipline (Perrey & Fabre, 2008; Grainer et al., 2017). This division has been considered since a previous level of experience may cause changes not to occur or be slight due to the habit of exercising.

Our results show that experienced women reach slightly greater intensity during the stress test, without finding signif-

icant differences, which may be because the stress tests were carried out at the beginning of the season after a period of rest, which could lead to veteran women disabling the exercise. Likewise, they show that various anthropometric indices influence the performance of the participants, reaching lower oxygen consumption and metabolic index when the physical condition is worse.

One of the main limitations of this study lies in the small sample size; however we must consider that we have studied all women who practice Nordic walking in an organized way of the city of Murcia, aged between 40 and 65 years. We consider another limitation to be that the stress tests were carried out at the beginning of the season, which could cause no differences between the two groups.

Regarding practical applicability, we consider that the data provided by this study allow the individual situation of each athlete to be assessed in order to adapt the intensity of the exercise according to their needs. Likewise, if the stress test were repeated at the end of each season, we would obtain information on the effects that this type of long-term training produces.

The results suggest that the indexes and anthropometric relationships RFM, BMI and WSI influence performance in women practising Nordic Walking. In addition, previous experience in this discipline is also an influential factor in the intensity of the exercise.

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There are no acknowledgements.

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

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ORIGINAL SCIENTIFIC PAPER

# An Analysis of the Role of the Social Acceptance of University Students' Bicycle Use in Sustainable Urban Development when Epidemics Spread

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**Abstract**

The purpose of this study was to investigate the role of the acceptance of university students' bicycle use in sustainable urban development in Iran when epidemics spread. The research method was descriptive-correlational, and the investigation was carried out as a field study. The statistical population of the study consisted of university students, 254 of whom were selected by a simple random sampling method to participate in the research. The research instrument was a questionnaire based on the Sustainable Development with a reliability coefficient of 0.83; the social acceptance component was based on the theory of planned behaviour with a reliability coefficient of 0.8. As the results of the investigation have demonstrated, the bicycle plays a significant role in the development of the socialization process of people, and there is a positive and significant relationship between social acceptance and sustainable development ($p<0.05$). Furthermore, 20% of sustainable development change was achieved through the dimensions of social acceptance (planned behaviour theory). Finally, it can be argued that perceived behaviour in social acceptance is most likely to play a significant role in the emergence of sustainable development by external factors such as encouragements and persuasion of the family, important people, friends, acquaintances, and even by the existing norms in society. Subsequently, as people change their mindset when epidemics spread, they can turn all the behaviours they manifest in their leisure time into a culture development movement.

***Keywords:*** *coronavirus, social acceptance, bicycle, epidemic spread, sustainable development*

## Introduction

In recent decades, much work has been undertaken, led by the WHO, to better prepare and protect health systems during mass gatherings (WHO, 2020). Due to the restrictions imposed by the WHO to prevent overcrowding during the outbreak of epidemics, it is best to use personal transportation instead of public transport. One of these devices is the bicycle, which is emphasized as a green tool. In a pandemic, primarily the health sector, then all aspects of the social, economic life, the daily lives of individuals, and finally all the sports activities are facing an exceptionally large challenge (Closkey et al., 2020). Professional sports events which are followed by crowds of spectators, all the business initiatives providing various sports services, industries producing sports products, the businesses within the marketing chain of all these products, the industry of sports tourism, all the individuals working for sports organizations of different levels, and all other industries and businesses linked

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with the sports industry have suffered from huge financial losses in the most recent pandemic (Turkmen & Özari, 2020). Undoubtedly, slowing down the spread of COVID-19 to manageable levels for the health systems to operate is the overriding priority. Re-thinking sport, whether elite or community/recreational, will play a significant part of that. The consequences of these postponements and cancellations are unknown, yet many commentators and those within sport expect this to fundamentally change the way the industry operates in the future (Parnell, Widdop, Bond, & Wilson, 2020). Relevantly, we should examine sports actions related to COVID-19, as there are valuable lessons to be learned. Certainly, when the next pandemic comes (which it will), we are better prepared in sport and society. Since a multitude of transportation issues and various environmental pollution problems have been created recently, the role of the bicycle as an active and sustainable transportation tool has gained significance in reducing traffic and air pollution (Saraei & Shamsi., 2012). Also, according to Moradi and Rostami (2013), cultural weakness in the field of traffic and lack of integrity in the management and decision making regarding bike riding projects in the city are the causes of lack of interest in bike lanes.

Travelling by bicycle brings about numerous benefits such as reduced traffic noise, cost-effectiveness, lack of pollution, good exercise for the body, parking convenience and health for both the individual and the others (Dolatkhah, Saatchian, & Keshtidar, 2018). For example, in Sydney, special routes have been arranged for buses, cars and ambulances along the streets. A 35-km route designated soles for bicycle has enhanced the bicycle culture in Sydney by about 500% (The Bureau of Infrastructure, Transport and Regional Economics). Therefore, attention to the promotion of walking and cycling culture is one of the approaches to integrate physical exercise into everyday activities (Su, Winters, Nunes, & Brauer, 2010) and the creation of this culture is influenced by existing attitudes and norms. Attention and identification of the effective aspects of using bikes by modifying human behaviour can and should be studied. These behaviours are well-documented in Eisen's theory of planned behaviour (1985), which suggests that attitudes, mental norms, and perceived behavioural control are influential factors that predict an individual's intention to engage in a particular activity and promote social acceptance. This approach plays a significant role in providing the basis for sustainable development (Mirmiran, Mirbolooki, & Azizi, 2001), the central goal of which is to provide for basic needs and improve and enhance the standard of living for all beings. Dolatkhah et al. (2018) have concluded that green marketing in sport-recreational activities can predict citizens' satisfaction and loyalty and public bicycle system can attract their attention to public bicycle use by employing any of the compounds of green marketing. Savan, Cohlmeyer and Ledsham (2017) suggest a five-part model and its integration with continuous activities. The model has the following parts: "(1) division of strategic population; (2) identification and removal of barriers; (3) use of commitment strategies; (4) tactics for maintaining behavior change, including images, encouragement, social indicators and modeling, social norms, feedback and motivation; and (5) continuous social support through modeling, local centers and community participation". These have been used to bring about successful participation and acceptance of cycling by means of various tools to create change, and allows communities to utilize scarce resources of active transportation. According to Babiano, Kumar, and Mejia (2017), the proper implementation of shared bicycle project can create long-term positive impacts by creating a cycling culture and changing travelling behaviour.

Biking is a part of sustainable development and a factor in dealing with the negative consequences of urbanization. For human resources to be efficient, students should be involved in physical and recreational activities alongside educational and research activities so that they can enjoy a healthy lifestyle. Despite the importance of the mentioned research variables, thus far there has been no similar study on the relationship between social acceptance based on the theory of planned behaviour and sustainable development according to economic, ecological, cultural and social components. The present study emphasizes the use of bicycles by students to manage their lives better when epidemics such as corona occur.

## Methods

In terms of research objectives, this was an applied study; regarding research type, it was descriptive-correlational. The statistical population of the study comprised male students in Iran (N=3000). The sampling method used in this research was simple random sampling. According to the statistical methodology of the research, the sample selection was five to ten times greater than the number of research questions (taking the correlational studies and return rate of the questionnaires into account). Finally, 254 questionnaires with 10% reduction were distributed among the individuals.

To collect information, two questionnaires were used. The first was an 18-item questionnaire of social acceptance based on Eisen's theory (1985) including dimensions of attitude, perceived behaviour and norms; the second was a 14-item questionnaire of sustainable development based on Spritzer's model (1997) with three subscales of economy, ecology and social-cultural components, used in a five-point Likert scale.

To confirm the face and content validity, questionnaires were distributed to five relevant university professors. Cronbach's alpha test was used to determine the reliability of the questionnaires; the reliability of social acceptance and sustainable development questionnaires were $\alpha = 0.83$ and $\alpha = 0.81$, respectively. Also, to collect data, the purpose of the study was explained to students, and they were asked to express their views following a discussion of the meaning of the questions. Finally, the collected data were analysed in two sections. In the first part, descriptive statistics and in the second part, inferential statistics (Kolmogorov-Smirnov test, correlation test, regression test, one sample t-test and structural equation model fit) were analysed using SPSS and LISREL software.

## Results

Based on the results of Table 1, the highest number of people belonged to the age range of 21 to 30 years old (52.8). Regarding marital status, 61.4% were single; in terms of the purpose of bicycle use, the highest percentage cited the recreational option (37.4%).

**Table 1.** Statistical description of demographic characteristics

| Demographic variable | Level | Frequency | Frequency (%) |
|---|---|---|---|
| Age | Under 20 years old | 57 | 22.4 |
| | 21–30 years old | 134 | 52.8 |
| | 31–40 years old | 44 | 17.3 |
| | 41 years old and over | 19 | 7.5 |
| Marital status | Single | 156 | 61.4 |
| | Married | 98 | 38.6 |
| Purpose of bicycle use | Environmental protection | 56 | 22.0 |
| | Physical readiness | 56 | 28.0 |
| | Traffic | 32 | 12.6 |
| | Recreation | 95 | 37.4 |

Subsequently, Table 2 examines the role and importance of social acceptance variable components. According to the results and the mean score of social acceptance variable components, only perceived behaviour and norms indicate a relative desirable status.

**Table 2.** One-sample t-analysis to determine the role of the score of social acceptance components

| Variable | Mean | t-statistic | Significance level |
|---|---|---|---|
| Social attitude | 2.85 | -3.86 | 0.001 |
| Perceived behaviour | 3.28 | 6.299 | 0.01 |
| Norms | 3.19 | 3.940 | 0.001 |

To determine the status of the components of the sustainable development variable, a one-sample t-test was applied. As shown in Table 3, the components of sustainable development indicate a favourable situation.

**Table 3.** One-sample t-analysis to determine the role of sustainable development score and its components

| Variable | Mean | t-statistic | Significance level |
|---|---|---|---|
| Economy | 3.67 | 12.183 | 0.001 |
| Ecology | 3.88 | 13.774 | 0.01 |
| Cultural and social | 3.84 | 14.628 | 0.001 |

To determine the internal relation between the components, the Pearson correlation test was used (Table 4). A positive and significant relationship between all components of social acceptance and sustainable development is present, and the correlation between them is reported to be moderate ($p<0.05$).

**Table 4.** Correlation test between social acceptance components and sustainable development

| Components | Sustainable Development | |
|---|---|---|
| | Correlation | Significance level |
| Social attitude | 0.24 | 0.01 |
| Perceived behaviour | 0.43 | 0.01 |
| Norms | 0.30 | 0.01 |

To fit the research model using structural equations in standard mode, results are presented in Figure 1.

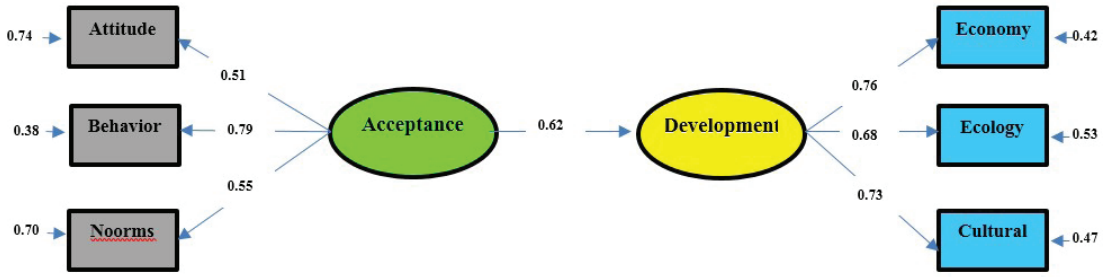


FIGURE 1. Structural Equation Modeling, social acceptance and sustainable development

The relationship between research variables and their components had acceptable values; these indicators demonstrate that the observed measured variables are well reflected in the hidden variables (social acceptance and sustainable development). The results also show that social acceptance can have a positive and significant effect equal to the path coefficient of 0.62 on sustainable development (t=7.20, Sig=0/01). The results of the fit indexes of the model show that fit indexes have a satisfactory value and the indexes of χ2/df (2.40), GFI (0/98), NFI (0/96), AGFI (0.94) are at favourable levels and are higher than 0.9. Therefore, the research model based on the impact of social acceptance on sustainable development is supported.

## Discussion

Travel bans imposed due to epidemics may accelerate fear and, in turn, impact the supply of essential items. Therefore, it is essential that reduced frequency of transport means such as bicycles is incorporated with route restrictions to lessen the demand for travel. Indeed, schools and universities have long been considered the main pillars of society for the promotion of the culture of sport, and it is almost impossible to take any cultural action in society without taking them into account. Consequently, the concept of social acceptance is introduced as a challenge in identifying the behaviour of sports consumers. Attention to factors affecting the improvement and progress of exercise goals among different levels of society can promote sport. Therefore, development is introduced based on a sustainable outlook.

According to the results of the research, the social acceptance variable, and components of perceived behaviour and norms indicate a relatively favourable status, which is in line with the results of studies conducted by Babiano (2015), Saffar and Azimzadeh (2014) and De Bruijn (2005). Results of the data analysis demonstrated that most people agree to use bicycles and encourage people close to them (e.g., family members, spouses, and friends) to use bikes. In the same vein, according to a study conducted by Babiano (2015), a significant issue contributing to the success of bicycle projects in Asian countries is the balance of transportation programs and policies with environmental, economic and social conditions of urban environments.

Furthermore, Saffar and Azimzadeh (2014) report that universities can create conditions for students to bring their bicycles to universities, thereby promoting the culture of bicycle use among students, which can result in a comprehensive student-led program to help the promotion of riding bicycles. Savan et al. (2017) concluded that a socio-psychological approach to behavioural change should be employed to increase the potential of bicycle use in transportation.

As the existing literature suggests, designing a program for social interventions to increase beneficial biking requires a combined or multi-step approach. Moreover, the relatively good prediction power of social acceptance (attitude, perceived behaviour, norms) about sustainable development confirms the fact that change in each of these components can exert an impact on sustainable urban development. Therefore, attention to the enrichment of sports-based leisure time among different classes of society, especially university students as cultural advocates in social environments, can lead to the promotion of favourable behaviour among other people.

Development of sport infrastructure among university students and attention to the bicycle as a facilitating tool can provide the basis for sustainable urban development in terms of financial resources, environment, health development, and transportation. The bicycle is a vehicle that (other than its application for recreational purposes and competitions at universities to grant special privileges to cyclists) can be employed as a means of transportation that not only does not pollute the air but also engenders a healthy lifestyle. Continued use of bicycles among university students and the staff cultivates the culture of bicycle use for other members of the community, because these people inevitably influence their families. In contrast, providing and maintaining favourable conditions for bicycles and cyclists leads to sustainable development at the community level.

In the present study, it has been concluded that perceived behaviour as an external factor plays a significant role in social acceptance, and encouragement of the individual by family, friends, acquaintances, and other significant people, and thus plays an essential role in bicycle use acceptance. Since people have more leisure time nowadays in comparison to the past, they can plan to improve their mental and physical condition during those times. Therefore, use of leisure time to engage in enjoyable activities is vital. University students, as a vital category of society who play a central role in the creation and promotion of culture and as future planners for the community, must be provided with the initial support, and have high-quality leisure time themselves.

Bicycles as public transportation could be valuable in the decision-making processes of leaders in sport, in particular. If events are cancelled without a risk assessment being done, the social and economic consequence of cancelled events may prove costly, both human and financial (Parnel et al., 2020). In the present study, the researcher concluded that perceived behaviour as an external factor plays a significant role in social acceptance, and encouragement of the individual by family, friends, acquaintances, and other important people plays a major role in bicycle use acceptance. This factor, in turn, influences the role of internal factors among influential factors on social acceptance. Internal factors, such as the norms in society about which people have their perceptions in different situations, as well as the attitude of people in all the behaviours they demonstrate, coupled with the lack of infrastructure and the idleness of individuals in some cases, all result in the failure to use bicycles. However, this can be compensated through encouragement to use bicycles, and will ultimately lead to the promotion of cycling culture. The expansion of this culture will increase demands and infrastructure for bicycle use and even create jobs, and the continuation of this process will result in the conservation of fossil and financial resources, and will greatly contribute to the preservation of the environment. The impact of COVID-19 on sport will take some time to play out. While, the evidence base is still developing on the infectious disease transmission during sport events (Memish et al.,2019), it is likely that any forthcoming event will attract intensified media interest, which will impact public and political perceptions and expectations (Closkey et al., 2020), whether in 2020 or 2021 and beyond. Therefore, as we look forward, it is appropriate for sport leaders and authorities to examine new WHO recommendations for mass gatherings.

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SportMont

ORIGINAL SCIENTIFIC PAPER

# Electromyography Comparisons of Lower Extremity Muscles during Maximum Velocity Instep Soccer Kicks

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**Abstract**

This study was conducted to compare the muscle activation of selected lower extremity muscles during maximum velocity instep kicks and establishing a relationship between muscle activation and ball velocity. Thirty-three male subjects were recruited for the study, and muscle activity of the rectus femoris, vastus lateralis, biceps femoris and tibialis anterior of both the kicking leg and the supporting leg was recorded. A significant difference was found between the muscle activation of selected muscles ($F(7,256) = 20.63$, $p<0.001$, partial eta squared $=0.361$). Further analysis revealed that the tibialis anterior of the supporting leg had the highest muscle activation during instep kicks. The study also revealed higher muscle activity in the biceps femoris of the kicking limb. A Pearson product-moment correlation found a negative relationship between the vastus lateralis of kicking leg and ball velocity ($r=-0.454$, $p=0.008$). The study concludes that the ankle muscles of supporting legs are responsible for absorbing and resisting the external force from the ground during instep kicks; it also demonstrates greater activation among all muscles. Greater muscle activity is shown by biceps femoris in the kicking leg; therefore, strengthening exercises for ankle and hamstring muscles are necessary and should be included in training sessions of soccer players.

***Keywords:*** *electromyography, maximum velocity, soccer, instep kick, analysis*

## Introduction

The total of 210 men and 155 women soccer team rankings in the FIFA/Coca-Cola World Ranking shows the popularity of soccer around the world. The rising popularity of soccer has also increased the number of research studies being conducted to enhance the performance of the players. The instep kick is one of the most important skills to be studied in soccer (Kellis, Katis, & Gissis, 2004). There are many different types of kicks in soccer, based on the type of players, position and velocity during contact, and the intention of making a new move. Of these, the most reported version of a kick in soccer is the maximum velocity instep soccer kick with the static ball (Kapidzic, Huremović, & Biberovic, 2014).

Electromyography (EMG) is a developing field of study in dynamic actions related to sports, in which muscle activity is investigated during specific technique execution; this analysis of muscle activity in technique in soccer may lead to novel evidence that might have been deficient from the literature. Many researchers have conducted studies in muscle activity during the soccer instep kick, such as Dörge et al. (2007) who studied EMG activity of iliopsoas muscles during soccer place kick and attempted to relate it with the kinetics involved. Brophy, Backus, Pansy, Lyman and Williams (2007) examined the muscle activity of nine lower extremity muscles of kicking limb and seven in supporting limb during instep kick and side-foot kicks. Scurr, Abbott and Ball (2011) recruited six soccer players to examine muscle activation in the vastus lateralis (VL), vastus medialis (VM) and rectus femoris (RF) of kicking leg during soccer kicking at four different targets. Cerrah et al. (2011) selected the RF, VL, VM, BF, and gastrocnemius of

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the kicking leg and compared the muscle activation pattern in professional and amateur players, while Thapa, Kumar, Sharma, Rawat, and Narvariya, (2019) studied the muscle activation of four lower limb muscles of both kicking limb and supporting limb when kicked from different approach angles. All these studies were reviewed by the authors of the present paper and resulted in the conclusion that most of the studies conducted in EMG used muscles of the kicking limb, and that studies that included muscles of supporting leg did not report the contribution of ankle muscles (tibialis anterior) of the supporting limb. The previously mentioned studies also lacked an overall comparison between the contribution of muscles of kicking and supporting leg during instep kick.

This study was conducted with a purpose of identifying the muscle, (among vastus lateralis, rectus femoris, biceps femoris and tibialis anterior of kicking and supporting leg) whose contribution is the highest during maximum velocity instep soccer kick, irrespective of the role of the leg (kicking or supporting). A separate analysis was also conducted among those four muscles for the contribution of muscles in the kicking leg and supporting leg.

## Method

*Subjects*

In this study, 33 male university soccer players who were right-foot dominant were included (age 21.2±2.3 years, height 171.9±7.8 cm and body mass 66.2±6.9 kg). Limb dominance was selected by asking the subjects about which foot they would prefer to kick the ball for maximum velocity (Thapa et al., 2019). The subjects had a minimum playing experience of six or more years during the collection of data. Only physically active players were selected as subjects, who had no recent records of lower extremity, spinal or neurological injury which could limit the maximum velocity kick. The subjects were asked to sign written consent forms before data collection, and the procedure for EMG recording was thoroughly explained to them. The Lakshmibai National Institute of Physical Education's departmental research committee approved the conduct of the study in conformity with the Helsinki Declaration.

*Procedure*

As a part of the warm-up, the subjects performed five minutes of dynamic stretching (Scurr et al., 2011) followed by a few short sprints. Rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF), and tibialis anterior (TA) of both the kicking leg and supporting leg (Thapa et al., 2019) were selected for the electromyography study. The SENIAM (Surface Electromyography for Non-Invasive Assessment of Muscle) group's recommendations were followed for the procedure of electrode placement in the muscles. Wireless surface electromyography with eight channels (BTS FREEEMG, S.P.A., Italy) was used for the acquisition of EMG signals from the selected lower extremity muscles.

The ball velocity of an instep kick was measured using a Doppler radar gun (Bushnell, USA) with ± 2 kph error (Figure 1). The radar gun was positioned three metres behind the goal (Sterzing & Hennig, 2008). The ball used was the FIFA-approved Adidas Capitano, and a pressure of 1.0 atmospheres was maintained throughout the data collection. A two-step approach run with an approach angle selected by the subject was allowed for the kick. A total of three trials was performed by each subject for maximum velocity, and a rest period of 30 seconds was allowed in between each trial. The trial with maximum velocity was selected for the study.

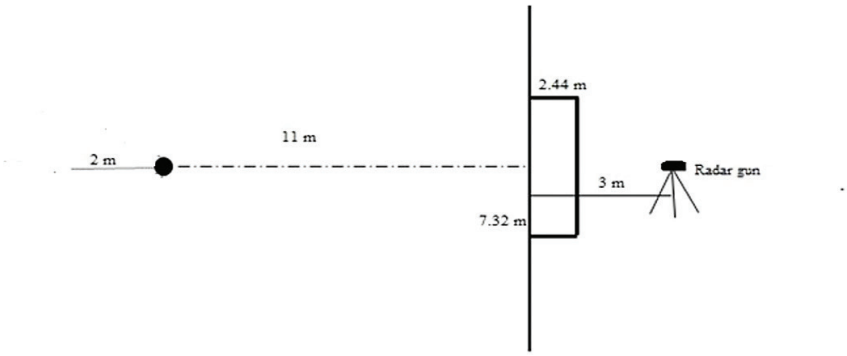


FIGURE 1. Set up for maximum ball velocity instep kicking and EMG recording

*Data analysis*

Analysis of the EMG signals was carried out in BTS EMG-Analyzer software (version 2.9.40.0). The EMG signals were bandpass-filtered using the Butterworth smoothing technique with a lower cut-off frequency of 20 Hz and higher cut-off frequency 400 Hz. A fixed window of 100 ms was used to calculate the RMS (root mean square) value of the signals. The normalization of the EMG signal was carried out by using peak activation of each muscle recorded during the instep kick (Halaki & Gi, 2012).

*Statistical analysis*

IBM SPSS (version 20.0.0) software was used for statistical analysis of the acquired data. The Shapiro-Wilk test detected normal distribution of the data, and parametric tests were thus applied. One-way ANOVA was conducted to compare muscle activation in the lower extremity (including muscle activation in both kicking leg and supporting leg), and separate one-way ANOVAs for kicking leg and supporting leg were also performed. A post-hoc test was conducted using the Games Howell test because the data violated the assumption of homogeneity of variances. The effect size was estimated using partial eta squared, with a value of 0.01 defining small, 0.06 defining a medium, and 0.14 defining a large effect size (Cohen, 1988). A Pearson product-moment correlation was used to study the relationship between muscle activation of different muscles

and ball velocity, and the correlation coefficient (r) was determined. A correlation value of r=0.10 meant low correlation, r=0.30 meant medium correlation, and r=0.50 meant a higher correlation (Cohen, 1988).

## Results

A one-way ANOVA aimed at comparison of normalized muscle activity of all the muscles involved in instep kicks revealed significant differences in muscle activity among various lower extremity muscles (F (7,256) = 20.63, p<0.001, partial $\eta^2$ =0.361; Table 1). A Games-Howell post-hoc test further revealed significant differences between rectus femoris and biceps femoris of kicking leg (p=0.002), rectus femoris of kicking leg and biceps femoris of supporting leg (p<0.001), biceps femoris of kicking leg and rectus femoris of supporting leg (p=0.004), biceps femoris of kicking leg and vastus lateralis of supporting leg (p=0.001), biceps femoris, tibialis anterior, rectus femoris, vastus lateralis of kicking leg and tibialis anterior of supporting leg (p<0.001).

**Table 1.** Mean and standard deviation of muscle activity of selected muscles of kicking and supporting leg

| | KRF | KVL | KBF | KTA | SRF | SVL | SBF | STA | p (Kicking Leg) Partial $\eta^2$ | p (Supporting leg) Partial $\eta^2$ | p (overall) Partial $\eta^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean ± SD | | | | | | | | | | |
| **Muscle activation (% of Peak activation)** | 19.73 ±2.74 | 21.50 ±3.23 | 23.13 ±3.63 | 21.85 ±4.65 | 19.96 ±2.69 | 19.47 ±2.89 | 24.11 ±4.13 | 28.05 ±4.52 | 0.003* (0.485) | 0.000* (0.104) | 0.000* (0.361) |

Legend: *denotes significant differences at 0.01 level of significance; SD: standard deviation; RF: rectus femoris; VL: vastus lateralis; BF: biceps femoris; TA: tibialis anterior; K: kicking leg; S: supporting leg.

Likewise, further analysis of the muscle activation using one-way ANOVA showed (Table 1) significant differences between selected muscles in the kicking leg (F (3,128) =4.929, p=0.003, partial $\eta^2$ =0.485) as well as in the supporting leg (F (3,128) =40.142, p<0.001, partial $\eta^2$ =0.104).

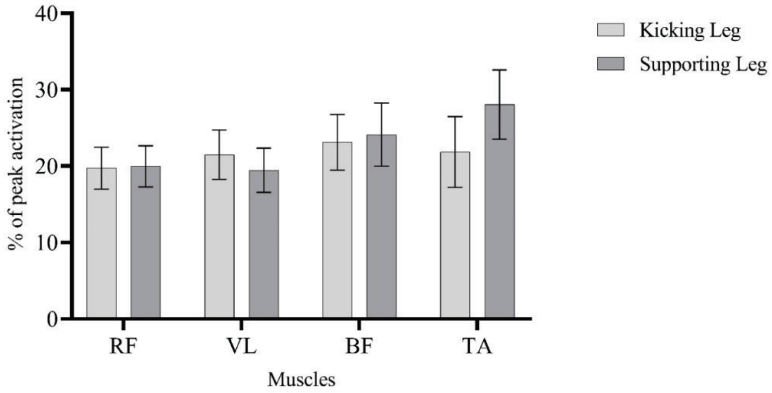


FIGURE 2. Normalized muscle activation of rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF), and tibialis anterior (TA) of kicking leg and supporting leg

While, product-moment correlation revealed a negative correlation between vastus lateralis of kicking leg (KVL) and ball velocity (r=-0.454, p=0.008), there was no significant correlation between ball velocity and other activation of the muscles.

**Table 2.** Correlation table of muscle activity of selected muscles of kicking and supporting leg with ball velocity

| | KRF | KVL | KBF | KTA | SRF | SVL | SBF | STA |
|---|---|---|---|---|---|---|---|---|
| **Ball Velocity (r)** | -0.279 | -0.454** | 0.004 | -0.031 | -0.222 | 0.045 | -0.211 | -0.084 |
| **p-value** | 0.115 | 0.008 | 0.981 | 0.862 | 0.214 | 0.803 | 0.237 | 0.641 |

Legend: **denotes significant differences at 0.01 level of significance

## Discussion

The main objective of the study was to determine the muscle that contributed the most during the maximal velocity instep kick. A significant difference with large effect size was observed between muscle activation of different muscles involved in the study. The findings of this study showed maximum contribution by the tibialis anterior muscle of the supporting leg during the instep kick. Since no earlier studies have been found for muscle activation of the tibialis anterior of supporting limb during instep kick, comparisons could not be made based on muscle activity. However, studies had been conducted on the biomechanical aspects of the instep kick, which reported the supporting leg (Inoue, Nunome, Sterzing, Shinkai, & Ikegami, 2014; Katis & Kellis, 2010; Kellis et al., 2004). These studies reported that the ground reaction force received by the supporting leg was two times the bodyweight of the subjects. Likewise, Inoue et al. (2014) reported two major roles of the supporting leg in their research findings: (1)

resisting the large external force to stabilize the body and (2) transferring of mechanical energy to the proximal segment, thus contributing to a proximal-distal sequential motion of the kicking leg. One of the results from that study showed that in most support leg joints, the joint motions were not counteracted by joint moments and also were not associated, which may be the reason for the lower contribution of thigh muscles of supporting leg. A similar result was also obtained in our study in which vastus lateralis, rectus femoris and biceps femoris were less active than the tibialis anterior muscle. The previously cited study (Inoue et al.2014) also reported that the ankle joint did not exhibit positive power during the support phase, and thus it was interpreted that the ankle joint absorbs the large external force from the ground. Tibialis anterior is one of the major muscles of the ankle joint and, therefore, may be responsible for absorbing and resisting the external force from the ground, and thus supports the finding of the studies conducted on the biomechanical aspect of the support leg during the instep kick.

The second objective was to find out the muscle of the kicking limb, which contributed the most during the maximum velocity soccer kick. Large effect differences were also observed in comparisons of muscle activation of the kicking limb. During the instep kick, the biceps femoris of the kicking leg displayed the maximum contribution. Earlier EMG studies in instep kick did not include biceps femoris muscle for amplitude comparisons, and only one study was found (Cerrah et al., 2011) which included biceps femoris of kicking limb in its study; however, the study was confined to patterns of muscle activity during different phases of the soccer instep kick, and no comparisons were made between the muscle activity during the kick. Cerrah et al. (2011) reported that biceps femoris was activated early during the kick action, which might contribute to the horizontal propulsion provided by the hip extension (Lees et al., 2009), and later muscle activity increased after the impact with the ball. A detailed observation over the graph of rectus femoris, vastus lateralis, and biceps femoris activation presented by Cerrah et al. (2011) may result in the conclusion that the biceps femoris peak resembles plateau at near 70-80 % MVIC, and the graph is constant with fewer fluctuations. However, in the graph of the rectus femoris and vastus lateralis, the peaks are sharp and fluctuate heavily throughout the kicking movement. This graph partially supports the findings of our study, in which we can observe the differences in muscle activity patterns between the three muscles.

The third objective of the study was the relationship between muscle activation and ball velocity. The results revealed a negative relationship between the activity of vastus lateralis of kicking leg and ball velocity. Due to the lack of studies in this field, the authors of the present paper are uncertain about this finding, and more research is required to determine the cause.

The findings of this study revealed activation of tibialis anterior of the supporting leg to be the highest among other muscles of both kicking and supporting legs during maximum velocity instep kicks; also, in the kicking leg biceps femoris showed higher activation, which might be a reason for a greater number of ankle and hamstring injuries in soccer players. Players especially amateurs and those in the developmental phase often neglect ankle and hamstring muscles strengthening exercise, and are prone to injuries. This study provides sufficient evidence for coaches to include strengthening ankle and hamstring muscles in their training plan and encourage players to actively involved in it.

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**Conflict of Interest**
The authors declare the absence of conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

# What is the Motivation to study Laws of the Game and Competition Rules in National Portuguese Football Referees?

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**Abstract**

The success of soccer referees is linked to several skills, including game knowledge, communication, strategic leadership, physical fitness, and psychological ability. During the game, referees make between three and four decisions per minute, paying attention to the multiple aspects of the game, which generates pressure and stress, meaning that the referees must master the laws of the game and competition rules (LGCR). The present study aims to understand the state of the motivation of Portuguese referees to study the LGCR and the dimensions that affect this motivation. One hundred and seventy-nine referees completed the Academic Motivation Scale, adapted to football arbitration, in order to assess amotivation, extrinsic motivation, and intrinsic motivation. Data were treated applying several statistical techniques that highlight multiple linear regression, which enabled testing a measurement model of the motivation of the referees to study and learn the LGCR according to the research objectives stated. The results show that although most of the members are motivated to study the LGCR, there is a small group that presents a deficit in motivation. The multiple linear regression model showed that referees are more intrinsically motivated than extrinsically, showing that they can motivate themselves more than to undergo external influences. A central finding of the paper is that the football referees show a high degree of autonomy, self-control, and determination to study the LGCR.

***Keywords:*** *academic motivation scale, amotivation, intrinsic motivation, extrinsic motivation, laws of the game, competition rules, football referees*

## Introduction

Several factors influence the process of learning a specific skill or subject of knowledge; one of the most predominant of these is motivation (Deci & Ryan, 2012). Motivation is closely related to the intensity, direction, strength, and frequency of a particular type of behaviour to achieve a particular goal (Reeve, Jang, Carrell, Jeon, & Barch, 2004). The motivation to learn is usually addressed in the literature through the use of scales based on the Self Determination Theory (SDT) of Ryan and Deci (2000). Consequently, the learning process primarily results from the motivation to study, and previous research has revealed that there is a three-dimensional approach resulting from the relationship between amotivation (AMOT), intrinsic motivation (IMOT), and extrinsic motivation (EMOT) (Eryilmaz & Mammadov, 2016).

Motivation is considered one of the critical indicators for individuals to succeed in the learning process, boosting efforts through the intrinsic and extrinsic motivation to reach

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a particular goal (Martin, 2008). Motivation may arise in many ways, but it is usually divided into IMOT (individual desire to achieve something important) and EMOT (a kind of external motivation promoted by others) (Vallerand & Blssonnette, 1992). The motivation to learn results from the SDT continuum and comes from these two types, but can be affected by a third dimension: AMOT ( Siemens, Smith, Fisher, Thyroff, & Killian, 2015). An intrinsically motivated individual is one who is engaged in learning for the pleasure it gives him, and because he feels self-actualized in that manner. Contrarily, an extrinsically motivated individual is one who seeks to accomplish less difficult tasks needing to undergo external impulses to motivate himself (Lizzio, Wilson, & Simons, 2002). In this sense, the motivational constructs are related with to the expectation and to the value being that the first ones that allow a greater use (Cerasoli & Ford, 2014). The expectations of individuals about their intelligence and attitude toward success and failure, as well as the influence of past experiences, influence the performance and therefore impact the learning experience (Richardson, Abraham, & Bond, 2012). Success in learning arises through the combination of the individuals' cognitive ability and motivational will, that is influenced by the effort expended and the degree of involvement (Lucas & Meyer, 2005).

Motivation is a dynamic phenomenon that can be measured in different ways according to the people who experience it, being influenced by the expectations and learning perceptions of each individual (Henderson-King & Smith, 2006). According to the SDT continuum, AMOT is the dimension with a lower degree of self-determination, autonomy, and sense of control because it refers to the motivation of an individual to perform a given task, EMOT refers to external motivation to promote concretization of an objective, and finally IMOT as the form of motivation with a higher degree of self-determination, autonomy and sense of control as it occurs when a specific individual engages in an activity by choice and personal interest (Ryan & Deci, 2000a). In this sense, being intrinsically motivated, the quality of behaviour is more positive than being extrinsically motivated (Deci & Ryan, 2000). When the satisfactory performance of a given task is evidenced, and no extrinsic motivation is necessary to leverage behaviour to the extent that the existence of incentives, the individual feel intrinsically involved (Dysvik, Kuvaas, & Gagné, 2013). The concept of AMOT proposed by Deci and Ryan (1985) emerged in order to understand human behaviour better, relating it to the conditions of discouragement, indifference, disinterest, self-disrepute or depression (Barkoukis, Tsorbatzoudis, Grouios, & Sideridis,, 2008). Thus, AMOT reflects a state of unwillingness to accomplish a particular task because individuals do not feel capable of or interested in achieving a goal (Ryan & Deci, 2000c). This highlights that there is a lack of expectation between actions and results since the subject shows little interest in dealing with a task, showing disbelief in the outcome as a result of the feeling of disability and incompetence (Ryan & Deci, 2000b). In this sense, Deci and Ryan (1985) also revealed that AMOT stems from the regularity of failure, which means that it is assumed that the desired outcome is unattainable, or the result of negative feedback.

The IMOT measures the degree of commitment with a task in which internal reasons, curiosity and the challenge: in essence, participation in which the task is an end in itself intrinsically related to the will of the individual (Pintrich, 2003). This type of motivation is related to involvement in activities for personal reasons for which feelings of pleasure increase participation (Cerasoli & Ford, 2014). IMOT is composed by the Intrinsic Motivation for Knowledge (To Know - IMTK), Intrinsic Motivation for Realization (To Accomplish - IMTA) and Intrinsic Motivation for Experimenting with Stimulation (To Stimulate - IMTS) (Deci & Ryan, 2008).

EMOT is related to the degree of participation of an individual in a given task, not by his own will but for external reasons, rewards, advantages related to his performance, or competition, being the learning a mean to achieve a particular purpose or goal previously delineated (Deci & Ryan, 2000). EMOT comprises four levels that are presented in the SDT Continuum in a growing form of self-determination through Extrinsic Motivation External Regulation (EMER), Extrinsic Motivation Introjection (EMIN) and Extrinsic Motivation Identification (EMID) (Deci, Koestner, & Ryan, 2001).

Motivation is one of the factors that can influence the individual ability to achieve success, increasing general well-being and professional achievement (Froiland, 2011). In this sense, reducing the levels of amotivation is essential for results, and there is a need to focus motivation in the learning process to achieve goals (Kim & Pekrun, 2014). Based on this theoretical background, it seems necessary to understand the levels of motivation of the Portuguese referees of the national championships to study LGCR, and which dimensions directly affect this motivation. In order to respond to the defined objective, two research questions were defined:

- What is the motivation of the Portuguese referees to study the LGCR?
- What are the dimensions of motivation that directly influence the will to study?

## Methods

### *Participants*

One hundred and seventy-nine referees aged between 20 and 44 years old (72% males/28% females) participated in this study. The referees filled the AMS scale during the recycling and evaluation actions, performed every year at the beginning of the season, aiming to evaluate the technical and physical performance of referees. Additionally, referees receive information about the guideline procedure in order to standardize performance criteria. Informed and written consent was provided to the referees before the beginning of the study. All participants were notified that they could withdraw from the study at any time. The study protocol followed the guidelines and was approved by the Local Institutional Research Ethics Committee and conformed to the recommendations of the Declaration of Helsinki.

### *Procedure*

A quantitative study was carried out, collecting data through a questionnaire survey using the AMS scale of Vallerand et al. (1992) adapted for arbitration. The AMS has been translated and adapted to test the motivation of Portuguese referees that perform at the Portuguese national level. In that sense, the main issue of the original AMS "Why do you go to college?" Has been translated and adapted to "Why would I spend my time studying Laws of the Game and Competition Rules (LGCR)? The 28 items of the scale

were translated and adjusted to be used in referees whose learning context was LGCR (Table 1). The adaptation of the scale did not require many changes, and it was adapted to the desired context, using almost equal affirmations in practically all the questions. The original AMS 7-point Likert scale, which varies from "Not fully corresponds to" and "Matched in full", was maintained, as well as all variables belonging to AMOT, EMOT, and IMOT.

*Statistical analysis*

The data were treated with the SPSS software 24, applying several statistical techniques that highlight Linear Regression Multiple (LRM), which enabled testing a measurement model of the motivation of the referees to study and learn the LGCR according to the research objectives (João Marôco, 2010). The use of MRL will enable estimating the value of the dependent variable Intrinsic Motivation to Learn LGCR (IMTK) according to the independent variables EMER, EMIN, EMID, IMTA, IMTS, and AMOT. The objective is to find the best possible and statistically significant relationship between variables to estimate the model that best explains the motivation. To evaluate the model, we will use adjustment quality measures such as the Pearson R correlation coefficient, the R2 determination coefficient, the adjusted R2, the Variance Inflation Factor (VIF) and the Durbin-Watson test (Marôco, 2014).

The study of the group was developed using a research model based on the following model:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon_i,\ i=1,2,\ldots,n$$

The use of SPSS software enabled us to determine which of the introduced independent variables should be included in the regression equation. In this study, IMTK will be used as the dependent variable in the linear regression and the independent variables AMOT, EMER, EMIN, EMID, IMTA, and IMTS. The model of investigation defined was:

IMTK = B0 + B1 AMOT + B2 EMER + B3 EMIN+ B4 EMID + B5 IMTA + B6 IMTS + ε

## Results

The response options provided through the Likert Scale ranged between 1 to 7, with an average of 4 for a subscale means that the affirmation stated moderately, between 5 and 6 corresponds very much, and 7 corresponds completely. Thus, for the EMOT and IMOT scales, a score equal to or greater than four points represents that the students are more motivated. In contrast, a high score on the AMOT scale means that students are less motivated because the scale, in terms of punctuation, is analysed and defined in an inverse way to that of the EMOT and IMOT scales. Tables 1, 2, and 3 present the results related to the descriptive statistic regarding the motivation to study LGCRs, in relation to the AMOT, EMOT, and IMOT dimensions.

In general, results showed that referees are motivated to study, because mean amotivation rates are very close to the lower limit of the scale. This result was expected since mastering the laws is key to a successful career of any referee. However, an in-depth analysis shows that some responses reveal some lack of motivation (Table 1).

**Table 1.** Amotivation

| Likert | AMOT 1 | AMOT 2 | AMOT 3 | AMOT 4 |
|---|---|---|---|---|
| 1 | 160 | 167 | 169 | 157 |
| 2 a 3 | 16 | 9 | 7 | 17 |
| 4 | 1 | 0 | 2 | 1 |
| 5 a 6 | 2 | 1 | 0 | 3 |
| 7 | 0 | 2 | 1 | 1 |
| Mean | 1.17 | 1.15 | 1.11 | 1.22 |
| Total | 179 referees (α=0.858) | | | |

In fact, when the referees are asked about "Honestly, I do not know. I feel it is a waste of time to study LGCR", it turns out that at least 19 referees agree that it is a waste of time to study the LGCRs, and 3 out of these 19 even consider that this statement corresponds moderately or very much to their opinion. Regarding the statement, "I cannot understand why I should study LGCR and frankly I do not want to know", related to the perception of the referees about the importance of the study, it is verified that 12 referees assume not to realize the importance of this study and 3 of these referees cannot understand any importance of studying. As for the statement "I do not know. I cannot understand what I am doing in the arbitration", which is related to what the referees consider to be doing in the arbitration, it was verified that 10 consider that they do not understand their role within the sector, and that 3 of these referees even consider that they are doing nothing in the industry. Finally, regarding the statement "I'm not sure. I cannot see how LGCRs can be of any value to me", we note that 4 referees fail to glimpse the importance of LGCRs for their career, with 1 of these referees being sure that they are not important.

A general analysis enables us to verify that the vast majority of the 179 referees surveyed are motivated to study LGCRs, but about 10% reveal some lack of motivation for the study of LGCRs as a way to be better referees in the future. This result demonstrates the need to adopt new measures and strategies that aim to reduce as much as possible the amotivation evidenced by this minority.

The average values obtained in the three types of extrinsic motivation are between 3.61 and 6.24; thus, referees are generally extrinsically motivated to study the laws of the game, showing results in the lower limit of scale that represent low extrinsic motivation (Table 2).

The overall results show that there are external factors that motivate referees to study the LGCRs, engaging in the study of third-party influences. However, as already mentioned in the previous scales, it is necessary to understand if there are individual situations in which EMOT does not meet the average standards already presented. A more in-depth analysis showed that some referees are not extrinsically mo-

**Table 2.** Extrinsic Motivation

| Likert | EMER 1 | EMER 2 | EMER 3 | EMER 4 | EMIN 1 | EMIN 2 | EMIN 3 | EMIN 4 | EMID 1 | EMID 2 | EMID 3 | EMID 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 1 | 24 | 33 | 16 | 10 | 25 | 6 | 2 | 1 | 1 | 1 |
| 2 a 3 | 19 | 7 | 26 | 48 | 43 | 24 | 42 | 10 | 3 | 4 | 4 | 2 |
| 4 | 35 | 15 | 29 | 40 | 33 | 37 | 27 | 26 | 17 | 13 | 7 | 7 |
| 5 a 6 | 78 | 97 | 72 | 47 | 75 | 90 | 66 | 87 | 87 | 99 | 99 | 79 |
| 7 | 40 | 56 | 28 | 11 | 12 | 18 | 19 | 50 | 70 | 62 | 68 | 90 |
| Mean | 5.06 | 5.76 | 4.45 | 3.61 | 4.20 | 4.77 | 4.11 | 5.41 | 5.90 | 5.92 | 6.03 | 6.24 |
| Total | 179 referees (α=0.810) | | | | 179 referees (α=0.887) | | | | 179 referees (α=0.863) | | | |

tivated to study and learn the LGCR. This result is not unexpected since the refereeing career is markedly individual, creating in the referee a habit of managing his motivation and of achieving individually, without much external interference. In this sense, it is crucial to understand the individual values reported by the referees regarding the various dimensions of EMOT. Relatively to the extrinsic external regulation motivation (EMER), recognition for performing with the objective of avoiding possible punishments or obtain advantages/rewards of the accomplishment task, not all referees have been shown to be influenced by external factors. Regarding the statement "Because if I do not get a good grade, I will not be able to be a better referee in the future", we find that 26 referees do not consider a good grade in a written test as an important external factor that convinces them to apply it, in the study of LGCR.

Regarding the question "To achieve a career with more prestige in the future", only 8 referees show that they are not influenced extrinsically by the preponderance of the LGCR study in their future career. Concerning the statement "Because I want to have a better life in the future", a surprising 50 referees say that the influence of studying LGCR and its career consequences are not related to the fact that they want to have a better life in the future because about 28% say that having this life better is not an external influence capable of changing their attitude. Finally, in relation to the statement "To have a better future salary", 101 referees reveal that money is not an external influence capable of convincing them to apply themselves more in the study of the LGCR. This last result is not surprising, because several studies have shown that the main reasons to the continuation of their career are the passion for the arbitration, the social aspect, and the possibility of maintaining healthy physical activity (Johansen, 2015).

The introjection extrinsic motivation (EMIN) results, which have a higher degree of internalization than EMER, showed the individual acts more by obligation than by his own will. Thus, their behaviour does not result from their own choices but from the pressure of others. In the analysis of the affirmation of the questionnaire "Because when I do everything that is related to the LGCR, I feel important", 59 referees revealed that doing everything right in relation to the LGCR does not influence them to have a feeling of importance, which reveals that the LGCRs for these referees are not preponderant to their visibility as referees. Regarding the statement "Because I want to show to others (managers, coaches, colleagues, family, friends) that I can be good in LGCR", this kind of extrinsic motivation coupled with the need to show third-party skills is something that is associated with the referees because they are constantly being evaluated. However, 34 referees have revealed that the opinion of these people is not essential for them to be motivated to study the LGCR. Some referees even reveal that these people do not have any influence on their willingness to perfect their skills in the study of LGCR. The analysis of the statement "To show to myself that I am an intelligent person" showed that 67 referees do not see any relation between the study of the LGCR and this conclusion. However, 37.5% revealed that they did not need to show anything themselves related to the LGCR domain. The last statement of the EMIN dimension was "Because I want to show to myself that I can do everything that is related to the LGCR", which showed that 9% of referees who responded to the study considered that mastering LGCR is irrelevant.

Extrinsic motivation by identification (EMIN) occurs when the individual identifies with the activity that will be performed, demonstrating a high degree of self-determination, sense of control and autonomy in the actions. Regarding the study of the LGCR, this can occur when the referees identify with the activities inherent to the study, accepting them voluntarily by regulating their behaviour to perform them properly (Deci et al., 2001). This is the closest dimension of IMOT's motivation, so the degree of self-determination and autonomy becomes stronger.

Regarding the statement "Because I think the LGCRs can help me better prepare for my future career as a referee", we find that only 5 referees have shown that they are not influenced to study LGCRs when they think it might be in their best interests. Regarding the statement "Because studying LGCR will be useful in the future" and in line with the previous one, only 5 referees stated that they did not allow themselves to be influenced by the usefulness of the LGCR in their future sport. In the same line, the statement "Because I believe that the LGCR will improve my competences", only 5 referees considered that the study of the LGCR does not interfere in the improvement of their competences as a referee. Finally, the statement "Because what I will learn in LGCR will be of great use throughout my career as a referee", presents the best results of extrinsic motivational influence by identification, since only 3 referees considered that learning LGCR is not very useful for your career. The obtained results in the EMID dimension are in agreement with the literature that affirms that this type of EMOT is the one that is most related to the individual motivation (IMOT) of an individual to perform an activity in an autonomous and self-determined way (Vansteenkiste, Lens, & Deci, 2006).

On the IMOT scale, higher results are linked with more

**Table 3.** Intrinsic Motivation

| Likert | IMTK 1 | IMTK 2 | IMTK 3 | IMTK 4 | IMTA 1 | IMTA 2 | IMTA 3 | IMTA 4 | IMTS 1 | IMTS 2 | IMTS 3 | IMTS 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 3 | 2 | 2 | 5 | 1 | 3 | 1 | 5 | 3 | 12 | 15 |
| 2 a 3 | 14 | 21 | 4 | 11 | 12 | 14 | 1 | 15 | 10 | 14 | 30 | 32 |
| 4 | 32 | 27 | 16 | 18 | 21 | 22 | 6 | 21 | 32 | 23 | 40 | 40 |
| 5 a 6 | 102 | 99 | 110 | 105 | 112 | 99 | 80 | 98 | 105 | 116 | 86 | 84 |
| 7 | 31 | 29 | 47 | 43 | 29 | 43 | 89 | 44 | 27 | 23 | 11 | 8 |
| Mean | 5.34 | 5.18 | 5.76 | 5.58 | 5.29 | 5.53 | 6.18 | 5.51 | 5.21 | 5.25 | 4.43 | 4.30 |
| Total | 179 referees (α=0.850) | | | | 179 referees (α=0.800) | | | | 179 referees (α=0.833) | | | |

intrinsically motivated referees to study LGCR. The mean values ranged from 4.30 to 6.18, showing referees to be intrinsically motivated to study game laws (Table 3), which means that the referees study the LGCR of their own free will, engaging in the study for personal reasons and for pleasure.

Regarding the IMTK, when referees are questioned about "Because I feel pleasure and satisfaction when learning new things related to LGCR", we have verified that 14 referees say that this statement does not correspond or corresponds little of what they feel. Every year there are news and changes in the LGCR; thus, it is not positive that 8% of the referees who are not interested in these contents. The statement "For the pleasure that I have when I discover new things related to the LGCR that I had never learned before", the results are in line with the previous answers, showing that 24 referees indicate that they do not feel any pleasure in learning new things related to the LGCR. When the question is related to "For the pleasure I have in improving my knowledge about LGCRs" it turns out that 6 referees reveal that they have no pleasure in being better at LGCRs, revealing that improving knowledge in this area does not give them any motivational feeling. Finally, with regard to "Because studying LGCR allows me to learn many things about this area" 13 referees say that studying the LGCR does not allow them to learn something about the area revealing that it is not the LGCR that will make them know more nor interfere in their performance.

Relatively to the Intrinsic Motivation for Realization - To Accomplish - (IMTA) the analysis of the affirmations allows us to verify the desire of the referees to perform a certain activity for the pleasure and satisfaction felt. The question "For the pleasure and experience in overcoming myself in the learning of the LGCR" showed that 17 referees refer to not having great pleasure in the learning of the LGCR. The responses to the statement "For the satisfaction I feel when I solve difficult issues related to LGCRs" showed that 15 referees have not shown any satisfaction to know how to solve LGCR questions. However, when they are asked about "Why I want to realize from LGCR" only 4 referees refer that it is not important to realize. When we address the question "Because I feel great personal satisfaction if I understand LGCR" we find that there are 16 referees who do not feel any personal satisfaction in understanding LGCR. In relation to the Intrinsic Motivation to Experience Stimulate - To Stimulate - (IMTS) that measures the desire to perform an activity that stimulates the individual that dedicates to it, we find that the referees present individualized results.

Regarding the statement "For the pleasure and motivation I experience when I communicate to others ideas about LGCRs," it turns out that 15 referees do not assume any sense of pleasure and motivation in communicating ideas to their peers about LGCRs. Regarding the statement "For the pleasure I experience when I learn how things work due to the interference of the LGCRs", 17 referees do not give importance to the experience of learning from the domain of the LGCR nor feel any pleasure in this experience. The response to the statement "For the pleasure I experience when I feel completely absorbed in what the leading authors who have studied LGCR wrote" shows that 23% of the referees who stated that everything they read about LGCR does not give them any pleasure. The statement "Because of the high feeling I experienced when I read several interesting studies on LGCR", shows similar results, with 47 referees reporting that reading studies related to LGCRs does not cause them any impact and/or positive motivation.

A general analysis of IMOT allows us to verify that the vast majority of the 179 referees questioned are intrinsically motivated to study the LGCRs, but when we study individually each type of IMOT we conclude that although the overall mean is quite positive, there are individual values that should be carefully analysed.

The analysis of the three types of IMOT shown the lower results, between 4.30 and 5.25, revealing that 17% of referees presented low intrinsic motivation to study LGCR. The higher results presented by IMTK and IMTA, between 5.18 and 6.18, show that the referees have the motivation to improve their knowledge about LGCR.

Finally, we conclude that IMOT and its dimensions have acceptable mean positive results despite some individual cases of very low intrinsic motivation for the study of LGCR.

The LRM results presented the final model: IMTK = 0.17 + 0.07 EMIN+ 0.30 EMID + 0.46 IMTA + 0.49 IMTS.

The analysis of the final model enables us to verify that the present model with R2a = 0.810 has a very high explanatory power due to the dimensions that constitute it explaining a high proportion of IMTK (R2 a = 81%). AMOT and EMER dimensions did not influence the IMTK of the referees, showing a reduced amotivation (Table 4). The absence of significant relevance of EMER revealed that referees are not influenced by external pressures to study LGCR.

The structural model (Figure 1) shown that IMTK is influenced by EMIN by 7.6%, resulting from external pressure to study. In the same line, EMID influenced 30.9%, presenting that the referees identified the value of the activities resulting from the LGCR study, accepting the importance of the same to their learning and regulating their behaviour for the study (Deci et al., 2001). IMTK is still influenced by IMTA in 46%,

**Table 4.** Linear Regression Model

| Dependent Variable: IMTK | | | | |
|---|---|---|---|---|
| **Dimensions** | **Initial Model** | | **Final Model** | |
| | ***B*** | ***t*** | ***B*** | ***t*** |
| (Constant) | -.017 | -.05 | .17 | .74 |
| AMOT | .08 | 1.09 | .08 | 1.09 |
| EMER | -.03 | -.50 | -.03 | -2.29 |
| EMIN | -.06 | -1.722 | .076** | 4.367 |
| EMID | .26*** | 4.45 | .30*** | 5.76 |
| IMTA | .33*** | 5.75 | .46*** | 11.91 |
| IMTS | .49*** | 11.55 | .49*** | .74 |
| VIF | [1.20 – 2.84] | | [1.63 – 2.72] | |
| R | .90 | | .90 | |
| $R^2$ | .81 | | .81 | |
| $R^2$ a | .81 | | .81 | |
| Durbin-Watson | 1.77 | | 1.75 | |

Legend: **p< 0.05 ***p<0.001

which demonstrates the desire of the referees to study the LGCR for the pleasure, satisfaction and stimulus of learning that it provides. Similarly, IMTS influenced 49.8% resulting from the intrinsic will to study LGCR (Deci & Ryan, 2008).

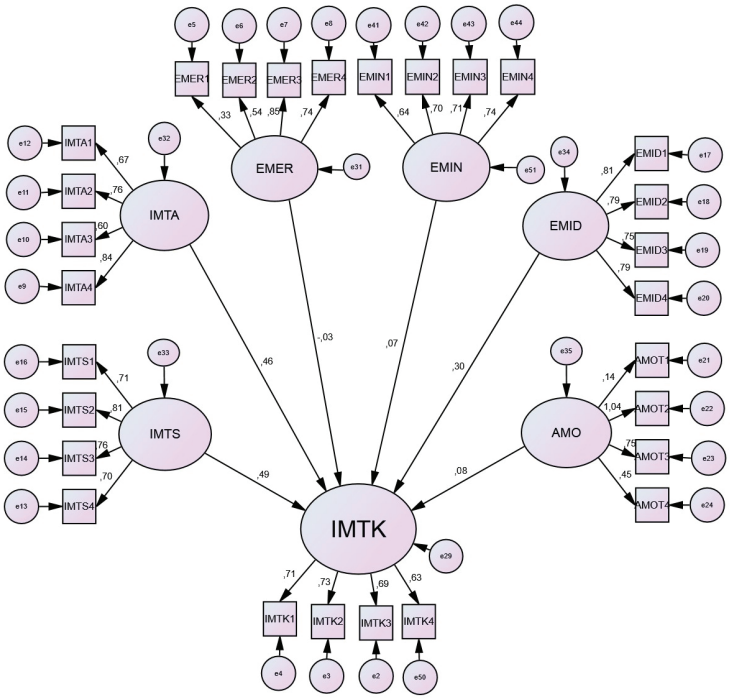


FIGURE 1. Structural Model

## Discussion

The research carried out enables us to determine the motivation of the Portuguese referees, who work in the national championships, to study the LGCR and also the dimensions of the motivation that influence their will to study. In this sense, several dimensions that compose the different types of motivation and demotivation (AMOT, EMOT, and IMOT) were assessed in order to evaluate motivation. Although the results show the presence of small groups that are less motivated to study, the general amount of referees presented positive values of extrinsic and intrinsic motivation, in relation to the study of LGCR. Still, the results seem to present that the referees are more intrinsically motivated than extrinsically, showing being able to motivate themselves more than to undergo third-party influences that pressure them to engage in this activity. Thus, extrinsic motivation does not affect the need for personal or intrinsic motivation (Ryan & Deci, 2000a). The results of the present study demonstrate a higher index of IMOT than EMOT, corroborating previous research in which AMS was applied to evaluate the motivation for the study (Ratelle, et al., 2007).

The motivation levels show an increase in Ryan and Deci's (2000b) Self-Determination continuum, with the IMOT dimension showing more relevance than EMOT to

the referee's motivation. The use of LRM to estimate the IMTK construction enables verifying that some variables of the initial model did not present statistical significance. We tested a new model by removing the dimensions that had not been statistically validated and obtained a more robust and significant model that explained a good percentage proportion (81%) of IMTK. However, in this new model, AMOT and EMER dimensions did not show statistical significance and were, therefore, removed in the construction of IMTK. The EMID ($\beta$=0.30; $p<0.001$) dimension was the most important dimension for the construction of the extrinsic motivation of referees, followed by the EMIN ($\beta$=0.07; $p<0.05$) dimension. Regarding the IMOT dimension, both IMTS ($\beta$ = 0.49; $p<0.001$) and IMTA ($\beta$ = 0.46; $p<0.001$) were fundamental to the motivation levels, with greater importance to the first. Such results are based on the theoretical SDT support, which assumes that intrinsic and extrinsic motivation may be promoted when basic psychological needs are met (Black & Deci, 2000). The present study showed motivational differences among referees of various national levels. Thus, it is necessary to promote several measures that can increase the levels of motivation of some referees to study the LGCR. Perhaps the emergence of a new way of studying that differs from the traditional and repeated study of books could contribute to a meaningful increase in motivation that could eventually make a difference in the future results of the referees in relation to LGCR learning. Thus, if the increase in motivation generated is capable of facilitating the learning process, the use of new tools in the near future may be considered to LGCR learning.

*Limitations*

The present study has some limitations, since the focus of the investigation is only centred on the national championships, excluding the small level referees. However, this research option is linked to the higher LGCR's dominance in the referee's success at the national level. The studies that usually assess motivation used self-reported scores, which may lead to biased evaluation as a result of the lack of self-awareness of the elements studied. The results of the present study were collected at the beginning of the 2019/20 season; thus, several personal and professional phenomena occurred in pre-season may have interfered and influenced some obtained results. Future research should be focused on the replication of the present study, using lower levels referees to perceive the differences of motivation among such different groups. Another proposal may be the study of motivation, differentiating the results in relation to gender, national category, years of national and district career, age and school background in order to assess if the sociodemographic differences influence the motivation to study the LGCR.

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**Conflict of Interest**

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ORIGINAL SCIENTIFIC PAPER

# Attitudes of Academic Staff from Different Stages of Their Proficiency in Research and Teaching Activities in Sports Sciences: A Case Study of the University of Montenegro

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**Abstract**

The goal of this research was the identification of differences between academic staff in sports sciences based on their proficiency from early-career researchers to experts related to different academic activities. A survey of professors from the University of Montenegro from different stages of their proficiency was conducted. Data collection included two standardized tools: 1) a questionnaire (N=23 respondents) and 2) interviews (N=6 respondents) about different academic activities, such as writing, researching, teaching, and learning. The results obtained revealed a lack of formal writing training as a barrier in academic writing, as well as other activities, including workloads (e.g., teaching, administration (54.6%)) and lack of time generally (45.5%) for early-career researchers. In the context of teaching support, early-career researchers confirmed a higher position to develop teaching competencies compared with expert teachers. Generally, the results showed that centralized support for teachers at this institution exists more for research than teaching activities at all career stages, which was expected according to standards and conditions for career progress. The theoretical and practical implications of results are discussed.

***Keywords:*** *writing, research, learning, teaching, sports sciences*

## Introduction

Universities must provide high-quality service to students (Suryadi, 2007), which requires the readiness of academic staff to be informed with cutting-edge information, for example, Academic staff in the field of sports sciences must provide enough theoretical and practical knowledge to ensure that graduate students will be well-prepared for the sports market.

The development of academic staff activities as a focus of the academic community dates from the late 1960s (Anderson & Eaton, 1982; Taylor, 1999; Åkerlind, 2005; Burke & Rau, 2010; Popovic, Matic, Bjelica, & Maksimovic, 2020a; Popovic, Matic, Bjelica, & Maksimovic, 2020b). A more in-depth insight into this topic shows that not all previous periods have been followed by the growth and development of academic activities. However, in recent decades, the intensive development of academic knowledge can be observed. This progress has been achieved through the development of modern technologies that have contributed to a tremendous transformation in the various activities of academic staff in higher education.

Nowadays, the benefits of developing teaching competencies are reflected in numerous teacher training courses, student feedback, the application of new or creative pedagogical/

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teaching methods, communication tools, the development of teaching skills through the realization of research, numerous scholarships, and other means. Also, numerous mobility programmes (through Erasmus and similar programmes) allow a significant number of teachers to facilitate international mobility and a better learning process. The development of research competences in contemporary teachers is achieved through numerous scholarships, grants, under the supervision of mentors who have been established as experts in specific fields. In the context of developing the writing competencies of the modern teacher, they include publications in high-impact journals, reviews in numerous journals, successful project proposals, multilingual publications, and excellent learning materials.

Likewise, continuing professional development is also facilitated by the creation of a favourable environment for more effective learning and research, with opportunities for attending many scientific events and the realization of interdisciplinary research.

The multiple opportunities that were spearheaded by new, innovative tools in teaching and research activities provided a significant shift and tremendous production in all scientific fields. An analysis of citations in 251 scientific categories according to G.S. Patience, C.A. Patience, Blais, and Bertrand (2017) reveals that over 11.9 million documents were indexed in the Web of Science Core Collection (WOS Core Collection, 2015) from 2010 to 2014. Considering that over 38,000 scientific papers have been published in the field of sports science, the enormous current contribution that researchers around the world undertake in the development of sports is evident.

The analysis of knowledge production from various scientific fields provides the identification of trends, deficiencies, and their effects (Patience et al., 2017); similarly, the analysis of teachers' developmental academic path contributes to the identification of factors that are crucial to academic progress. Furthermore, little scientific research that examines the critical factors in a teacher's career development path from the beginning of his career to an expert in his field exists. The approach to this research problem requires a reflection on some earlier research that evaluated the characteristics of academic development (Ramsden, 1992; Boyer, Altbach, & Whitelaw, 1994; Martin, Prosser, Trigwell, Ramsden, & Benjamin, 2000; Ayub Khan, 2017). In these studies, the authors highlighted the common characteristics of academic development: academic values, research and teaching, and the work environment. Current research on the role of the modern academic teacher emphasizes that academic development involves improving activities such as teaching, learning, research, and writing development. According to Åkerlind (2005), all these characteristics should be treated with a holistic approach, while Karagiannis (2009) emphasizes the increasing demand for balance in the development of different academic activities. It is clear that during academic development, the effectiveness and efficiency of teachers require the proper management of all these activities. In connection with this, the author points out that many teachers regard the obligations related to teaching and lecturing consider as an additional load and a waste of time and other resources that do not provide academic progress. The additional reason in that process based on the fact that academic staff engaged in teaching are undervalued then other staff who are engaged in research activities (Lucas, 2006). Accordingly, this research endeavours to find a response to the question of what the path of development of current researchers in the field of sports sciences is. What do teachers at different stages of their careers consider to contribute to the development of academic activities, and how should they develop them in a balanced way?

Therefore, the main aim of this research was to identify the differences concerning writing, research, learning, and teaching activities according to the teacher's experience and professional progression at different stages of their proficiency.

## Methods

### *Data collection*

The selection of the Faculty for Sport and Physical Education at the University of Montenegro is based on the fact that this institution had effective results in the previous decade in the field of sports sciences. Therefore, the authors of the present paper have assumed these results are based on significant capacities from younger teachers' resources, and it seems this higher education institution (HEI) represented an ideal place for this type of research. These competencies were contributing to serious development for this institution in the previous decade in organizing reputable annual scientific conferences in the field of sports sciences, and three scientific journals (Sport Mont, Montenegrin Journal of Sports Science, and Medicine and Journal of Anthropology of Sport and Physical Education) which have reached a high-ranking position in sport sciences.

### *Study sample*

The study sample included 23 subjects (18 male and five female teachers) that have filled the standardized questionnaire out and six subjects (five male and one female teacher) that have been interviewed. The interviews were conducted with teachers from different stages of their proficiency (two teachers as early-career researchers (pre-doctoral, 1–7 years post-doctorate and/or 1–7 years higher education experience), two teachers as teacher/consolidators (7–12 years higher education experience and/or 7–12 years post-doctorate) and two teachers as experts (more than 12 years education experience)). However, the sample of respondents from the analyses with questionnaire was not proportionally balanced among teachers regarding their experience and professional progression (early-career researcher (47.8%), consolidators (21.7%), and experts (30.5%)).

According to the writing, research, teaching and learning competencies, a short description of a sample of respondents described by themselves seemed to be: writing (61.1% consider themselves to be successful writers of academic manuscripts (30.4 had a neutral attitude and 8.5% considered themselves to have a lower level of this competency); researching (52.2% of the respondents describe themselves as good researchers; 30.4% neutral, and 17.4% as not good in research competencies); teaching (87.0% think they have good teaching competencies: 8.7% neutral and 4.3% low level): learning (95.7 considered themselves to be excellent in learning competencies and only 4.3% had a low level).

### *Research instruments*

Data collection comprised two standardized tools: 1) the questionnaire and 2) interviews with teachers. The questionnaire included six sections of questions about researching, administrative, and teaching obligations: 1) participant information, 2) centralized supports the institution, 3) writing, 4) research support, 5) teaching support, and 6) professional learning support: initial and continuing professional devel-

opment. The interviews with teachers last approximately half an hour each. The interview included some questions about researching, administrative, and teaching obligations. This instrument consisted of giving their explanations about the most critical factor that has contributed to their success in the four mentioned areas, about their challenges and the way of managing that challenge, professional demeanour, and advice for early-career colleagues. Respondents included all available teachers from the Faculty for Sport and Physical Education at the University of Montenegro, from early-career researchers to expert teachers.

Descriptive statistics (frequencies) and qualitative methods of analysis were used for the estimation of teacher's attitudes about science and research activities according to different stages of their proficiency.

## Results

Statistical indicators in Figure 1 show that there were some differences among teachers in the writing process and support from the early-career researcher of an expert teacher. The early-career researchers see lack of formal writing training (18.2%) as a significant barrier in academic writing, as well as other activities: workloads (e.g., teaching, administration; 54.6%) and lack of time generally (45.5%).

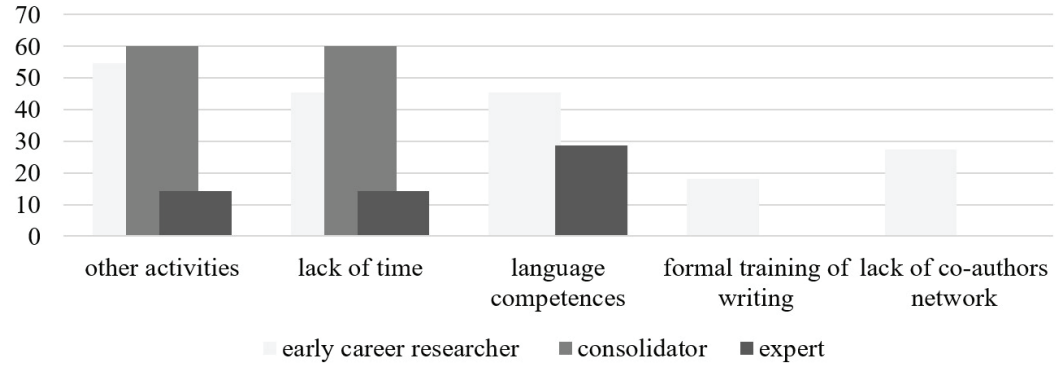


FIGURE 1. Barriers to academic writing by career stage of researchers (%)

The findings from the consolidator's results showed more obligations in the administration (60%) and lack of time generally (60%). In contrast, only 14.3% of experts considered these kinds of obligations to be barriers. The early-career researcher and consolidators have more obligations and overload in the context of administration. Probably, centralized support can be better organized, with more rational time management for all teachers as part of effective research support.

Furthermore, statistical analysis showed that centralized support for teachers at this institution exists more for research than teaching activities at all career stages (Figure 2), which may be expected because the career progress development is conditioned by success in research work. The obtained results confirmed that the emphasis on centralized support at all career stages is much more about supporting research and writing than teaching and learning. These results are expected because teachers' progress in their academic careers is generally evaluated regarding the quality of their research and in achieving the different standards set by the university, senate, or faculty.

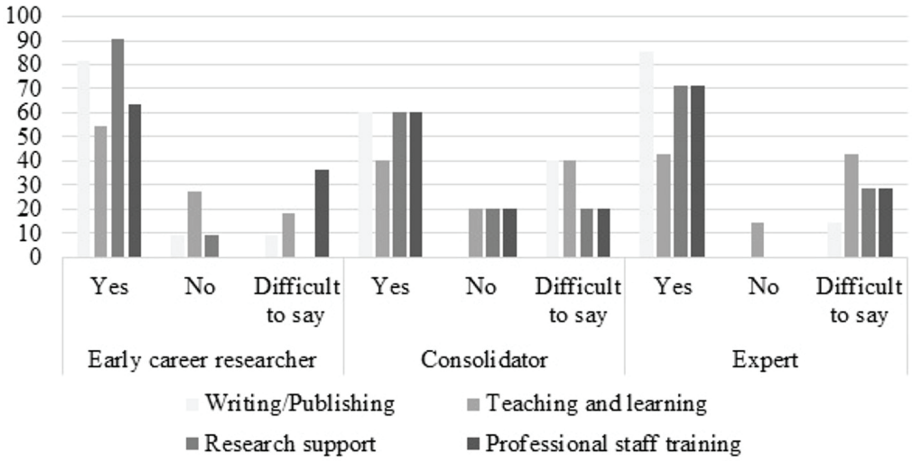


FIGURE 2. Centralized support in the institution for writing/publishing, teaching and learning, research and professional development/staff training

Popovic, Pekovic, and Matic (2019) mentioned the specificity of academic progress in social sciences in Montenegro, which is reflected in the requirement that every teacher in every selection from assistant to full professor must have at least one single-author article published in international journals. Also, this result is in line with similar research studies, which emphasized the importance of research for contribution to increasing research performance indicators by Patel et al. (2011), and increasing income through research projects (Asif, & Searcy, 2014; Ayub Khan, 2017; Lukman, Krajnc, & Glavic, 2010).

In Figure 3, it can be observed that teachers at all career

stage levels emphasized the relevance of intrinsic motivation, institutional demands, desire to progress in the discipline, job security (above 80%), and lifelong learning (above 60%). Mobility and opportunity for international travel are closely related with early-career researcher; 81.9% see this kind of opportunity as an essential step in further research career development (20% and more then consolidators and expert teachers).

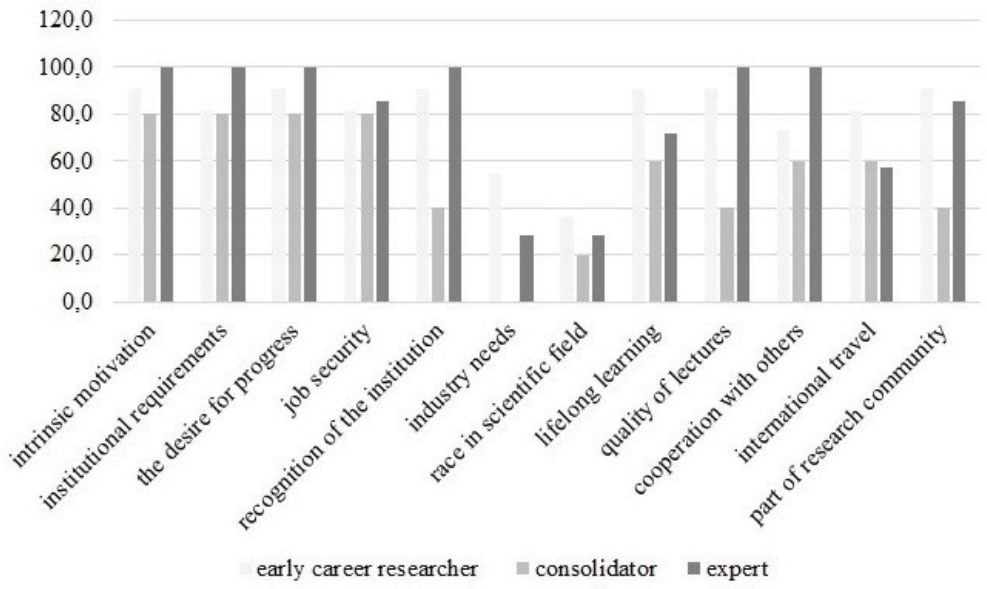


FIGURE 3. Factors that influenced motivation to be successful and effective as a researcher

The primary support for all researchers (Figure 4) comes from attending research-oriented events (conferences, seminars, etc.) according to 69.6% of respondents, flexibility in the realization of obligations (about 60%), release time to conduct research (56,5%), and presenting the research results at international events (56.5%).

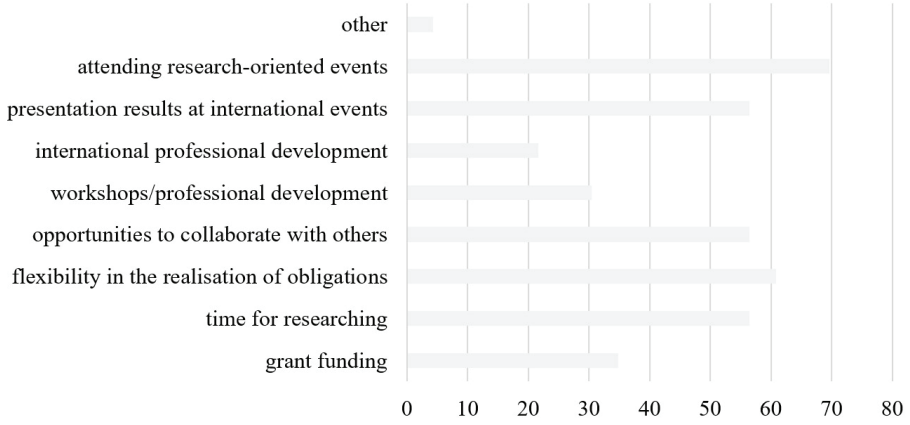


FIGURE 4. Factors of researcher's support

In teaching support among teachers at the different career stage levels, some differences are observed. In seven of the 11 variables in Figure 5, observed differences among teachers related to teaching support were calculated in the variables of research related to lectures, international teaching opportunities, team learning, awards and honours, attending workshops and seminars, mentoring and feedback from colleagues. Specifically, in all of these variables, early-career researchers confirmed a better position compared with expert teachers.

## Discussion

During the earlier period, when consolidators and experts started their academic careers, we can ascertain that academic job was more focused on teaching than research competencies. It was expected that teaching competencies could be developed without central support from the university. Therefore, over two decades ago, institutions in HEIs in Western Balkan countries, as well as the University of Montenegro as one of the youngest universities in this region, cared little about teaching support. That is a reason that revealed the significant differences in this aspect. Nowadays, it is evident that the organizational climate at the University of Montenegro, and specifically the Faculty for Sport and Physical Education, has recognized the importance of teaching support. Therefore, this research confirmed that strengthen the self-esteem of teachers covered by researching results which can determine the quality of their lectures.

Further, we used a qualitative analysis based on informa-

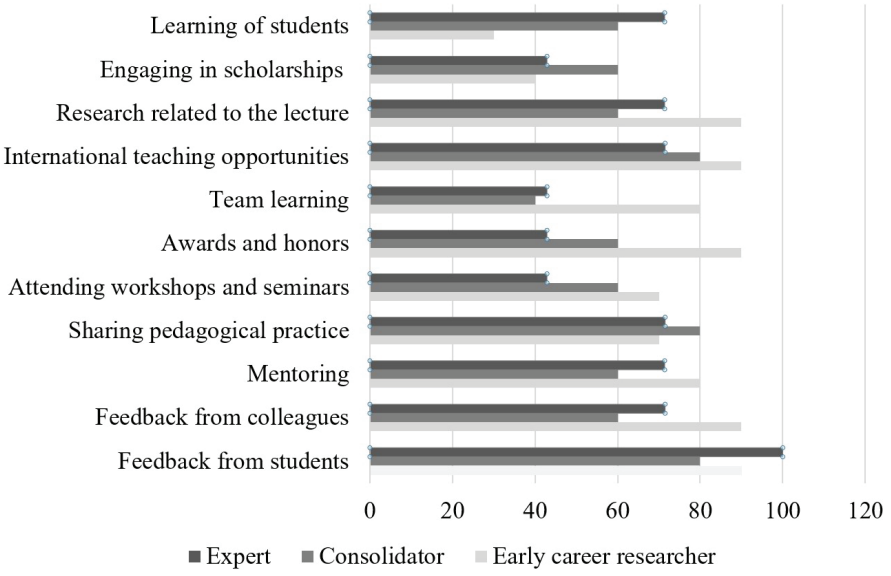


FIGURE 5. Important factors for teaching development

tion from interviews. First, we evaluated the most important factors in a teacher's success as a researcher, writer, teacher, and learner. Results obtained from interviews showed that the most critical factor is a desire for success and the work which teachers have invested in achieving the planned goal. Further analysis showed that the quality of presentations and of the lecturer of the subject Research Methodology, which contributes to the dissemination of student's interest or other audience, and "pulled the trigger" for further research interest for repetitions and creating some new research activities. At the same time, teachers indicate the basic requirements in methodology, such as being persistent that research goes exactly as the project is designed, and always processing accurate data. Such practices ensure that all that they learn/do during their research/writing enriches them with new knowledge, which they will most definitely need in further career development. Based on that, we can conclude that course of Research Methodology and the professor who teaches and motivates others in this area must be a very innovative, creative, charismatic person.

These facts can contribute to the better transfer of useful information in this field and affect the motivation of future young researchers to continue and improve their planning research design. Also, as one of the most important in all four areas, teachers emphasized the ability to accept new knowledge and disseminate it to others. Logically, the majority of teachers gave advice that is reflected in strengthening a clear desire for success and value and hard work that can be invested in achieving the set goal.

Furthermore, the differences between teachers who did and did not achieve success, effectiveness, and productivity across the four areas were identified. The significant differences in the successful teacher come from the creative atmosphere and ambience of support of other colleagues (especially mentors) in the research who were warmly welcomed and creates possibilities for them to go further. Next, it seems that most depended on their desire and progressive work. Also, they emphasized the importance of many seminars organized by the Ministry of Education. Many successful teachers point out their multidisciplinary interests during the whole process of education, as well as the importance of creativity and ingenuity in contributing to success in publishing in high-impact scientific journals.

Some academic staff emphasized an excellent relationship with other colleagues as one of the most critical factors in the whole process, because only well-networked scientists at the national and international levels have a chance to be part of good projects, more interesting research, similar. Scientists from the same or different scientific disciplines are becoming increasingly networked with strong teamwork needs, and the realization of future projects depends on international cooperation and time management.

The main barriers in the process of academic growth were found in several factors. In the first place is a misunderstanding of the social environment about the importance of scientific research. Next, respondents talked about the lack of time for adequate preparation of many subjects and presentations for students. Specifically, they mentioned the very difficult situation for the teacher with two simultaneous activities during the teaching process: introducing themselves to a new area, while presenting lectures to students without sufficient time for reading literature and developing more in-depth insights in a given field. A lack of support by advisors and others and insufficient space for independent work and progress were observed.

Lastly, identification of the most significant and effective research support provided by institutions showed that there were several ways of helping: postdoctoral studies, covering the costs of travel and registration fees for participation in scientific meetings, opportunities for using cost-effective instruments, adequate advice, and accessible scientific databases of relevant journals and works. Furthermore, a comparison of teacher's opinions about initial and continuing professional development observed the only difference in the field of negotiating institutional systems and processes; teacher experts rated these skills as very important compared to the other two groups of respondents.

This kind of information can help many researchers align and balance teachers' potentials in the different directions imposed by teaching, research, writing, and similar – in short, whatever makes an ideal teacher. Therefore, the authors expect that the results obtained can help in developing good practices in similar Western Balkan environments.

In conclusion, it is logical that advice is reflected in everything mentioned in previous paragraphs. Early-career researchers must concentrate on working solely on strengthening a clear desire for success and value and hard work that will be invested in achieving the set goal. Everything else will come by itself, sooner or later, if they consistently dedicate themselves. Also, the respondents emphasized that it should always be remembered that an early-career researcher needs to build quality relationships with other colleagues, which is one of the most critical factors in the whole process. Likewise, advice for early-career researchers about academic writing recommended by experienced colleagues is related to learning the methodology of writing, the selection of high-quality mentors and advisors, learning from the best colleagues or experts in their environment, and networking with other scientists from related disciplines and time management skills. All of these things must be done with ethical norms, with confidence in one's work.

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ORIGINAL SCIENTIFIC PAPER

# Differentiated Training Model for Marathon Runners on Building Tempo and Speed Endurance Based On the Types of Energy Metabolism

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**Abstract**

This article discusses the issues of improving the quality of the training process for marathon runners in competition preparation by utilizing the application of a differentiated training model based on the types of energy metabolism for the development of tempo and speed endurance. The studies conducted have shown that marathon runners of different energy metabolism types adapt differently to competitive loads, as well as to speed and tempo development. The process of adaptation of their functional systems (which define tempo and speed endurance) occurs mainly due to the differentiation of the tools and methods used correspondingly to the type of energy metabolism. It allows not only for the more effective expansion of the cardiorespiratory system capabilities but also for bringing athletes to a higher level of tempo and speed endurance development. As a result of the study, it was revealed that for aerobic athletes, tempo endurance should be developed by using standard continuous training, while speed endurance should be developed through repeated training. Tempo endurance in anaerobic marathon runners should be developed by using interval training, while speed endurance should be developed through non-maximal effort training with a normalized number of distance segments. Tempo endurance in marathon runners of the mixed type of energy metabolism should be developed by using the variable training method, while speed endurance should be developed through a combination of non-maximal effort and repeated training with a fixed number of distance segments.

***Keywords:*** *marathon running; muscle activity; types of energy metabolism; training of marathon runners*

## Introduction

Competitive activities of high-class marathon runners are highly demanding regarding their physical fitness level (Skof, Hadzic, & Dervisevic, 2012; Bolotin & Bakayev, 2017a; Bakaev, Bolotin, & Aganov, 2016). The basis of specialized training for long-distance running lies in the development of special endurance to varied speed and tempo of running in the course of competitive activities (Bakayev, Bolotin, & You, 2018; Przybyła et al., 2016; Bakayev, Vasilyeva, Kalmykova, & Razinkina, 2018). The efficiency of developing this physical quality is determined by a directed impact of different energy production mechanisms on the athlete's body based on the type of energy metabolism (Bakayev et al., 2018; Bohuslavska, Furman, Pityn, Galan, & Nakonechnyi, 2017; Bolotin & Bakayev, 2016).

A large number of the articles devoted to this problem are only indirectly related to the issues of energy supply for muscle activity in marathon runners (Bolotin, & Bakayev, 2017b; Boullosa, Tuimil, Leicht, & Crespo-Salgado, 2009; Vesterinen et al., 2013; Pieralisi et al. 2017). This contradiction limits the possibilities of using differentiated tools and methods for developing special endurance in marathon runners (Auersperger, Jurov, Laurencak, Leskosek, & Skof, 2020; Manzi, Iellamo, Impellizzeri, D'Ottavio, & Castagna, 2009). The methods of developing special endurance in marathon runners, differentiated based on the types of energy metabolism, are only used to a limited extent (Bolotin, & Bakayev, 2017a). Preliminary studies have shown that without

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taking into consideration the type of energy metabolism of an athlete, it is difficult to increase the results of high-class marathon runners by more than 1.5% in specialized training during competition preparation.

Aim of the study to determine the efficiency of specialized training techniques for athletes in long-distance running while taking into consideration the types of energy metabolism.

## Methods

Sixteen marathon runners specialized in long-distance running (from 10 to 100 km) took part in the study. The participants were in the age range of 25 to 37 years. To test the developed training options, four groups of athletes were formed depending on the energy metabolism type: aerobic type runners, anaerobic type runners, mixed type runners, and the group for which no account was taken of the energy metabolism types. The experiment lasted for six weeks of the special preparatory stage of training. The tools and methods of specialized training for each group of athletes were developed based on the characteristics of their mechanism of energy supply for muscle activity. To substantiate the training model for marathon runners, a comparative analysis was performed based on the functional capabilities of athletes from various groups that were differentiated by the type of energy metabolism.

To address the challenges of the study, we used the express-diagnostics D&K test (Dushanin, 1986) to assess the functional state and reserve capabilities of the athletes. Following the algorithms of the programme, energy metabolism types of athletes were determined based on the morphology and height analysis of the R wave (i.e., the main ECG wave) and S wave (i.e., the intermittent ECG wave) in an electrocardiogram recorded on three limbs, with three augmented and six precordial leads.

The data obtained enable calculating the following parameters:

1. Capacity of anaerobic supply of energy (CANSE), which characterizes the ability to carry the load in the 3rd, 4th, and 5th intensity zones.
2. Anaerobic disposal threshold (ANDT), which characterizes an athlete's predisposition to anaerobic work, expressed as a percentage.
3. Capacity of aerobic supply of energy (CASE) aerobic source index, which characterizes the ability to fulfil the load in the 1st and 2nd intensity zones.
4. Aerobic disposal threshold (ADT), which characterizes an athlete's predisposition to aerobic work, expressed as a percentage.
5. Total metabolic capacity (TMC), which characterizes the total work capacity of the body.
6. Power of creatine phosphate energy supply (PCPES), which characterizes the speed performance of marathon runners.
7. Glycolytic power supply (GPS), which characterizes the speed endurance of marathon runners.
8. Power of aerobic energy supply (PAE), which characterizes the ability to demonstrate general endurance, as well as to recover from anaerobic work.
9. Anaerobic metabolic threshold (AMT), which characterizes the efficiency of aerobic energy supply mechanisms.

The efficiency of managing the training process was achieved through differentiating the methods of specialized training for marathon runners, depending on the characteristics of their energy supply for muscular activity.

Tempo endurance of the primarily aerobic marathon runners was developed by using long-term continuous exercise, while speed endurance was developed through repeated training.

In athletes of the anaerobic type of energy metabolism, tempo endurance was developed by using interval training, while speed endurance was developed through submaximal effort training with a fixed number of run segments.

Tempo endurance in athletes of the mixed type of energy metabolism was developed by using the variable training method, while speed endurance was developed through a combination of non-maximal effort and repeated training with a fixed number of distance segments. Standard tools and methods for developing tempo and speed endurance were used for the control group of marathon runners.

The load for marathon runners was selected (Table 1) based on the current result in the 10,000 m run (Table 2) and the marathon run (Table 3). The number of run segments' repetitions and the weekly volume of the training load were selected depending on the level of the functional state of the athletes.

To manage the special training, we have developed and used a system to control the training process. It included running power testing, lactate profile testing, skinfold test, and the blood profile test. The system was used to plan the programme of training for marathon runners while taking into consideration the heart rate beat and the type of energy metabolism.

**Table 1.** Main Training Load Parameters of Marathon Runners at the Special Preparatory Stage of Training for Competitions (6 Weeks)

| Load parameters | Groups of subjects divided by the type of energy metabolism | | | |
|---|---|---|---|---|
| | Aerobic type | Anaerobic type | Mixed type | Without reference to metabolism |
| Daily running distance, km | 60–80 | 42–62 | 46–70 | 46–70 |
| Weekly running distance, km | 350–480 | 240–370 | 270–420 | 270–420 |
| Number of training per week | 12 | 12 | 12 | 12 |
| Main training exercise | 6×3,000 m<br>4×9,000 m | 4×(5×2,000 m)<br>6×6,000 m | 3×(2×2,500 m)<br>4×8,000 m | 8×2,500 m<br>2×9,000 m |
| Training method | Balanced, repeated | Interval, submaximal effort | Variable, non-maximal effort | Balanced, repeated, interval |

## Results

As a result of the studies, differences in the dynamics of specialized tests parameters were revealed. These differences depended on the energy metabolism type of marathon runners (Tables 2, 3).

In the 10,000 m run, athletes of the aerobic type showed an improvement, in a time of 44.1 s; the increase in the results was 2.4% ($p<0.05$). Marathon runners of the mixed type of energy metabolism had their results improved by 32.7 s; the increase was 1.8% ($p<0.05$). The test groups of the anaerobic energy

**Table 2.** Result Dynamics in the 10,000 m Run of Marathon Runners of Various Types of Energy Metabolism (Min)

| Period of testing at the special preparatory stage of training | Groups of subjects divided by the type of energy metabolism | | | |
|---|---|---|---|---|
| | Aerobic type | Anaerobic type | Mixed type | Without reference to metabolism |
| Beginning of the stage | 31.52±0.11 | 31.44±0.18 | 31.40±0.17 | 31.48±0.16 |
| End of the stage | 30.78±0.15 | 30.17±0.11 | 30.87±0.13 | 30.91±0.18 |

Legend: Seconds to minutes were converted as follows: 0.1 min = 6 sec; 0.2 min = 12 sec; 0.3 min = 18 sec, etc.; 1.0 min = 60 sec.

metabolism type showed an improvement in the temporal index by 82.3 s; the increase was 4.2% ($p<0.01$). The average improvement in this test among athletes from the group with no reference to the type of energy metabolism was 38.8 s, which corresponded to an increase of 2.2% ($p<0.05$).

In marathon running, the aerobic athletes had their average distance passing time improved by 6 min 3 s; the increase was 2.9% ($p<0.05$). Athletes from the group of mixed type of energy metabolism showed an improvement in time of 6 min 52 s; the increase in results was 3.3% ($p<0.05$). The subjects from the group of anaerobic energy metabolism had their average result improved by 5 min 7 s; the increase was 2.4%. The average improvement in this test among athletes from the group with no reference to the type of energy metabolism was 5 min 2 s, which corresponded to an increase of 2.3% ($p<p0.01$).

**Table 3. Result Dynamics in Marathon Running of Athletes of Various Types of Energy Metabolism (Min)**

| Period of testing at the special preparatory stage of training | Groups of subjects divided by the type of energy metabolism | | | |
|---|---|---|---|---|
| | Aerobic type | Anaerobic type | Mixed type | Without reference to metabolism |
| Beginning of the stage | 139.22±1.14 | 146.36±1.18 | 143.31±1.14 | 141.27±1.12 |
| End of the stage | 133.19±1.16 | 141.29±1.12 | 136.88±1.15 | 136.21±1.14 |

Table 4 presents the results of evaluating the functional and reserve capabilities of the athletes before and after completing the special preparatory stage of training.

**Table 4.** Dynamics of functional and reserve capabilities parameters of marathon runners as a result of completing the special preparatory stage of training

| Testing period | Groups of subjects divided by the type of energy metabolism | | | |
|---|---|---|---|---|
| | Aerobic type | Mixed type | Anaerobic type | Without reference to metabolism |
| Capacity of anaerobic supply of energy (CANSE), p.d.u. | | | | |
| before | 45.32±13.68 | 71.08±6.91 | 124.67±8.76 | 76.22±34.63 |
| after | 48.86±11.23 | 76.91±4.89 | 136.19±9.31 | 82.53±11.15 |
| t | 0.63 | 2.18* | 2.45* | 0.83 |
| Capacity of aerobic supply of energy (CASE), p.d.u. | | | | |
| before | 240.17±21.37 | 229.51±17.63 | 204.41±21.69 | 226.65±29.49 |
| after | 260.21±18.23 | 249.53±13.68 | 218.92±18.67 | 244.85±16.83 |
| t | 2.21* | 2.87* | 1.37 | 2.51* |
| Total metabolic capacity (TMC), p.d.u. | | | | |
| before | 285.53±12.33 | 300.63±21.42 | 329.06±22.18 | 302.78±34.07 |
| after | 308.52±14.38 | 326.47±19.22 | 355.23±23.01 | 327.65±18.87 |
| t | 4.10** | 2.98** | 2.34* | 2.98** |
| Power of creatine phosphate energy supply (PCPES), p.d.u. | | | | |
| before | 31.54±2.35 | 29.55±1.95 | 38.75±2.26 | 32.64±5.93 |
| after | 34.79±2.17 | 32.03±2.19 | 41.93±2.12 | 35.57±2.16 |
| t | 3.23** | 2.96** | 2.86* | 2.17* |
| Glycolytic power supply (GPS), p.d.u. | | | | |
| before | 31.60±2.65 | 29.52±2.47 | 33.57±2.03 | 31.28±3.19 |
| after | 34.35±2.76 | 31.94±2.03 | 35.77±1.58 | 33.75±2.12 |
| t | 2.35* | 2.47* | 2.35* | 3.00** |
| Power of aerobic energy supply (PAE), p.d.u. | | | | |
| before | 57.48±4.43 | 52.12±5.80 | 46.39±4.03 | 51.62±9.67 |
| after | 62.25±3.22 | 56.03±6.13 | 51.63±4.34 | 56.28±8.96 |
| t | 2.63* | 1.60 | 2.57* | 1.56 |

Legend: ** – $p<0.01$; * – $p<0.05$

## Discussion

Thus, as a result of using the differentiated training methods for marathon runners, a significant increase in the parameters of the functional and reserve capabilities was revealed. It should also be noted that in the absence of a significant increase in the CANSE and PAE indices in the group of athletes with no reference to the type of energy metabolism, a significant increase in these indices was observed in the groups of mixed and anaerobic types of energy metabolism.

The data obtained enable concluding that the differentiated methods of preparing marathon runners for competitions that take energy metabolism types into consideration are efficient.

As a result of carrying out the special preparatory stage of training for competition preparation of marathon runners with various types of energy metabolism, a different reaction of the body to the training load was recorded. Athletes of anaerobic and mixed types of energy metabolism adapted to speed-power work more quickly, while aerobic athletes were better in adapting to long-term endurance work, which suggests that considering the types of energy metabolism may be critical for the definition of the tools and methods used for athlete 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

# Relationship between Sitting Height Measurements and Standing Height: A Prospective Regional Study among Adolescents in the Northern 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 northern region of Kosovo. This research was carried out on 177 individuals (87 male and 90 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, following which a linear regression analysis was carried out to examine the extent to which sitting height can reliably predict standing height. The results reveal that northern Kosovan males are 180.29±5.72 cm tall and have a sitting height of 95.64±3.93 cm, while northern Kosovan females are 165.36±4.56 cm tall and have a sitting height of 90.19±3.03 cm. The results indicate that both genders made northern Kosovans a tall group, slightly taller than the general male and a slightly shorter than the general female Kosovan population. Moreover, the sitting height reliably predicts standing height in both genders, but not as reliably as arm span. This study also confirms the necessity for developing separate height models for each region in Kosovo as the results from northern Kosovans do not correspond to the values of the general Kosovan population.

***Keywords:*** *prediction, measures, stature, sitting height, northern Kosovan*

## Introduction

This study was conducted with to analyse the standing height and the possibility of its prediction utilizing sitting height measurements in adolescents in the northern region of Kosovo. Northern Kosovo is one of five Kosovan regions (eastern, western, northern, southern, and central), and in includes seven municipalities: Leposavić, Mitrovica, North Mitrovica, Skenderaj, Vushtrri, Zubin Potok, and Zvečan (Gardasevic, Masanovic, & Arifi, 2019; Masanovic et al., 2018a). It extends over an area of 2,077 square kilometres and has a population of 272,247 inhabitants, while average density per square kilometre is 110 inhabitants (Arifi, Sermaxhaj, Zejnullahu-Raçi, Alaj, & Metaj, 2017). The territory of Kosovo is small but has a highly varied relief. Most of Kosovo's borders are dominated by mountains and high grounds (Popovic, Gardasevic, Masanovic, Arifi, & Bjelica, 2017). The most noticeable topographical features are the Albanian Alps, which are a geological continuation of the Dinaric Alps that run laterally through

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the west along the border with Albania and Montenegro (Gardasevic, Masanovic, & Arifi, 2018). It is widely known that body height and body proportions are specific with regard to populations living on the Dinarides (Grasgruber et al., 2019; Starc et al., 2019; Masanovic et al., 2020). People from this area were recognized as tall by European anthropologists more than 100 years ago (Popovic, 2019). 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 social, economic and geographical characteristics as potential influencing factors (Gardasevic, Rasidagic, Krivokapic, Corluka, & Bjelica, 2017).

Every diagnostic procedure begins with measuring standing height and other morphological parameters, regardless of whether it is a health assessment of children or a physical fitness assessment of adults (De Onis et al., 2019; Nugent et al., 2019). Particularly important is the parameter of standing height, because of its diverse application in different procedures. The systematic monitoring of standing height, its changes, and changes of body proportion enables the determination of preschool and school children development stadium (Eiben et al., 2005), as well as the prediction of final growth, which is essential for the talent identification process in sport (Gusic, Popovic, Molnar, Masanovic, & Radakovic, 2017; Arifi, Bjelica, & Masanovic, 2019; Masanovic, 2019). Lastly, according to this parameter, it is possible to rate basic energy needs and to determine dosages of medication for each individual when necessary (Tanner, Hayashi, Preece, & Cameron, 1982).

However, when it is impossible to measure standing height in the standard way, because deformity, amputations, bone fractures and ageing-caused height loss cause problems, there is a necessity to predict objective standing height indirectly, in accordance with specific anthropometric measures (Quanjer et al., 2014; Masanovic, 2018). According to data from all previous studies, the relationship between arm span and standing height is marked as the most reliable parameter for indirectly determining standing height (Bjelica et al., 2012; Popovic et al., 2016; Popovic, Bjelica, Georgiev, Krivokapic, & Milasinovic, 2015). In these studies, the most reliable parameters are the foot length and standing height ratio, and the sitting height and standing height ratio (Kanchan et al., 2008; Abou-Hussein, Abela, & Savona-Ventura, 2011; Masanovic et al., 2018b; Masanovic, Arifi, & Gardasevic, 2019). The foot length and standing height ratio is the recommended parameter to predict adolescents' standing height, because short bones ossify more quickly, so that the dimension in this period is the most approximate to the final size (Jakhar et al., 2010). In contrast, the sitting height and standing height ratio is the recommended parameter to predict adult's standing height because that relationship changes during growth process (extremities grow faster in the first stage of adolescence, and torso tracks growth slightly later), and adequate data during adolescence would not be obtained (Leung et al., 1996).

Nonetheless, the fact that the relationship between individual anthropometric parameters and standing height is different in different ethnic and racial groups makes determining indirect standing height difficult (Quanjer et al., 2014; Steele, & Chenier, 1990). For example, the Cormic index (which provides an estimate of relative trunk length and is expressed as sitting height/standing height × 100) of the European population is 52%, while the African population have slightly longer legs on average; for them, this index is about 51%. Asian populations have slightly different body proportions, so this index is 53–54%, and lastly, the Cormic index of Australian Aborigines is between 45% and 49% (Ukwuma, 2009). Therefore, researchers agree that it is necessary to create specific formulas for indirect standing height calculation for each ethnic and racial group (Reeves, 1996; Chumlea et al., 1998). Furthermore, for standing height, regional variations for residents of Montenegro and Kosovo have proven (Popovic, 2017; Masanovic, Bavcevic, & Prskalo, 2019a), and it is also necessary to test the regional differences for standing height and sitting height ratios. The number of studies addressing this problem in Europe is quite limited (Fredriks et al., 2005; Ariba-Munoz et al., 2013), and regional analyses for standing height/sitting height ratio in the Dinaric Alps has been insufficient.

Consequently, the purpose of this study is to examine the standing height and sitting height ratio of men and women in the northern region of Kosovo.

## Methods

The study included 177 final grade high-school students (87 male and 90 female) from the northern Region of Kosovo as subjects. There are two reasons that this group was selected: the fact that the growth of an individual ceases by this age, yet there is not yet any related loss in standing height. The average age of the male subject was 18.25±0.46 years old (range 18-20 years), while the average age of the female subject was 18.29±0.46 years old (range 18–19 years. It should be noted that the researchers have excluded from the data analysis the individuals with physical deformities as well as those without informed consent. Another exclusion criterion was also being non-northern Kosovan.

Standing height and sitting height were measured according to the protocol of the International Society for the Advancement of Kinanthropometry (Marfell-Jones, Olds, Stew, & Carter, 2006). Measurement conducted trained measurer, while the quality of their performance was evaluated against the prescribed "ISAK Manual". Lastly, the age of each subject was obtained directly from their birthdays.

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. A linear regression analysis was then 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 anthropometric measurements in both genders is presented in Table 1. The mean of the standing height for male was 180.29±5.72 centimetres, and sitting height was 95.64±3.93 centimetres, while for female the standing height was 165.36±4.56 centimetres, and sitting height was 90.19±3.03 centimetres. The gender difference between standing height and sitting height measurements was statistically significant (standing height: $t=19.234$; $p<.000$, and sitting height: $t=10.334$; $p<.000$).

**Table 1.** Anthropometric Measurements of the Study Subjects

| Subjects | Standing Height Range (Mean±SD) | Sitting Height Range (Mean±SD) |
|---|---|---|
| Male | 167.9-197.3 (180.29±5.72) | 86.2-103.3 (95.64±3.93) |
| Female | 158.7-182.0 (165.36±4.56) | 83.2-101.9 (90.19±3.03) |

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<0.000) and high in this sample, regardless of gender (male: 0.735; female: 0.586).

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

| Subjects | Correlation Coefficient | 95% confidence interval | Significance p-value |
|---|---|---|---|
| Male | 0.735 | 0.588-0.881 | <0.000 |
| Female | 0.586 | 0.414-0.757 | <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, and therefore, age was excluded, and estimates were obtained as univariate analysis. The high values of the regression coefficient (male: 0.735; female: 0.586) signify that sitting height notably predicts standing height in both northern-Kosovan genders (male: t=9.984, p<0.000; female: t=6.780, p<0.000), which confirms the R-square (%) for the male (54.0) as well as for the female (48.5).

**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 | 0.735 | 3.901 | 54.0 | 9.984 | 0.000 |
| Female | 0.586 | 3.719 | 58.5 | 6.780 | 0.000 |

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

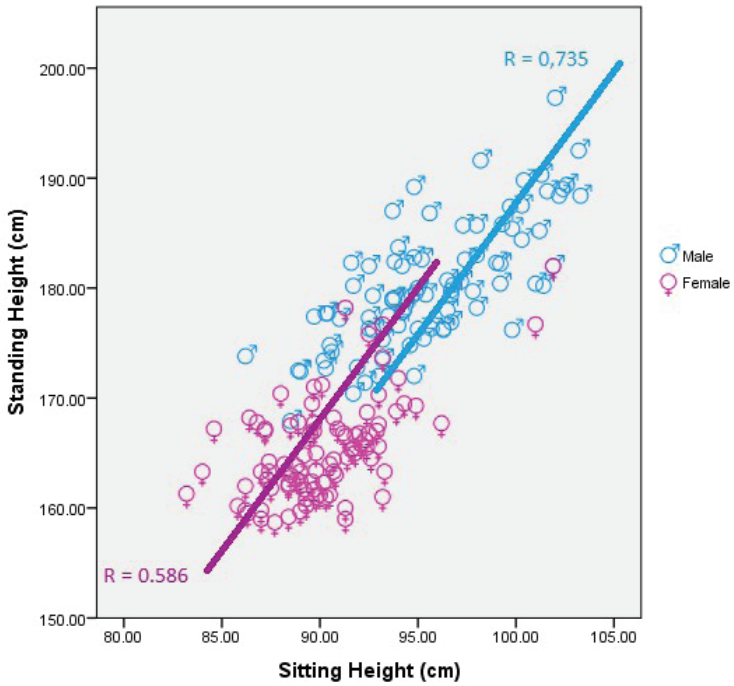


FIGURE 1. Scatter Diagram and Relationship between Sitting Height Measurements and Standing Height among Both Genders

## Discussion

It's been over a century since researchers attempted to discover which anthropometrical method is the best for the indirect assessment of authentic standing height. All of them agree that the most reliable predictor is the relationship between standing height and arm span (Datta Banik, 2011; Arifi et al., 2017; Masanovic, Arifi, & Gardasevic, 2020). This study confirms a very high linear correlation between standing height

and sitting height in both northern Kosovan genders (r=0.735 in males; r=0.586 in females), which is in line with studies conducted on the population of the Netherlands, Indonesia, and Spain (Fredriks et al., 2005; Fatmah, 2010; Arriba Munoz et al., 2013).

However, it is essential 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 are affective on these measures and reduce the possibility of generalizing (Bjelica et al., 2012; Grasgruber et al., 2019). Nevertheless, some recent studies have confirmed that there are regional differences in standing heights between the same ethnic group members (Popovic, 2017; Masanovic et al., 2019a), and it has also been proven for foot length and standing height ratio (Popovic et al., 2017), also for tibia length and standing height ratio (Gardasevic, 2019). Whether the same applies to the relationship between sitting height and standing height is debatable. This study determined that regional differences also exist in sitting height and standing height ratios. For the population of northern Kosovo, a different correlation coefficient for sitting height and standing height ratio (r=0.735 in males and r=0.586 in females) was calculated compared to other regions. The population of eastern Kosovo has a correlation coefficient for sitting height and standing height ratio r=0.743 in males and r=0.705 in females (Gardasevic, 2018), while the population of western Kosovo has a correlation coefficient r=0.661 in males and r=0.614 in females (Masanovic et al., 2019). Even though these relations are similar, the estimation equations that are obtained in the northern Kosovans differ considerably from the populations of 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 developing separate regional models for both genders in Kosovo was also based on the fact that all of Kosovo does not fall into Dinaric Alps racial classification (Mustafa et al., 2012; Arifi, Gardasevic, & Masanovic, 2018).

Limitations of this study may be the structure of the selected sample as final grade high-school students, because there are studies that indicate that the growth and body development of persons of this age remain active (Grasgruber et al., 2017; Wronka & Pawlinska-Chmara, 2009). However, if review studies implemented in Montenegro (Bjelica et al., 2012; Popovic, 2018), we can see that body height difference between university students and final grade high-school students is not found, "and can easily happen that the same case is established with the Kosovo population, given the certain similarities between Montenegrins and Kosovars, or some common specific features in relation to other populations in the region" (Popovic, 2019). Another limitation is the fact that residents of all regions in Kosovo have not reached their full genetic potential, and that positive secular trend may lead to change in body proportions. Quanjer et al., 2015 claims that in low-income countries, improving health conditions drive increases in standing height, and changes in relative leg length. This increase in height has been due almost entirely to longer legs (Tanner et al., 1982), which results in changes in body proportions, which implies that height-based prediction equations for such populations will need to be periodically updated. It also implies that predicting equations must be revised after a certain period. In the literature, an update period of every ten years is commonly cited. (Kubota et al., 2014).

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

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SportMont

ORIGINAL SCIENTIFIC PAPER

# Decreasing the Effectiveness for Shooting the Basket: A Basic Problem for the U16, U18, and U20 European Women's Basketball

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**Abstract**

The view of experts regarding women basketball in Europe is that in recent years the effectiveness of shooting baskets is slowly diminishing, which impacts the game negatively. The purpose of our research is to effect studies related to the effectiveness of shooting the basket in women basketball for various age groups: U16, U18, and U20. For the research, we have studied specialized literature and analysed game effectiveness statistic data from the Genius Sport official system for registering the game indicators of the European Basketball Federation (FIBA). The initial data are processed mathematically-statistically by variation analysis, relative share for establishing the effectiveness of shooting baskets from various distances, and comparative analysis. We have researched shooting effectiveness data from the last European championships for the three age groups. The results show a decrease in the competitors' skills for effecting baskets by the growth of age. We can conclude that women's basketball is a dynamic sport with many elements, but the effectiveness of shooting baskets is at its core, which is something that is often forgotten. Coaches working at each level should use at least 30% of the training and training process for specific shooting exercises for the basket; this is the minimum that can stop this process so that the game of basketball does not go into an existential crisis.

***Keywords:*** *European championships, women's basketball, shooting*

## Introduction

The development of women's basketball has been in regression at the global level in recent years. The technical and tactical skills of good players are so well perfected that aggression and speed when playing is simply routine for them. To a greater degree, that is due to the changes in the rules of playing, stimulating the spectacular and active game, both in offence and defence. That fact requires the optimization of the basketball school and training process for the upcoming generation but in relation to increasing the efficiency (Borukova, 2018). Following a deep analysis of the European and World championships for the period of 2017–2019 (11 total), we have established that four teams only pass over the average limit of 70 points per match and only one of the teams is from Europe; these are the teams of the USA, China, Hungary, and Japan. We think that part of the reasons for that state is the insufficient effective school and training work with the upcoming women basketball players in relation to scoring baskets.

Modern women's basketball requires from the players a game of dynamic, varied, and simply better play than the opponent has. At the same time, the players should have high levels of precision when shooting baskets, which influences the presentation in basketball considerably but, during a competition, are performed in more difficult conditions. In order to shoot baskets correctly, the player should have good motor abilities, which are different for men and women.

One of the most obvious and important differences in sexes for the presentation in many kinds of sports is the correla-

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tion between strength and body mass, which is in favour of men during puberty (DeVries,1986). At the age of 15-16 years of the young women basketball players, it is assumed that the majority of them are at the end of the puberty second phase, i.e., of the maturing of the body (Borukova, 2018); for the girls, the is characterized by the development of the muscles and width of the body proportions (skeleton). During that period, the proportions are formed to the state of an adult body (Slanchev, 1991), which is of great importance for basketball, particularly for shooting baskets.

Until 2004, all basketball competitions for both sexes used a size 7 ball. To make women's basketball more attractive and interesting, as well as improving the effectiveness and precision of shooting baskets, on June 12, 2004, the FIBA Central Council changed the Official Basketball Rules 2004, and for the 2004/2005 FIBA season introduced a smaller and lighter ball: size 6 for women, which is to be used in all FIBA competitions. The same ball was introduced in the United States' Women's Professional Basketball League (WBL) in 1978. The difference between size 6 and size 7 is 34 mm measurement, 10.8 mm diameter and 70 g mass, all in the middle of the scope interval.

Consequently, by introducing the 6 size ball, the correlation between the diameter of the ball and the basket (hoop) is changed as well as the correlation between the clear zone of the basket (ring), the surface of the ball (projection to the plane) and the minimal angle of entering (falling angle) under which the ball passes through the basket. Therefore, it can be concluded, at least theoretically, that it is easier to score a basket with size 6 ball (Podmenik, Leskošek, & Erčulj, 2012). Following a range of studies (Podmenik et al., 2012) it is established that the introduction of a size 6 basketball ball does not lead to improving the exactness of shooting (the reverse was established for free throws only), although the amount of three-point shooting has increased.

Many authors confirm the positive effect of strength on the exactness of shooting (Sherwood, Schmidt, & Walter, 1988; Tang & Shung, 2005; Justin, Strojnik, & Šarabon, 2006). The precision of shooting the basket depends on the performance technique and the position from which the player plays. Women's basketball is more interesting for the spectators as women basketball players are apt to shoot more often and from greater distances than men are and, as a whole, have more precise control of the ball while shooting. Resulting from planning the school and training process for many years and the accumulated experience, by increasing the age from 16 to 18 years and respectfully to 20 years of age, the young players are expected to improve their skills and be ready to move to a women's basketball league.

The purpose of our study is to verify that with the increase of age, a change of the shooting basket effectiveness is observed for the women basketball players in Europe. The study is the first to engage with this theme. To date, we have not found similar studies in Europe or elsewhere.

## Methods

The present study covers all U16, U18, and U20 teams having participated in Division A women's European championships during the years 2017, 2018 and 2019. We have studied 144 teams (48 teams per age) participating in Division A European championships, having played 224 matches. For greater representativeness of the results, we have studied 32 more teams, which participated in the last two World championships for women but have different age limits of U17 and U19 (112 matches total).

Specific literature data is studied, and an analysis of the statistical data regarding game effectiveness is annexed. Data are taken from FIBA official website of official basketball statistics for all above-mentioned European and World championships; they are processed by the official system for game indicators (FIBA Genius Sport). In order to perform the analysis, we have studied four indicators: points per game (PPG), shooting percentage (FG%), 3PShooting percentage (3P%), and free throws (FT%). The initial mathematic-statistic data are processed according to descriptive statistics, relative share for establishing shooting effectiveness from various distances, comparative analysis for independent extracts by t-criterion of students, and ANOVA, with the help of SPSS21 and Microsoft Excel.

## Results

Following the application of descriptive statistics on the initial data of the teams participating in the Division A U16, U18, and U20 European championships during 2017, 201,8 and 2019, we have established that the values are distributed normally and close to normal. For the needs of the study, we have applied comparative analysis of the average values of the three U16 European championships in 2017, 2018, and 2019, presented in Table 1.

**Table 1.** Comparative analysis of the average values for three U16, U18, U20 European championships in 2017, 2018, and 2019

| Age | Years | PPG | FG% | 3P% | FT% |
|---|---|---|---|---|---|
| 16 years | 2017 | 59.19 | 33.64 | 25.34 | 65.11 |
| | 2018 | 57.94 | 33.4 | 24.28 | 62.84 |
| | 2019 | 57.13 | 33.04 | 23.99 | 63.19 |
| 18 years | 2017 | 62.64 | 36.27 | 27.61 | 66.80 |
| | 2018 | 59.16 | 34.69 | 26.14 | 63.06 |
| | 2019 | 66.18 | 36.08 | 27.4 | 64.56 |
| 20 years | 2017 | 67.81 | 38.48 | 29.29 | 69.92 |
| | 2018 | 63.64 | 37.46 | 29.34 | 72.06 |
| | 2019 | 57.69 | 33.94 | 25.08 | 65.49 |

Legend: PPG-points per game; FG%-shooting percentage; 3P%-3PShooting percentage; FT%-free throws

The data cover 168 matches total (56 matches per championship and 7 matches per team). Analysing Table 1, it is seen that during the period of 2017-2019, the U16 teams realized an average between 57.13-59.19 points per match, the total

shooting percentage is within the frames of 33%, three-point shooting is between 23.99-25.34%, and the free throws are between 62.11-65.11%. It is noteworthy that the results are decreasing each year, and the lowest are in 2019.

In order to establish the importance of the results of the average for all indicators, ANOVA is applied; it shows no statistically important differences.

When analysing Table 1, it is seen that U18 realized an average between 59.16 and 66.18 points per match, the total shooting percentage is within the frames of 34-36%, three-point shooting is between 26.14 and 27.40%, and free throws are between 63.06 and 66.80%. A decrease of the results is not observed here, except for 2018 when they are the lowest; in 2019, the general efficiency is the highest, but the successful percentages are not the highest, this is in favour of the greater number of shots performed per match: 67 trials for 2019, 62 in 2018, and 63 in 2017.

For establishing the importance of the differences of the average values of the symptoms, ANOVA was applied, which shows statistically important differences for the "PPG" indicator between the teams that participated in the 2018 and 2019 European championships, respectively 59.16 and 66.18 points scored, supported by reliability (p=0.02) and value of F Ratio=4,925. There are no statistically significant differences for the other indicators.

When analysing Table 1, it is seen that for the U20 European championships there is no increase of the performed points; they are between 67.81 and 57.69, the total shooting percentage is within the frames of 33.94-38.48%, and three-point shooting is between 25.08 and 29.34%. It is interesting to note that during the 2018 championship, for the first time, a pass over the limit of 70% is observed for the free throws. It is seen from Table 3 that a drop off in the results is observed during each coming championship. For establishing the importance of the differences in the average values, ANOVA is applied; it again shows statistically important differences for the "PPG" indicator only for the teams that participated in the 2017 and 2019 European championships, respectively 67.81 and 57.69 points scored, supported by p=0 reliability; for the rest of the indicators, there are no statistically important differences, and they are due to occasional reasons.

Low results are also observed for the last U17 and U19 World championships. Table 2 presents a comparative analysis of the average values, in which it again becomes clear that the average realized points of the teams are around 62. Table 2 presents a descriptive statistics of the data of the two championships, which shows that again the average realized points of the teams are about 62.

**Table 2.** Descriptive Statistics of the average values for World Cup U17, 2018 World Cup U19, 2019

| Group | N | Min | Max | Mean±SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Total | 32 | 45.3 | 89.3 | 62.13±9.09 | .778 | 1.615 |
| U17 | 16 | 45.3 | 89.3 | 62.39±10.25 | .958 | 2.261 |
| U19 | 16 | 48.1 | 80.6 | 61.86±8.10 | .428 | .601 |

It is a matter of some concern that only four teams succeeded in surpassing the average limit of 70 points per match: the USA, China, Hungary and Japan. Some teams can score only between 40 and 55 points. The percentage correlation is again low: around 35% general shooting and 25% for 3-point shooting, while the lowest percentage for the performance of free throws is observed for U19, at 52.78%. The comparative analysis by t-criterion of student, which is annexed, does not show statistically significant differences for the symptoms under study.

Table 3 presents Descriptive Statistics for "PPG" indicator only for the teams of all ages that participated in the last European and World Championships.

**Table 3.** Descriptive Statistics of the "PPG" indicator for the teams of all ages that participated in the last European and World Championships

| Groups | N | Min | Max | Mean±SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| U16 | 16 | 40.60 | 75.70 | 59.13±9.63 | -.184 | -.237 |
| U18 | 16 | 56.40 | 79.00 | 66.18±7.33 | .464 | -.929 |
| U20 | 16 | 47.10 | 72.70 | 57.69±6.67 | .262 | .390 |
| U17 | 16 | 45.30 | 89.30 | 62.39±10.25 | .958 | 2.261 |
| U19 | 16 | 48.10 | 80.60 | 61.86±8.10 | .428 | .601 |
| Total | 80 | 40.60 | 89.30 | 61.45±8.79 | .350 | .639 |

It can be generalized that these age categories score per match 57.69 (U20) the least, and the highest result is 66.18 (U18). For the last two European women's basketball championships, the average efficiency of the teams is 66.39 p. for 2017 and 66.66 p. for 2019; however, for these teams, Range does not significantly differ from the teams under study.

ANOVA is applied to establish the importance of the differences in the average. During the 2019 European championships, ANOVA registrants for the "PPG" indicator has a statistically considerable higher realization of points for U18 only at 66.18, as compared to U20 who had a considerably lower number of points at 57.69 (Hkey HSD post-hoc test of Tukey, p=0.04). ANOVA does not register statistical differences for the rest of the teams and indicators under study.

## Discussion

The results of the study do not show essential differences in relation to the increase or decrease of the effectiveness of shooting baskets for the teams under study (i.e., U16, U18, and U20). The fact that they are in different age groups and have different years of playing experience does not privilege any of them in any way. They are approximately at the same

level as to scoring average points per championship. These observations are based on ANOVA results, which show that the younger U18 score more baskets than the older U20. Scoring baskets is the most important skill for basketball, but the players should have many others. The precision of shooting is determined by many factors, which we have not treated in our study; however, it is important to specify that modern basketball is very dynamic, varied, of and exceptionally aggressive defence, which hampers the precision of shooting and makes the players do it in difficult situations from various positions. That leads to changes in the tactical plan. More teams play by short attacks relying on the individual drive to the basket and extra pass. The purpose is to take the player to an open shoot, to be able to score undisturbed.

Nevertheless, the efficiency for the various ages is not increased, and the percentage of shooting, in general, is very close 33%, and for 3 points is 23%. Most interesting is the fact that for the free throw performance, the values surpass 70% only for U20 at the 2018 European championship. The performance of free throws is the only situation in the game in which shooting is made from the same position, without any counteraction, which provides the possibility for the player to rest for five seconds. Nevertheless, no considerable increase of the precision for the older groups is observed, which is confirmed by ANOVA.

It can be concluded that the precision of shooting of the upcoming players is a complicated matter, which depends on many factors, some of which will be an object of future study.

The results of the study cannot be generalized as clear availability of a decrease of the shooting effectiveness of the young players; neither can it be defined as positive as no increase of the realized points is observed during the period. The introduction of high technology means in the activities of the coaches in the modern world help their work but can also hamper it. More of the coaches count on specific apparatuses for establishing the functional state level; a greater part of the training sessions time is spent on fitness; the other part is used for deep tactical preparation and the most important element of the game – shooting baskets – is neglected. Everybody working in that area, but most of all coaches, should use at least 30% of the training time for specific shooting exercises, which could stop the process that could degrade women's basketball. The players should know how important it is to be able to score baskets from various difficult situations during a match. Only when the player knows for what she is exercising can she be convinced of the usefulness of certain exercises in favour of achieving success (Aleksieva, 2012). The results of the study suggest that if we want women's basketball to be interesting and attractive for the audience, we have to know that the heart of the game is the effectiveness of shooting the basket – something that many people forget.

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ORIGINAL SCIENTIFIC PAPER

# Differences in Anthropometric Characteristics and Body Composition between Two Elite Female Basketball Clubs – Champions of Slovenia and Champions of Montenegro

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**Abstract**

This research aimed to determine the differences among the female basketball players of the Women's Basketball Club (WBC) Celje, which is the champion team of Slovenia, and WBC Buducnost Bemax, which is the champion team of Montenegro, in terms of their anthropometric characteristics and body composition. A sample of 26 subjects was divided into two sub-samples. The first sub-sample consisted of 12 players of WBC Celje (average age 21.75±2.70), while the other sub-sample consisted of 14 players of WBC Buducnost Bemax (average age of 20.71±3.15). All players were tested in Podgorica, Montenegro. Anthropometric characteristics and body composition were evaluated using a battery of eleven variables: body height (cm), body weight (kg), triceps skinfold, back skinfold, biceps skinfold, abdominal skinfold, thighs skinfold, calf skinfold, body mass index (BMI), percentage of fat and muscle mass (kg). Differences in anthropometric characteristic and composition of the body of the female basketball players of two clubs were determined by using a discriminatory parametric procedure with t-test for small independent samples ($p<0.05$). It was found that the basketball players of Celje are slightly higher and have more body mass than the players of Buducnost Bemax. Also, there are significant statistical differences by two variables that estimate the calf skinfold and thigh skinfold, in favour of the Celje, but WBC Buducnost Bemax had better fat percentage value. These results could be helpful to other clubs and coaches in Slovenia and Montenegro, in selecting and planning of the training process.

***Keywords:*** *anthropometric characteristics, body composition, female basketball players*

## Introduction

The evolution of basketball, since its inception in 1891, and to this day, is characterized by significant changes in the demands placed on the top players (Ljubojevic & Nikolic, 2012; Vukasevic, Spaic, & Masanovic, 2018). Although the basic rules are practically the same, the characteristics of the game itself, speed, pace, energy, length of attack, number of shots scored, points scored, number of sprints, rebounds, duels, fouls, are changing very rapidly and in some way are defined as more complicated. In such conditions, basketball places extremely high demands on athletes regarding the players' morphological characteristics and motor ability (Ben Abdelkrim, El Fazaa, & El Ati, 2007; Ochoa, Hall, Alarcon, Arrayales, & Sanchez, 2014; Popovic, Akpinar, Jaksic, Matic, & Bjelica, 2013; Masanovic, 2019), and also determines selection criteria for this sport. The morphological profile of basketball players could be defined as extremely tall, with long extremities, arm spans, large hand, wide diameters of the knee, shoul-

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der joints (Karalejic & Jakovljevic, 2009; Ljubojevic & Nikolic, 2012; Popovic et al., 2013). In contrast, although the amount of subcutaneous adipose tissue is considered to have a negative effect on player efficiency, in basketball, this may vary with the position of the player on the team, as well as the body composition and somatotype of the player.

Basketball is, second to football, the most popular sport in the Balkans. National teams from the Balkans, or locals, have often won European championships, Olympic medals, and/or European club competitions. Regarding the countries of the teams we compared in this research, Slovenia was the winner of Eurobasket in 2017, while Montenegro participated in the FIBA Basketball World Cup 2019. WBC Celje is the champion and winner of the Slovenian Cup. In its history, the team has won ten Slovenian Championships and nine Slovenian Cups. WBC Buducnost is the champion of Montenegro and the winner of the national cup. In its history, Buducnost was 12 times a winner of the National Championship and 10 times a winner of the National Cup. Also, Celje and Buducnost have twice been WABA league champions, and in recent years they have been regular participants in the Final Four WABA League (regional league). WBC Celje is also a regular participant in the European competition (EuroCup).

Due to all of the above, this research aimed to identify differences in morphological characteristics and body composition of top players from two clubs, Slovenia and Montenegro. Also, we wanted to determine the model characteristics of top players playing WABA league. Specifically, to compare variables of the best Slovenian female basketball clubs with the variables of the best Montenegro female basketball clubs. Finally, based on this outcome, potential specificities in selected variables are compared.

## Methods

*Sample of subjects*

A sample of the subject consists of a total of 26 top-level female senior players who were members of two clubs who participated on Slovenian First League and Montenegrin First League and together participated in WABA league. The first sub-sample of the subjects consisted of 12 players of Women's Basketball Club Celje, average age 21.75±2.70, and 14 players of Women's Basketball Club Buducnost Bemax, average age 20.71±3.15. The players were tested in November 2019 in Podgorica, Montenegro, when two teams held games during the championship. All participants signed the approved consent form, which was in accordance with the Declaration of Helsinki.

*Sample of measures*

Anthropometric measurements were taken according to the IBP-International Biology Program recommendations. For the purpose of this study, eight morphological measures have been taken: body height, body weight, triceps skinfold, biceps skinfold, back skinfold, abdominal skinfold, calf skinfold, thigh skinfold, as well as three body composition assessment variables: body mass index (BMI), fat percentage and muscle mass.

To evaluate body composition, a Tanita body fat scale (model BC-418MA) was used. The principle of this scale is based on indirect measurement of the body composition; a safe electrical signal is transmitted through the body via electrodes located in the standalone unit. The Tanita scale, in its athletics mode, enables athletes to closely monitor their body weight, health condition and form with all relevant parameters. An anthropometer and calliper were used for morphological measurements.

*Data processing method*

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

## Results

Basic descriptive statistical parameters of anthropometric variables and body composition of the basketball players of the two clubs, for which the values of central measurements and dispersion tendencies are calculated, are presented in Tables 1 and 2: minimal (Min) and maximal (Max) values, arithmetic mean (Mean), standard deviation (SD), coefficient of curvature (Skewness) and elongation (Kurtosis). First, the central and dispersion parameters of the variables were analysed to evaluate the anthropometric characteristic and body composition of the female basketball players of WBC Celje (Table 1).

**Table 1.** Descriptive data for WBC Celje (Slovenia) female basketball players (N=12)

| Variable | Range | Min | Max | Mean±S.D. | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| age | 9.0 | 17.0 | 26.0 | 21.75±2.70 | 7.30 | -.45 | -.60 |
| body height (cm) | 33.0 | 165.0 | 197.0 | 182.54±8.62 | 74.25 | -.35 | .67 |
| body weight(kg) | 33.8 | 59.6 | 93.4 | 75.48±8.94 | 79.84 | .29 | .50 |
| triceps skinfold | 7.1 | 12.1 | 19.2 | 14.84±2.37 | 5.62 | .59 | -.83 |
| back skinfold | 13.0 | 6.0 | 19.0 | 10.93±3.49 | 12.17 | 1.00 | 1.71 |
| biceps skinfold | 7.0 | 5.0 | 12.0 | 6.48±1.96 | 3.83 | 2.75 | 8.34 |
| abdominal skinfold | 11.0 | 8.0 | 19.0 | 13.09±3.29 | 10.82 | .47 | -.31 |
| calf skinfold | 8.8 | 6.4 | 15.2 | 11.81±2.91 | 8.48 | -.62 | -.85 |
| thigh skinfold | 9.0 | 8.0 | 17.0 | 13±2.94 | 8.63 | -.18 | -1.04 |
| body mass index | 9.0 | 18.0 | 26.0 | 22.57±2.61 | 6.81 | -.34 | -.39 |
| percentage of fat | 9.0 | 17.0 | 25 | 21.33±2.53 | 6.40 | -.43 | -.42 |
| muscle mass (kg) | 14.0 | 27.0 | 41 | 33.27±4.37 | 19.11 | .50 | -.37 |

As shown in Table 1, it can be noted that all the variables are placed within the normal distribution boundaries, the results of which are based on dispersion and central parameters.

In general, according to all the statistical parameters listed, we can conclude that the survey is conducted on a sample that is known for top basketball players. By the value of skewness, it can be observed that in the variables of the back skinfold (1.00) and biceps skinfold (2.75), there was a slight inclination on the side of the lower results, which is good because subcutaneous fat is a disrupting factor for professional athletes. An insight into the results of the peak of the Gaussian curve (kurtosis) shows that there is no significant deviation from the normal distribution of the results for most variables. The most significant deviation from the normal values is seen in the variables biceps skinfold (8.34), and back skinfold (1.71), which for most athletes are homogeneous.

Table 2 showed the central and dispersion parameters of the variables that were analysed to evaluate the anthropometric characteristics and body composition of the female basketball players of WBC Buducnost Bemax.

**Table 2.** Descriptive data for WBC Buducnost Bemax (Montenegro) female basketball players (N=14)

| Variable | Range | Min | Max | Mean±S.D. | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| Age | 9.0 | 17.0 | 26.0 | 20.71±3.15 | 9.91 | .255 | -1.37 |
| body height (cm) | 28.0 | 168.0 | 196.0 | 181.57±8.16 | 66.57 | .089 | -.889 |
| body weight(kg) | 34.0 | 57.0 | 91.0 | 72.71±10.25 | 104.98 | .552 | -.516 |
| triceps skinfold | 9.0 | 10.4 | 19.4 | 14.36±2.8 | 7.82 | .215 | -1.04 |
| back skinfold | 14.0 | 7.0 | 21.0 | 11.27±3.65 | 13.34 | 1.42 | 3.28 |
| biceps skinfold | 10.0 | 5.0 | 15.0 | 7.59±2.58 | 6.66 | 2.08 | 5.77 |
| abdominal skinfold | 19.0 | 5.0 | 24.0 | 15.79±4.87 | 23.74 | -.347 | .673 |
| calf skinfold | 11.9 | 10.3 | 22.2 | 15.39±3.24 | 10.48 | .868 | .782 |
| thigh skinfold | 8.0 | 14.0 | 22.0 | 17.88±2.51 | 6.32 | .199 | -.904 |
| body mass index | 6.0 | 20.0 | 26.0 | 22.12±1.83 | 3.36 | .845 | -.114 |
| percentage of fat | 16.0 | 13.0 | 29.0 | 19.01±5.02 | 25.211 | .410 | -.428 |
| muscle mass (kg) | 13.0 | 25.0 | 38.0 | 32.83±3.54 | 12.55 | -.251 | .026 |

Based on the central and dispersion parameters of the values of the skewness and the kurtosis of WBC Buducnost Bemax, it can be stated that all the variables are within the normal distribution boundaries and that the values are very similar to those of the players from WBC Celje. It can also be noted that players of WBC Buducnost Bemax are younger on average. Furthermore, body height and body weight values are higher at WBC Celje. However, a comparative statistical procedure, a t-test (Table 3), shows whether this is statistically significant. By the value of the skewness, it can be observed that in the variables of the biceps skinfold (2, 08) and back skinfold (1, 42) there was a slight inclination on the side of the lower results, which is good because subcutaneous fat is a disrupting factor for professional athletes. Similar results were obtained with WBC Celje. An examination of the results of the peak of the Gaussian curve (kurtosis) shows that there is a significant deviation from the normal distribution of results in most values. The largest significant deviation from the normal values is seen in the variables back skinfold (3.28), and biceps skinfold (5.77), where it is evident that there is a grouping of results around the mean.

To determine whether there are statistically significant differences in the analysed variables of the top basketball players of these two clubs, the t-test statistical procedure (Table 3) was applied.

**Table 3.** Descriptive data and t-test of 26 female basketball players members of two female basketball clubs (Celje and Buducnost Bemax)

| Variables | WBC Celje | WBC Buducnost | t | Sig. |
|---|---|---|---|---|
| | M±SD | M±SD | | |
| age | 21.75±2.70 | 20.71±3.14 | .903 | .376 |
| body height (cm) | 182.54±8.61 | 181.57±8.15 | .293 | .772 |
| body weight(kg) | 75.47±8.93 | 72.71±10.24 | .736 | .469 |
| triceps skinfold | 14.842±2.37 | 14.364±2.79 | .471 | .642 |
| back skinfold | 10.93±3.48 | 11.27±3.65 | -.241 | .812 |
| biceps skinfold | 6.48±1.95 | 7.59±2.58 | -1.244 | .226 |
| abdominal skinfold | 13.09±3.28 | 15.79±4.87 | -1.672 | .108 |
| calf skinfold | 11.808±2.91 | 15.386±3.23 | -2.966 | .007* |
| thigh skinfold | 13.00±2.93 | 17.88±2.51 | -4.510 | .000* |
| body mass index | 22.57±2.61 | 22.12±1.83 | .487 | .632 |
| percentage of fat | 21.33±2.53 | 19.01±5.02 | 1.503 | .148 |
| muscle mass (kg) | 33.27±4.37 | 32.83±3.54 | .274 | .787 |

Legend: * p<.05

Based on the results of the t-test (Table 3), it was found that the players of the two clubs have statistically significant differences in the two variables that estimate the calf skinfold and thigh skinfold.

## Discussion

In recent decades, basketball has undergone major changes. By changing the rules of the basketball game in terms of shortening attack time, changes in the dynamics and style of the game, basketball became more demanding for players and requires anthropological characteristics adequate to that level of quality performance, as well as functional and motor skills. Morphological characteristics occupy an increasingly important place in the primary selection of basketball players.

The results of the t-test for the values of all six tested skinfolds were in favour of WBC Celje. However, not all of them have shown statistical significance. The values of the calf skinfold significantly differ by 0.007, in favour of WBC Celje. Also, the value of the thigh skinfold has shown a statistical significance of 0.000. In addition, values of upper skinfolds (biceps, triceps, abdomen and back) are in favour of WBC Celje, but that did not show special significance. Consequently, it can be concluded that WBC Celje have less subcutaneous adipose tissue than the players of Buducnost Bemax.

If we compare the values of the height of WBC Celje and WBC Buducnost Bemax, we can conclude that results approximate the values of the height of these clubs with average height teams participating in Women Euroleague 2019/20 (Table 4), as the highest quality club competition in Europe. Also, we see that the average height of WBC Celje (182.54 cm) is taller than that of BLMA (179 cm), **Asvel (180 cm) and Praha (181cm). However, it approximately equals that of Castors Braine (182 cm) and is lower than all other teams on average. Players of Buducnost Bemax are taller than those of BLMA (179 cm), Asvel (180 cm), and have equal values as those of Praha (181 cm). Therefore, the average height of teams from these areas is less than most teams playing high-level European competition. This can be explained by the fact that the teams playing Women's Euroleague are made up of a large number of internationals, while the teams examined in this research are mostly made up of domestic players, which can be a good indicator of the importance of height as a morphological feature in reaching high ranges. In support of this claim, results obtained among the players of the Spanish first (183.2 cm) and second (180.2 cm) divisions are also relevant (Salgado-Sánchez et al., 2009). The difference in the level of competition is also seen in the differences in the average height of the players, in favour of a higher level of competition. The average values of WBC Celje and WBC Buducnost Bemax are lower than Spanish First division players and higher than Spanish Second division players. If we compare these with the results with other teams from this area, then we can say that the average values of the height of the players of these two teams are higher than the female players of the Bosnian First league, at 177.6 cm (Basinac, Mikic, & Pojskic, 2009), and the Greek basketball players (Bayios, Vergeles, Apostolidis, Noutsos, & Koskolou, 2006) from the second division, whose average height is 174.7 cm.

**Table 4.** Body height and age of teams participating in Women Euroleague 2019/20

| Team | State | Height (cm) | Age |
|---|---|---|---|
| Arka | Pol | 184 | 25 |
| Bourges Basket | Fra | 184 | 26 |
| Dynamo Kursk | Rus | 185 | 28 |
| Fenerbahce | Tur | 183 | 26 |
| Asvel | Fra | 180 | 25 |
| Venezia | Ita | 184 | 28 |
| Girona | Ita | 183 | 27 |
| UMMC Ekaterinburg | Rus | 185 | 27 |
| BLMA | Fra | 179 | 23 |
| Castors Braine | Bel | 182 | 25 |
| Famila Schio | Ita | 184 | 26 |
| Gelecek Koleji Cukurova | Tur | 183 | 24 |
| Nadezhda | Rus | 183 | 27 |
| Sopron | Hun | 185 | 26 |
| TTT Riga | Lat | 184 | 23 |
| ZVVZ USH Praha | Czech | 181 | 24 |

In comparison with the national teams participating in Eurobasket 2019, we can conclude that WBC Celje and WBC Buducnost Bemax have approximate results in body height as the five first-ranked teams (Spain, France, Serbia, whose average height is 182 cm, Great Britain and Belgium, whose average height is 181 cm). Average height values are lower than Turkey's national team, with an average height of 185 cm, the highest on the EP, as well as the Montenegro, Ukraine and Russian national teams (184 cm). In contrast, their results are higher only in comparison with the Slovenian national team (180 cm) (FIBA Women's EuroBasket 2019).

Having all this in mind, we can conclude that the average height of women's basketball players of WBC Celje and WBC Buducnost Bemax have approximate results in body height and that their average heights are lower than most Euroleague teams. In contrast, these values are similar to the values of the most successful national teams at the last European Championship. Compared to other national leagues, the height values are higher, which also means a higher level of competition.

During the game, players move in different ways: walking, walking in different directions and with different body orientation relative to the direction of movement, walking with pivoting, straight running, running in different directions and with different body orientation with respect to the direction of movement, jump up one leg, high jump with both legs (Nazaraki, Berg, Stergiou, & Chen, 2009). In order to have the excellent motor movements mentioned above, we must em-

phasize that the value of body fat component is physiologically significant.

The average body mass values of the respondents are also approximate (WBC Celje 75.47±8.93 and WBC Buducnost Bemax 72.71±10.24). We can conclude that the players of WBC Celje and WBC Buducnost Bemax have approximately equal values of body height and body weight. This can be explained by the equal level of competition in which they participate (WABA league), as well as the region from which these players are selected. Results in weight of Celje and Buducnost Bemax players are similar and narrow with the values of the players in Spanish second division (Salgado-Sánchez et al., 2009).

Body mass values are lower than those of the first division basketball players of the England Basketball Division (Berdejo-del-Fresno, Lara-Sances, & Gonsales-Rave, 2012), and those of the Second Spanish League, and have approximate values with the players of the First Spanish League at 74.3kg (Salgado-Sánchez et al., 2009).

Observing the results of values of BMI for WBC Celje (22.57±2.61) and WBC Buducnost Bemax (22.12±1.83), we can conclude that there are no significant differences between the two clubs. We can say that these results are the same in comparison with other studies (Nunes et al., 2008; Salgado-Sánchez et al., 2009; Berdejo-del-Fresno et al., 2012).

The average fat percentage variable values are also approximate: 21.33±2.53 for WBC Celje and 19.01±5.02 for Buducnost Bemax. The result of the average value in the case of Celje is slightly lower compared to the results of the highest level of Spanish basketball players (Salgado-Sánchez et al., 2009), whose fat percentage was 19.01. The case of Buducnost Bemax is completely identical (19.01). It should be noted that Celje players have poor results when it comes to the fat percentage, which can affect their motor performance, since it is known that players with lower body fat content invariably perform at a higher level than those with higher body fat (Ostojic, 2002).

Results of the muscle mass value were in favour of WBC Celje (33.27±4.37), Buducnost Bemax measured some lower results (32.83), but this did not show notable significance. However, compared to the results from the Spanish league (Salgado-Sánchez et al., 2009), that showed 44.3, we may conclude that both clubs show poorer values, which can be explained by the fact that the teams surveyed are relatively young (21.75 and 20.71), and that they have time to make progress in muscle mass value, assuming of course, if the training processes are focused on that. In contrast, the comparison with the Spanish League teams may not be the most optimal, as it is the strongest in Europe and the highest quality players play in it. Compared to results (Ljubojevic, Bojanic, Bjelica, Vasiljevic, & Vukotić, 2020) of the National team of Montenegro (32.83), Buducnost Bemax results are identical, whilst Celje is approximately the same, indicating that it is a similar sample, from the same region, from which the selection of female players is made for these clubs.

The subject of this paper was to study the morphological status of top elite female basketball players, who are members of two selections that participate in the WABA League 2019/20, and that were the champions of Slovenian and Montenegrin National leagues. The goal was also to obtain quantitative data that can be used to determine the morphological model and define the morphological status of elite basketball players.

The results showed that the players of WBC Celje and Buducnost Bemax are equal in age and height. Also, in terms of height, they are similar to the best-placed teams in the European Championship, but their average height is lower than most teams that play Euroleague. On average, they are taller than many previous subjects in research, who have been part of major international competitions but also national leagues. It was also found that WBC Celje players had better skinfolds, while Buducnost Bemax had better fat percentage value. Finally, we can conclude that the results obtained in this research can serve to compare the future selections of Celje and Buducnost Bemax. This survey can be useful for another comparison in regard to other selections, on local or national levels, in order to achieve different results than those treated here.

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**Conflict of Interest**

The authors declare that there are no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

# A Comparative Study of Differences in Consumers' Impulse Buying Behaviour, Purchase Satisfaction, and Complaint Behaviour Based on Types of Product Purchased

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**Abstract**

The internet enables consumers not only to buy products anywhere and at any time but also to compare prices and make informed consumption decisions. However, the increased convenience resulting from advancements in technology has simplified consumers' decision-making process, thereby leading to impulse buying behaviour. In the present study, the differences among consumers' impulse buying behaviour, purchase satisfaction, and complaint behaviour were compared based on the types of product purchase decisions (online v. offline). A total of 382 customers who had previously bought sportswear and voluntarily participated in the present study were divided into two groups, based on their preferred type of purchase. The respondents completed a questionnaire survey regarding their impulse buying behaviour, purchase satisfaction, and complaint behaviour. SPSS/AMOS 23.0 version was used to confirm the reliability and credibility of the collected data, and a multivariate analysis of variance was used to compare the participants' questionnaire responses regarding their consumption behaviour, based on their preferred type of purchase. The results showed that although consumers who preferred online purchasing were increasingly likely to exhibit impulse buying behaviour, they did not complain about their purchase dissatisfaction. In comparison, although consumers who preferred offline purchasing were more satisfied with the product they bought, they indulged in private complaint behaviour regarding their purchase dissatisfaction. The study results show that consumers exhibited different behaviours, depending on their preferred type of purchase. The present study results serve as an important reference for understanding evolving consumption trends through a multi-faceted approach.

***Keywords:*** *consumer behaviour, impulse buying, purchase satisfaction, complaint behaviour*

## Introduction

The arrangement of five working days per week and shorter statutory working hours has been firmly established for decades. Therefore, a growing number of people are becoming increasingly interested in improving their well-being, enjoying various leisure activities, and improving their quality of life. In particular, leisure sports activities are gaining significant attention. Kim (2003) stated that participation in leisure sports not only strengthens the physical body but also significantly affects peoples' psychological stability by relieving stress and depression or relaxing their minds. Furthermore, participation in these sports activities serves as a platform for people to network with others who have common interests (Kim, 2003). The growth of the leisure sports market has led to an increase in the purchase

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of sportswear. According to the Korea Federation of Textile Industries, the sportswear market earned approximately USD 3 billion in 2010; however, the market grew beyond USD 5.4 trillion in 2018 (Maeil Business Newspaper, November 18, 2018).

In the leisure sports market, increasing numbers of consumers want to buy products easily from online shopping malls anywhere and at any time. Hoffman and Novak (1996) defined online shopping malls as a technological system wherein customers purchase items through the internet, instead of buying products from physical stores or shops. An advantage of online shopping is that it allows consumers to compare a wide range of products and prices for easy consumption at any place and time (Bloch & Pigneur, 1995). Due to this advantage, the Korea Information Society Development Institute states that the Korean online shopping market has grown 19.4% on average annually from 2013 to 2018 and predicts that it is expected to exceed USD 837 billion in 2019 and USD 155 billion in 2022 (Munhwa Ilbo, July 4, 2017). This fact is cited as one of the most important reasons that smartphone-based mobile shopping has become a popular choice among people with busy lives.

Although online shopping provides clear advantages from the consumer's perspective, it is highly likely to lead consumers to indulge in impulse buying behaviour while casually browsing the internet (Parboteeah, Valacich, & Wells, 2009). Shon and Yoon (2012) noted that more impulse purchases were made online than offline, and fashion products accounted for the highest percentage of products purchased on impulse. Solomon (1996) argued that these impulsive buyers are those who do not plan their shopping and tend to buy things based on their uncontrollable impulses. Studies have reported that these impulsive buyers experience positive or negative emotions after making purchase decisions (Rook & Hoch, 1985). Because consumers experience these emotions after making purchase decisions, their willingness to buy a product may be affected. An in-depth study is required for this topic.

Impulse buying behaviour occurs spontaneously when a consumer has weak control over themselves (Rook, 1987) and refers to an unplanned purchase behaviour caused by exposure to an unspecifiable stimulus (Piron, 1991). Lee (2005) provided the following explanation about the unique characteristics of impulse buying: Consumers who frequently exhibit impulse buying behavioural patterns voluntarily react to an external or internal stimulus, although they did not plan to shop. Moreover, this behaviour is accompanied by a strong desire that is difficult to control and stems from the consumer's lack of cognitive behaviour. This behaviour is governed by pleasure instead of reasonable thinking. A common factor among these consumers is that, for a short moment, they experience an enormous internal conflict due to their unplanned or unexpected behaviour. Studies have reported that women were more likely to exhibit impulse buying behaviour in comparison to men (Rook & Hoch, 1985). This behaviour is also commonly noted among younger people or people with higher income (Bellenger, Robertson, & Hirshman, 1978). Although some studies have reported that consumers experience negative emotions after indulging in impulse buying behaviour (Rook, 1987), several other studies have suggested that consumers feel satisfied instead (Park, 2017). Therefore, empirical studies analysing whether consumers experience satisfaction after indulging in impulse buying behaviour would be useful.

Although customer satisfaction does not have a conclusive definition, it is regarded as a type of pleasure that consumers perceive about a product or service (Hellier, Geursen, Carr, & Rickard, 2003). Kotler and Keller (2006) argued that the compatibility, or incompatibility, between consumers' pre-purchase expectations and post-purchase emotions leads to consumers experiencing either joy or disappointment, which results in practical satisfaction. Consumers' cognitive or emotional evaluations regarding a product or service may directly or indirectly affect their satisfaction (Mano & Oliver, 1983). Consumer dissatisfaction is an unfavourable emotion that stems from consumers' unmet expectations (Smith & Bolton, 2002). Because consumer dissatisfaction can lead to various types of complaint behaviours, customer satisfaction is considered crucial from the perspectives of producers or sellers (Mowen, 1990).

Customer complaint behaviour refers to any action that includes consumers providing negative feedback to third parties while they are feeling dissatisfied with the product or service that they purchased or sending negative feedback to producers or sellers (Lee, 2009). Day (1980) categorized complaint behaviour into two types: private and public. Private complaint behaviour refers to consumers expressing negative emotions about the product or service with which they experienced dissatisfaction to others, including their family and friends. Public complaint behaviour refers to consumers requesting compensation or refunds or filing a complaint or lawsuit with an official institution (Choi, Lee, Oh, & Suh 2004). Park and Moon (1990) reported that young people primarily engage in compliant behaviour, which is increasingly common among groups with a higher-than-average level of education or income. Therefore, because customer satisfaction or complaint behaviour intention can significantly affect a firm's profitability or image, the effect of impulse buying on these variables should be analysed.

Therefore, the present study analyses the differences among impulsive buying behaviour, purchase satisfaction, and complaint behaviour among consumers buying sportswear, based on their preferred type of purchase (online vs offline).

## Methods

*Participants and data collection*

The target population was limited to adults aged 20 years or older, who had previously purchased sportswear on impulse. Data were collected from April to May 2019 (2 months) from three sports centres located in Seoul. The respondents, who voluntarily participated in the questionnaire survey, were informed about its purpose before they completed the survey. They were first requested to fill out their demographic information in the questionnaire and were then prompted to respond to the question about their preferred type of purchase, which was set as an important independent variable in the present study ("What type of purchase do you usually prefer while buying sportswear?"). The respondents were asked to select either online or offline purchasing as their preferred type of purchase. Those who had experienced both types of purchases were asked to select their preferred type of purchase.

Among the 550 distributed questionnaires surveys, 411 responses (approximately 74.7% response rate) were collected. Among the 411 collected responses, 29 responses with incomplete or inappropriate responses were excluded. These 29 excluded surveys either did not contain responses to more than half the questions, or they provided the same answer to all of the questions. A total of 382 questionnaire responses were used in the present study to compare the consumption behaviour

of consumers who purchased sportswear online or offline. The respondents were divided into two groups: online purchasing group (Group 1, n=207, 54.18%) and offline purchasing group (Group 2, n=175, 45.81%). Table 1 provides the demographic information of the respondents and includes their preferred type of purchase.

**Table 1.** Descriptive Statistics

| | | Online consumer (Group 1) | Offline consumer (Group 2) |
|---|---|---|---|
| Gender | Male | 112 (54.1%) | 95 (54.3%) |
| | Female | 95 (45.9%) | 80 (45.7%) |
| Age | 20s | 66 (31.9%) | 20 (11.4%) |
| | 30s | 56 (27.1%) | 33 (18.9%) |
| | 40s | 48 (23.2%) | 49 (28.0%) |
| | 50s | 31 (15.0%) | 40 (22.9%) |
| | Over 60s | 6 (2.9%) | 33 (18.9%) |
| Favourite Sport | Baseball | 30 (14.5%) | 15 (8.6%) |
| | Basketball | 37 (17.9%) | 32 (18.3%) |
| | Golf | 51 (24.6%) | 45 (25.7%) |
| | Running | 38 (18.4%) | 33 (18.9%) |
| | Gym | 28 (13.5%) | 35 (20.0%) |
| | Yoga | 11 (5.3%) | 3 (1.7%) |
| | Hiking | 12 (5.8%) | 12 (6.9%) |
| Total | | 207 (54.18%) | 175 (45.81%) |

*Measures*

A single factor (3 items) that was used by Kim (2014) to analyse the effect of impulse buying on consumer behaviour was revised and adapted as the impulse buying factor in the present study. A single factor (3 items) that was used in previous studies to examine consumers' purchase satisfaction after impulse buying (Kang, Jing, & Park, 2014) was applied as the purchase satisfaction factor in the present study, without any revision. A scale that was used in previous studies regarding consumer behaviour (Lee, 2017) was revised and adapted as the complaint behaviour factor in the present study. Ten items under three sub-factors (inaction and private and public complaint behaviours) were adapted from the previous study, and one item listed under public complaint behaviour was removed in the present study. Each factor was based on a Likert scale, ranging from "strongly disagree (1 point)" to "strongly agree (5 points)". Table 2 lists the items included in the questionnaire.

*Data Analysis*

SPSS/AMOS 23.0 version was used to process all data in the present study. Descriptive statistics were used to identify demographic information, including the respondents' preferred sports. Cronbach's alpha coefficient was used to test the reliability of the data. The comparative fit index (CFI), the Turker-Lewis index (TLI), and the root mean square error of approximation (RMSEA), which are designed to demonstrate validity, were applied to conduct a confirmatory factor analysis. Finally, a multivariate analysis of variance (MANOVA) was conducted to analyse the differences in consumers' impulse buying behaviour, purchase satisfaction, and complaint behaviour, based on consumers' type of sportswear purchase.

## Results

*Scale Validity and Reliability*

The results of the confirmatory factor analysis showed that all the values of the parameter estimate (greater than ±1.96) exceeded the baseline. The goodness of fit test showed CMIN=115.177, DF=109, P=.324, CMIN/DF=1.057, CFI=.998, TLI=.997, and RMSEA=.012. The result is satisfactory when CFI and TLI are greater than .900 and when RMSEA is less than .800, respectively. Therefore, the validity of the scale was ensured based on all the baselines.

In addition, the reliability of the scale was tested based on Cronbach's alpha coefficients and after applying the baseline (greater than .70): (a) impulse buying (α=.899), (b) purchase satisfaction (α=.818), and (c) complaint behaviour (inaction, α=.832; private complaint behaviour, α=.830; and public complaint behaviour, α=.801). Therefore, all numbers exceeded the baselines, thereby ensuring the reliability of the scale. Additional information is provided in Table 2.

**Table 2.** Results of Confirmatory Factor Analysis and Reliability Analysis

| Factor | Questions | Estimate | S.E. | C.R. |
|---|---|---|---|---|
| Impulse Purchase (α=.899) | | | | |
| | I have purchased sportswear that I had no prior plans of purchasing after watching an advertisement indicating that there was not much time left to buy it. | 1.000 | | |
| | I have purchased sportswear on impulse after watching an advertisement indicating that there were a limited number of stocks available. | .852 | .057 | 14.955*** |
| | I had not considered buying sportswear, but I have purchased it on impulse. | 1.069 | .058 | 18.300*** |
| | When I purchase sportswear, I often do so on impulse. | .718 | .045 | 16.049*** |
| | I have bought the latest, popular sportswear without any prior plans to purchase it because it looked attractive. | 1.223 | .061 | 20.042*** |

*(continued on next page)*

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| Factor | Questions | Estimate | S.E. | C.R. |
|---|---|---|---|---|
| Purchase Satisfaction (α=.818) | | | | |
| | I am positive with the things that I impulsively buy. | 1.000 | | |
| | I am satisfied with the things that I impulsively buy. | .705 | .060 | 11.766*** |
| | I am pleased with the things that I impulsively buy. | 1.314 | .090 | 14.656*** |
| Complaint Behaviour | | | | |
| Inaction (α=.832) | | | | |
| | I did not complain about a dissatisfactory product. | 1.000 | | |
| | I did not make a complaint. | .733 | .056 | 13.094*** |
| | I just moved on. | .791 | .053 | 14.992*** |
| Private Complaint Behaviour (α=.830) | | | | |
| | I discussed my dissatisfaction with the product among my family or friends. | 1.000 | | |
| | I informed my family or friends about the dissatisfactory aspects of the product. | .658 | .054 | 12.275*** |
| | I informed my family and friends that they should not purchase the product. | .784 | .049 | 15.868*** |
| Public Complaint Behaviour (α=.801) | | | | |
| | I officially requested a refund. | 1.000 | | |
| | I visited the relevant institution and requested them to resolve my complaint. | .747 | .066 | 11.363*** |
| | I took legal action, such as legal counselling, to receive compensation. | .903 | .070 | 12.813*** |

*Multivariate Analysis of Variance (MANOVA)*

MANOVA was conducted to analyse the differences in consumers' impulse buying behaviour, purchase satisfaction, and complaint behaviour factors, based on their preferred type of purchase. The homogeneity of covariance was tested (Box's M=17.079, F=1.122, p>.05), thus confirming statistically significant differences between the two groups (Wilks' lambda=0.784, F=20.679, p<.05). As shown in Table 3, statistically significant differences between the two groups were observed among impulse buying, purchase satisfaction, inaction, and private complaint behaviour (under complaint behaviour), whereas no statistically significant difference was noted in public complaint behaviour, which is yet another sub-factor categorized under complaint behaviour.

**Table 3.** Results of Multivariate Analysis of Variance

| Dependent Variables | df | F | p | $\eta^2$ |
|---|---|---|---|---|
| Impulse Purchase | 1 | 6.929 | .009* | .018 |
| Purchase Satisfaction | 1 | 76.008 | .000* | .167 |
| Complaint Behaviours | | | | |
| Inaction | 1 | 5.065 | .025* | .013 |
| Private Complaint Behaviour | 1 | 16.408 | .000* | .041 |
| Public Complaint Behaviour | 1 | 3.037 | .082 | .008 |

Legend: *p<.05

In addition, Table 4 shows the average of the dependent variables between the groups identified from the questionnaire used in the present study.

**Table 4.** Mean Scores of Dependent Variables by Groups

| | Impulse Purchase | Purchase Satisfaction | Inaction | Private Complaint Behaviour | Public Complaint Behaviour |
|---|---|---|---|---|---|
| Group 1 | 2.586 | 2.412 | 2.683 | 2.478 | 2.523 |
| Group 2 | 2.327 | 3.191 | 2.469 | 2.895 | 2.358 |

Legend: Statistically significant higher mean scores between groups in bold.

## Discussion

The present study analysed consumers' behaviour regarding purchasing, which has become increasingly simplified and convenient due to the use of the internet and smartphones. The growing use of online purchasing provides many benefits to consumers and leads to changes in people's consumption patterns by causing consumption phenomena, such as impulsive buying (Limayem, Khalifa, & Frini, 2000). Therefore, comparing online and offline purchases aids in understanding of the newly changed consumption environment. Although impulse buying leads to negative consequences, it can also garner some positive responses (Solomon, 1996). Therefore, conducting a comparative analysis in the present study can provide a meaningful interpretation of the psychology of consumers' purchase patterns.

The results of the comparative analysis on consumers' impulse buying behaviour, purchase satisfaction, and complaint behaviour, based on their preferred type of purchase (online vs offline) showed that the consumer group which preferred online purchasing had higher scores for impulse buying and inaction (under complaint behaviour). These results can be interpreted to reflect the characteristics of online purchasing.

One of the advantages of online purchasing is that it allows anyone to use the internet to buy items anywhere and at any time (Bloch & Pigneur, 1995). However, this may also become a disadvantage of online purchasing because although consumers can easily buy products by using the internet or smartphones, their impulse purchase decision occurs without giving them a chance to check the item physically. These results are consistent with that of a previous study wherein consumers' inclination toward impulse buying was more noticeable in online purchasing (Shon & Yoon, 2012). There is a possibility of consumers mistaking low-quality products for high quality ones instead and buying them on impulse.

Moreover, consumers are easily exposed to product advertisements while purchasing products online through digital devices, which stimulates their purchase desire and impulse buying. These advertising effects were noted to have stimulated online buyers' impulse buying behaviour in the present study. Online purchasing exposes consumers to many advertisements, thus triggering impulse buying behaviour, without allowing consumers to check products physically. In addition, the disadvantage of online impulse buying is increasingly noticeable in inaction (under complaint behaviour), a factor wherein the online purchasing group in the present study had higher scores. This result suggests that consumers did not complain even though they were dissatisfied with the product, thus transforming an advantage of online purchasing into a disadvantage. Because face-to-face interaction with consumers is impossible in online purchasing, the scope for expressing complaint behaviour may also be limited. Hankyoreh (2017) argued that completely removing interaction to ensure convenience can cause a crisis of the manufacturing and service sectors in the technological industry.

In contrast to the aforementioned results, the offline purchasing group received higher scores for purchase satisfaction and private complaint behaviour (under complaint behaviour). These results have significant implications on the recent situation in which online purchasing has become increasingly popular among customers. Purchase satisfaction is recognized as the most important factor in studies analysing consumer behaviour because the concept of satisfaction has a positive effect on other factors in consumers' decision-making process (Mano & Oliver, 1983). Consumers who are satisfied with a product not only provide a favourable evaluation regarding the price of the product but also have an increased tendency to buy the product again (Choi, Greenwell, & Lee, 2018). Therefore, the results of the present study show that the offline purchasing group indicated a higher average score for satisfaction. This result suggests that offline purchasing is a smart consumption behaviour, compared with the convenience of online purchasing.

Furthermore, the offline purchasing group indicated a higher average score for private complaint behaviour (under complaint behaviour), which would be affected by the aforementioned results of inaction. Many consumers in the online purchasing group showed inaction and did not complain about products they deemed dissatisfactory. Therefore, the offline purchasing group would receive a higher score in private complaint behaviour. However, the offline purchasing group was not as impulsive as the online purchasing group and showed discreet consumption patterns with a higher level of purchase satisfaction, which suggests that these consumers are increasingly likely to be active in complaint behaviour.

The present study compared impulse buying behaviour, purchase satisfaction, and complaint behaviour between the online and offline purchasing groups to examine the development of online purchasing in recent years. The study results confirmed the advantages and disadvantages of both online and offline purchasing. In addition, consumers showed varying consumption behaviours, depending on their preferred type of purchase (online vs offline), which serves as an important reference for future studies that aim to establish a marketing strategy based on consumer behaviour.

*Limitations*

In recent years, online purchasing has become increasingly popular among consumers, and most consumers engage in both online and offline purchases. During the data collection process, the respondents selected their preferred type of purchase and were fully informed about the aim of the present study. Therefore, the respondents completed the questionnaire based on their personal experiences regarding their selected type of purchase. However, because an individual's intricate decision-making process is unintentionally affected by his or her past experiences, it may raise questions regarding the objectivity of the recorded responses. Therefore, in the future, researchers can conduct a qualitative study to gather more subjective opinions.

In addition, many other factors can influence a consumer's purchase patterns. Numerous studies have reported that factors, such as the product price or type of purchase, may significantly affect consumer decision-making. The same consumer may show different consumption behaviour if the product price is lower or higher than those used in the present study. For instance, even if a consumer was dissatisfied with a product after buying it on impulse, they were unlikely to indicate complaint behaviour if the product price was low. Therefore, future studies regarding consumer behaviour should consider more varied factors.

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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 Effect of Respiratory Muscle Training on the Maximum Oxygen Consumption and the Anaerobic Threshold

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**Abstract**

The purpose of this research was to determine if respiratory muscle (RM) training, through the MRFit protocol, increases the maximum oxygen consumption and the anaerobic threshold in a group of young professional swimmers, to improve their sports performance. Eleven professional swimmers (7 women and 4 men) between 13 and 17 years old were recruited in this study. Participants were randomly assigned into two groups: control (CG) and training (TG). TG received RM training (MRFit) 20 minutes, two times a week for eight weeks incorporated into their usual training, while the CG only continued their usual training. All the participants performed, before and after the training, ergospirometric tests on a treadmill, to compare the results at the end of the eight weeks. Subsequently, a parametric statistical analysis was performed via a t-test. No significant differences were found for $VO_2$max between CG and TG nor for the anaerobic threshold ($p>0.05$). Despite the non-significant results, we have determined different tendencies between both groups and clinical improvements.

***Keywords:*** *respiratory muscles training, maximum oxygen consumption, anaerobic threshold, physical performance, young athletes*

## Introduction

Over the years, one of the main objectives of the professionals dedicated to physical activity and sport has been to find a way to improve the factors that indicate an increase in physical performance, such as aerobic capabilities, evaluated through maximum oxygen consumption ($VO_2$max) and the anaerobic threshold.

$VO_2$max is one of the parameters most commonly used in the physiology of exercise in the evaluation process, and to define cardiorespiratory fitness (Riboli, 2015); however, direct measurement of $VO_2$max technically requires access to expensive laboratories, equipment and specialized personnel (Koutlianos et al., 2013). The most commonly used method for the direct measurement of $VO_2$max, during progressively incremental exercise, is the treadmill or the cyclo-ergometer (A. Viru, & M. Viru, 2003); an indirect calorimetry system is also required. Using these methods, the evaluated subject must exercise with great intensity.

The "anaerobic threshold" is a parameter that indicates the intensity of the exercise in which the anaerobic system significantly begins its participation in the production of energy for the movement (Mora, 2010). This term is used to define the sudden increase in the ventilatory equivalent, caused by the non-metabolic production of carbon dioxide by the accumulation of lactate (Katch, McArdle, & Katch 2015); therefore, measuring the anaerobic threshold enables obtaining information on physical performance. Due to the higher the anaerobic threshold, the feeling of fatigue is delayed.

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The general training of an athlete, related to muscle strengthening and resistance, is a well-documented and investigated topic. According to Bompa (2003), a more solid knowledge basis has been developed in sports, directly reflecting the methodological aspects of the training; however, the strengthening of the respiratory muscles (RM) in relation to the sports performance has barely been studied (González et al., 2012).

It is a fact that the RM play a fundamental role during the performance of physical exercise through their action in the maximum capacity of obtaining oxygen; therefore, the fatigue of these muscles during exercises that require high intensity can be a cause of implications directly related to sports performance (Romer & Polkey, 2008), such as direct implications in the VO2max and the anaerobic threshold. The fatigue of these muscles seems to be due to the high levels of work of the RM combined with a competition for blood with the locomotor muscles. Janssens et al. (2013) believe that the fatigue of the RM contributes to the limitation in the execution of exercises and respiratory failure; therefore, the RM must be used.

In swimming, the work of the RM implies great demand, because when the body is horizontal in the water, the respiratory muscles decrease their capacity to generate force by 16%, in comparison to when the body is placed vertically; therefore, fatigue is experienced during the training of this sport due to the high oxygen demand (Biolaster, 2009).

For almost two decades, researchers have been concerned with determining the effect of strengthening respiratory muscles on physiological markers. William and Dupler (2002), Bravo et al. (2005), Aznar et al. (2007), Jakhotia et al. (2014) focused on different areas of application; therefore, the results are diverse. Positive results have been observed in elderly populations (Aznar et al., 2007), in smokers (Bravo, 2005), in long-term effects after a Stroke (Parreiras, Rodríguez, Cunha, Ada, & Teixeira, 2016) and in chronic obstructive pulmonary disease (COPD) (Hassan, 2017) In contrast, in populations of children and adolescents with neuromuscular diseases (Human, Corten, Jelsman, & Morrow, 2017), as well as in the sports field, no conclusive results have been found, because of the diversity of existing protocols (González et al., 2012, Ozmen, Gunes, Ucar, Dogan, & Gafuroglu, 2017).

The aim of this research was to determine if respiratory muscle (RM) training, through the MRFit protocol, increases the maximum oxygen consumption and the anaerobic threshold in a group of young professional swimmers, to improve their sports performance.

## Methods

*Design and participants*

The present study is quantitative and correlational field research, with experimental design and a grade II manipulation of the independent variable. This study was in agreement with the principle of the Helsinki Declaration and approved by the ethical committee in the sports club Alpha. Eleven young professional swimmers (7 women and 4 men) were recruited in this experimental research (age: 14.3±1.2 years; weight: 57.7±9.4 kilograms; height: 165.7±5.5 centimetres). Because all the participants in the study were underage, written informed consent was given the parent or legal guardian of each participant. The inclusion criteria of participants were: professional swimmer (a professional swimmer defined, according to the information provided by club Alpha 2, like the athlete who participates in state and national competitions in any swimming discipline), belong to the youth 500 programme in Club Alpha 2, ages between 13 and 17 years and good state of health and previous medical evaluation. The exclusion criteria also were health problems, lack of permission from parents or guardians, and ages out of range.

*Protocol*

Subjects were randomly divided into two groups: the control group (CG n=5), carried out their usual training without MRFit, and the training group (TG n=6) performed RM training (MRFit) 20 minutes, two times a week for eight weeks incorporated into their usual training. All the participants performed, before and after the training, ergospirometric tests on a treadmill to compare the results at the end of the eight weeks.

To determinate $VO_2$max and anaerobic threshold, treadmill ergospirometry was used in combination with a continuous load increase protocol, based on pre-existing protocols with construct validation: the Bruce and Bruce modification, Naughton and Blake (CENETEC, 2005), the norms proposed by Macdougal, Wenger and Green (2000), also the gender and age of the athletes were taken into account. Participants on this study spent a minimum of five minutes warming up before starting the test; the speed and slope of the treadmill were gradually increased. Participants were allowed to stop the test when they could not continue.

Korr$^R$ software and a Cybex$^R$ treadmill were applied for the test protocol. All the parameters obtained in the test were collected constantly throughout the test via automatic controllers. After this, the data were analysed, and training zones were established, delimited by the aerobic threshold, the anaerobic threshold, and VO2max. The automatic controls compare the effective value of the output with the desired value, determine the deviation, and produce a control signal that reduces the deviation (even a small value) to zero, increasing the reliability (Sotelo, Rodríguez, Sánchez, Ramírez, & Cabrera, 2016).

The MRfit protocol consisted of 16 training sessions of 20 minutes, distributed over eight weeks, using a weighted load device for respiratory muscles made with tubes of four different calibres (own elaboration and previously validated), Each tube was used in four sessions as follows:

- Session 1: 10 minutes alternated 1 minute of average intensity running per 1 minute walking.
- Session 2: 5 repetitions of speed race, with rest between each of 1 minute.
- Session 3: 5 repetitions 1 minute of high intensity running per 1 minute of rest. In the rest periods, in addition to the weighted load device for respiratory muscles, the subject was placed with an elastic resistance band around the thorax.
- Session 4: Work in pool, 200 m warm-up with crawl style, 5 repetitions of 50 m crawl style at maximum speed, with 1 minute rest between each, In this case, the weighted load device was used only in the minutes of rest, in conjunction with the elastic band around the thorax.

Warm-up and cool-down were done at initial and end of each training session.

*Statistical analysis*

First, an exploratory analysis was carried out for the quantitative variables, in which the values of central tendency were obtained. A parametric statistical analysis was used, through

the t-test ($p<0.05$), to evaluate the differences between the control group and the group trained with the MRFit protocol. IBM SPSS Statistics software version 24 was employed to analyse the data.

## Results

The results of statistical analysis have shown that there were no significant differences in the $VO_2$max a $p>0.05$ for the two groups.

**Table 1.** Test t for independent samples

| Variable | Groups | M±SD | t | p |
|---|---|---|---|---|
| $RelVO_{2max}$ | TG (N=6)<br>CG (N=5) | 49.4±4.7<br>53.4±7.9 | .40 | .07 |
| RelUA | TG (N=6)<br>CG (N=5) | 35.8±13.2<br>37.1±16.5 | .35 | .39 |

Legend: $RelVO_{2max}$: relationship between maximum oxygen consumption before and after training; RelUA: anaerobic threshold ratio pre and post training

Comparison using t-test indicated that the score of the TG group was not significantly different from that of the CG nor for $VO_2$max or the anaerobic threshold, as shown in Table 1.

The means and standard deviations for the two groups in the two temporal moments are shown in Table 2.

**Table 2.** Ergospirometric tests after the application of the MRFit protocol

| Variable | TG | CG | p |
|---|---|---|---|
| $VO_{2max}$ (ml/min) | 47.35 | 49.12 | .718 |
| UA-2 | 39.96 | 36.80 | .664 |
| FC-2 | 90.57 | 86.02 | .560 |

Legend: VO2max: maximum oxygen consumption; UA: anaerobic threshold; FC: heart rate

Comparison between tables 2 and 3 shows that for both groups, the $VO_2$max decreased, for the TG it was shown an average of 47.35ml/min, decreasing by 2.03ml/min, while in the CG the average in the second $VO_2$max was 49.12ml min, a difference of 4.9 ml/min, with respect to its first sample. The anaerobic threshold increased by 8.66 ml/min in the TG, with an average of 39.96 ml/min, in contrast to the CG which decreased the anaerobic threshold levels in 1.9 ml/min, with an average of 36.80 ml/min evidencing improvements in the TG related to their physical performance.

**Table 3**. Ergospirometric tests before the application of the MRFit protocol

| Variable | TG | CG | p |
|---|---|---|---|
| $VO_{2max}$ (ml/min) | 49.38 | 54.02 | .292 |
| UA | 31.30 | 38.70 | .444 |
| FC | 86.20 | 83.60 | .745 |

## Discussion

Through this experimental study, we have not observed statistically significant improvement in $VO_2$max in relation to the aerobic threshold. However, we have seen different tendencies between both groups and clinical improvements.

On the one hand, the CG decreased its levels, both $VO_2$max and anaerobic threshold, which is an indicator of decreased sports performance, since, as stated by Sánchez and Salas (2008) $VO_2$max is the main indicator of the aerobic possibilities of a subject, because it integrates multiple organic functions (ventilatory, cardiovascular, blood and muscle) so it has an intimate relationship with the level of physical conditioning. In addition to the previous comment, some researchers conclude that among the main performance factors is the ability to raise the anaerobic threshold with respect to $VO_2$max (Cejuela, Pérez, Villa, Cortell, & Rodríguez, 2007).

On the other hand, the TG also decreased its $VO_2$max levels, although to a lesser extent than the CG, coinciding with other studies (William, & Dupler, 2002; González et al. 2012) that concluded that studies that confirm an improvement in $VO_2$max are very scarce, which may be because the respiratory system is not a limiting factor to $VO_2$max, it is more dependent on cardiac output.

The results of the present investigation also coincide with those obtained by William and Dupler (2002), in which they strengthened respiratory muscles of triathletes without observing significant changes at the end of the training period: This study was carried out over four weeks, suggesting that changes could be observed with more weeks of training, so in the present investigation the strengthening protocol was performed for eight weeks.

Otherwise, the TG increased the anaerobic threshold, reflecting the fact that the TG subjects improved their capacity to maintain the intensity of effort without the appearance of a progressive accumulation of lactate (Chavarren, Dorado, & López, 1996). The preceding indicates that some factor, derived from training, such as constancy in training, may have influenced the differentiated response between the trained and control groups, observing thus a decrease in anaerobic threshold of the CG during the eight weeks that the TG participated in the MRFit training protocol.

The study by Cejuela et al. (2007), although carried out in triathletes, serves as a reference for the present investigation because it shows a swimming component. The authors

of this study warn that a fundamental parameter to perform in a physical test is that the athlete must be able to maintain oxygen consumption close to the maximum for a longer time, which is a parameter determined by the anaerobic threshold. Regarding the observed changes related to the anaerobic threshold, improvements were observed in this study; however, they did not reach statistical significance. González et al. (2012) studied the effects of MR training and its relationship on blood lactate concentration, $VO_2$ during exercise and its relationship with physical performance; the results of this study show lower concentrations of lactate in blood after respiratory muscle training, caused by increased consumption of trained respiratory muscles, which leads us to consider that by decreasing blood lactate accumulation the anaerobic threshold also increases.

The members of the TG in the present study increased the anaerobic threshold by 27%, indicating a better aerobic efficiency, which allows the optimization of fat oxidation and increase of their deposits inside the muscle fibres in the form of muscle triglycerides (Pallares, & Moran 2012), which are aspects that allow resisting the different works of aerobic and anaerobic power. An important aspect of improving athletic performance is the upper limit at which a continuous exercise can be sustained, which is a limit that is directly influenced by the anaerobic threshold (Reilly, referred by Sánchez, & Salas, 2009).

Differences and similarities found in the present study with others may be due to the different protocols used for training the respiratory muscles, or are related to the methodology and the devices used for this purpose.

The major limitation of this study was the small sample of participants, and future studies might explore a larger sample.

The present study did not yield conclusive results, but we believe that respiratory muscle training can be used to improve sports performance, evidenced by the clinical differences presented, suggesting a continuation with related studies in this regard.

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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

# Performance Improvement in Yo-Yo Intermittent Recovery Test Level 2 and During Official Matches: The Role of Speed Endurance Training Production in Élite Football Players

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**Abstract**

This study aims to examine the performance improvement in yo-yo intermittent recovery test level 2 (IR2) and official matches, during a competitive season in professional football players (Italian 3rd Division Series C, 2019-2020). Twenty-eight (n=28) élite football players participated in this study (age 21.4±3.3; body weight 79.7±3.4; height 182.4±5.5; fat mass 9.2±1.9), without goalkeepers. In the pre-season (4 weeks, from July to August), the players performed yo-yo intermittent recovery test level 2 (IR2), to evaluate aerobic and anaerobic performance before the start of the season. Every player has been analysed with a K-GPS Live device 50Hz (K-Sport Universal STATS, Italy) and Polar Team System PRO 2 heart-rate sensor (Polar Electro, Finland) to recorder maximal heart rate. After 12 weeks of training (in season), the same players repeat an IR2 test to check performance improvements and verify whether the training programme is correct. The first element was to determine whether the improvement in distance covered during a test is better, the same, or worse with respect to the pre-season. After 12 weeks of training, the difference between the first trial (pre-season) and the second one (in-season) is statistically significant (ES: 0.48; $p<0.05$; 24%). At the same time, there has been a significant improvement in match physical performance. Regarding the importance of speed endurance training during a season, it is necessary to improve performance in IR2 test after 12 weeks and improve maximal oxygen uptake and glycolytic enzyme activity. Comparing match performance before (T1) the second trial IR2 with match performance after second (T2) trial of this test, there are statistically meaningful changes.

***Keywords:*** *speed endurance, IR2, training, performance, distance covered, high intensity*

## Introduction

Football is an intermittent sport characterized by about 1200 acyclic and unpredictable changes in activity (each lasting from 3 to 5 s) involving, among others, 30 to 40 sprints, more than 700 turns and 30 to 40 tackles and jumps (Izzo, Giovannelli, & D'Isanto, 2019). The rhythm of play has become faster in recent years, and players can run faster, performing technical skills with higher speed (Altavilla, Riela, Di Tore, & Raiola, 2017). This team sport involves periods of high-intensity activity, interspersed with lower intensity actions (Strauss, Sparks, & Pienaar, 2019), as well as technical and tactical components (Raiola & D'Isanto, 2016). Recent studies have pointed out that football players cover between 8000 m and 14000 m during a match (Aguiar,

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Botelho, Lago, Maças, & Sampaio, 2012) showing that several physical skills such as running, kicking, dribbling, and tackling can affect a player's performance (Filetti, D'Ottavio, Ruscello, Manzi, & Moalla, 2016; Chang & Dong, 2016). These efforts increase the physical demands of the players and contribute to the characterization of football as a sport with high metabolic and physiological demands (Iaia, Rampinini, & Bangsbo, 2009; Arslan et al., 2017). Moreover, computerized time, motion, and video analyses have revealed that top-class football players perform 2 to 3 km of high-intensity running (>15 km/h) and about 0.6 km of sprinting (>20 km/h). In addition, the less successful teams exhibit more significant decreases in the total speed distance covered during the match, suggesting the importance of performing high-intensity activities (Izzo & Sopranzetti, 2016) through football-specific exercises (Iaia et al., 2009).

In recent years, different training methods, such as endurance training, high-intensity interval training (HIIT) and strength training, have been proposed to develop physical, technical, and tactical skills (Hammami, Negra, Shephard, & Chelly, 2017). Several studies have examined the effect of performing high-intensity training through football-specific exercises, showing that is possible to achieve an elevated exercise intensity using the ball, as demonstrated by elevated heart rates, marked blood lactate accumulations, and high rates of perceived exertions (Iaia et al., 2009; Izzo & Giovannelli, 2018). The ability to perform intense exercise is a key component of performance in a football game (Izzo & Lo Castro, 2015). Studies have demonstrated that both male and female top-class football players perform more considerable high intensity running and more sprinting in a game compared to elite players at a lower competitive standard. The difference is mainly due to the players at the higher level carrying out a higher number of intense runs, which is related to a better ability to recover from intense exercise. Fatigue development in a game can be evaluated by examining fluctuations in highly intense exercise throughout the game. In the most intense intervals during a game, a player can experience fatigue temporarily and needs to recover before another sequence of intense actions can be performed with high quality (Bangsbo, & Mohr, 2019). This is illustrated in Figure 1, which shows the high-intensity running of a male elite player during a game divided into five-minute periods.

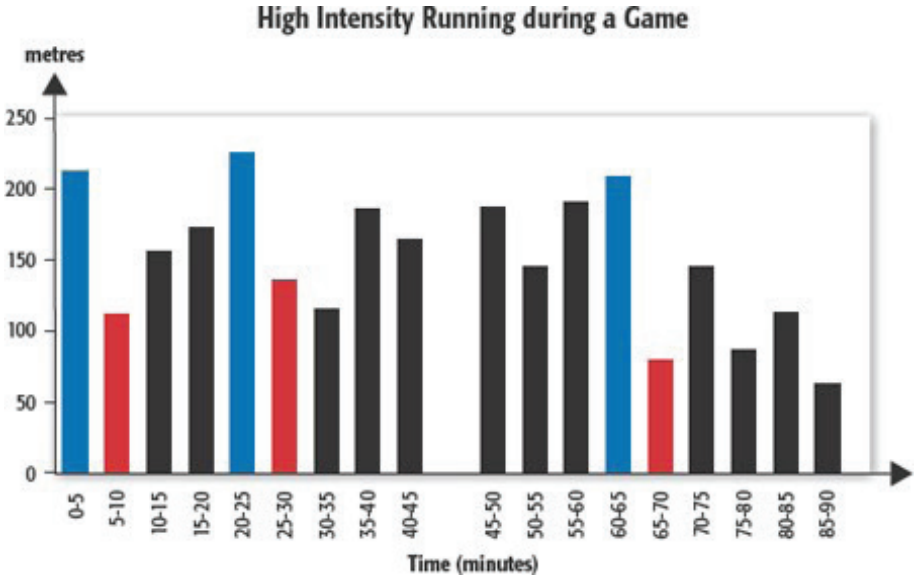


FIGURE 1. The figure shows the distance of high intensity running covered by an Italian Serie A midfield player (Bangsbo, & Mohr, 2019). Note that the player after the three most intense 5-minute intervals (blue bars) performed significant less work (red bars)

After the three most intense five-minute intervals (in blue), this player does less considerable high speed running in the following five-minutes (in red) because he has to recover from the intense exercise in the demanding game-periods. This type of temporary fatigue is different from the fatigue towards the end of a game and requires different testing modes. The faster a player recovers, the quicker the player can repeat another bout of intense exercise. Thus, the recovery capacity of a player should be evaluated (D'Isanto, D'Elia, Raiola, & Altavilla, 2019) to determine the ability to do football-specific intense exercise. In football games; the high-intensity bouts of running range from 5 to 70 metres, but the majority of these runs are less than 20 metres.

Furthermore, the player should be able to accelerate, decelerate and change direction, which are essential variables in intense football runs and need to be included in a football-specific test. Most of the high-intensity running bouts in a game at an elite level are performed at speeds of 14–21 km/h, which means that running at these speeds must be challenged in an intense intermittent test for football players.

All these aspects are included in the Yo-Yo Intermittent Recovery (Yo-Yo IR) test, which measures the ability to recover and repeatedly perform intense exercise with similar characteristics as in a football game. For these reasons, it is obvious why the Yo-Yo IR test is the most commonly used test in both recreational and professional football; it has two levels (see below). In a recent study, all players in a Scandinavian National league were tested both with the Yo-Yo IR1 and Yo-Yo IR2 test, which demonstrated that the top three teams had significantly higher Yo-Yo IR2 scores than the bottom three, while no difference was observed in Yo-Yo IR1 performance (Figure 2).

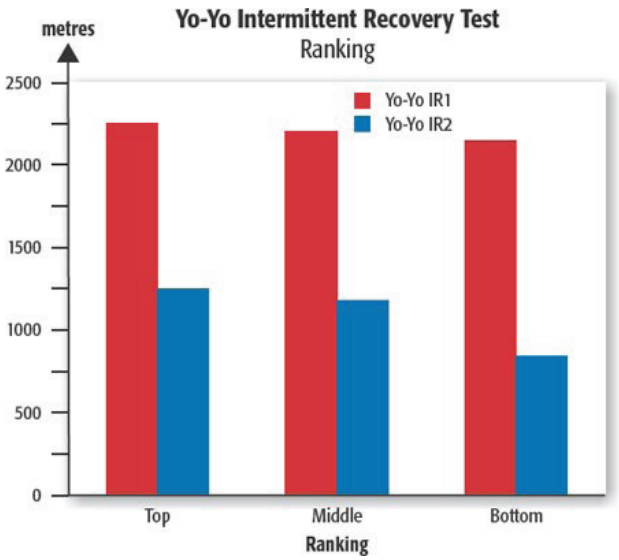


FIGURE 2. The figures shows performance in the Yo-Yo IR1 (red) and Yo-Yo IR2 (blue) test for the three teams positioned in the top of the league (op), teams in the middle (Middle) and the three teams in the bottom (Bottom). Note that the players in the top teams performed significantly better in the Yo-Yo IR2 test than the players in the bottom teams, indicating that the test result reflects the quality of play even within the same league.

Thus, for elite players, the Yo-Yo IR2 test provides a precise measure of performance in football and can distinguish between teams of different performance levels within the same league, which is further supported by observations of male players in a top-league being superior to players in the second and third divisions in the same country (Figure 3).

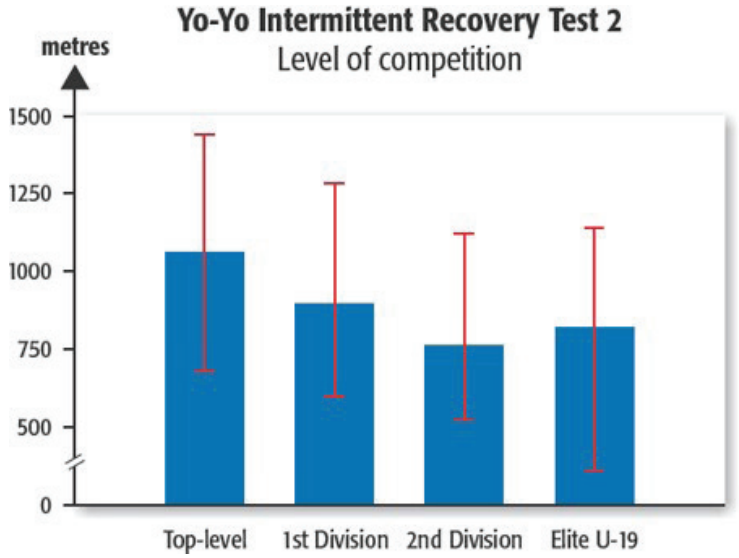


FIGURE 3. Yo-Yo IR2 performance of players from a European top-league, second and third division as well as elite U19 players from the same country. The range is also shown as vertical lines. Note that the senior players from the top-league are superior to the other three groups and that the U19 players had the same performance level as the senior players from the second and third division.

Moreover, in the same study, it was demonstrated that elite U19 players had a Yo-Yo IR2 performance level similar to that of senior players in the second and third divisions, but were inferior to the senior players in the top-league (Figure 3). Newer GPS devices may provide an acceptable tool for the measurement of constant velocity, acceleration, and deceleration during straight-line running, showing sufficient sensitivity for detecting changes in performance in team sports.

## Methods

Twenty-eight (n=28) élite football players participated in this study (age 21.4±3.3; body weight 79.7±3.4; height 182.4±5.5; fat mass 9.2±1.9), without goalkeepers. All athletes are elite players by Italian football championship. To be included in the study, subjects had to 1) ensure regular participation in all the training sessions, 2) have competed regularly during the previous competitive season, and 3) possess medical clearance. Before entering the study, participants were fully informed about the study aims and procedures, and they provided written informed consent before the testing procedure. The study protocol was conformed to the code of Ethics of the World Medical Association

(Declaration of Helsinki). The professional football team trained for approximately 1h five times per week (always on Monday, Tuesday, Wednesday, Thursday, and Friday) plus the official match played on Saturday or Sunday. The study was conducted during the 2019–2020 competitive season (i.e., from July to October) and we examined and recorded 13 official matches during this period. The team was systematically playing in a 4-3-3 module. All participants during the week were followed by video analysis, GPS Live (50Hz, K-Sport Universal STATS Italy) and heart rate monitoring during training; at the end of each session, RPE (rating perceived of exertion) was recorded. During a test, there was an MP3 sound system for IR2 audio track. The same protocol is followed during matches on Saturday or Sunday to analyse the external and internal loads. Before and after 12 weeks, each player completed an IR2 test on the same grass surface.

*Equipment*

The players' physical activity during the matches and each training session was monitored using a portable live 50 Hz global positioning system (GPS) technology (GPS, K-Sport, Universal STATS Montelabbate, PU, Italy) positioned on the upper back in a pocket of a tailored vest (K-Sport/STATS Vest). Several studies have investigated the validity and reliability of GPS devices for measuring movements and speeds (Rampinini et al., 2015); a sample rate of 20 Hz is sufficiently accurate to quantify the very high intensity, acceleration, and deceleration running phases in team sports. For testing, we used MP3 track IR2.

*Data Analysis*

The external load measures, as the distance run at high speed (D_SHI; >16 km·h–1) (Di Salvo, Gregson, Atkinson, Tordoff, & Drust, 2009), the distance run at very high-intensity speed (D_S5 > 20 km/h) (Rampinini et al., 2009), the number of very high-intensity accelerations (D_A8; ≥ +3 m·s–2) and decelerations (D_A1; ≤ –3 m·s–2) (Osgnach, Poser, Bernardini, Rinaldo, & di Prampero, 2010) were recorded. With regards to the predicted metabolic parameters, the average metabolic power (AMP; W·kg-1) was calculated (Di Prampero, Botter, & Osgnach, 2015). Immediately after each match and training session, all players were asked to state their rate of perceived exertion (RPE) of the game just completed, using a printout of Borg's CR10 scale (Borg, 1998). Each subject was previously familiarized on the use of Borg's CR10 scale, including the anchoring procedures.

*Statistical Analysis*

We analysed variables with d-Cohen (effect size; ES), to compare two different parts of the season and Pearson's correlation coefficient (r). An alpha level of $p < 0.05$ was chosen. The statistical analyses were performed with SPSS (SPSS, Inc., Chicago, IL, USA). Data are presented as means ± standard deviation. The effect size dimension is low from 0 to 0.4, moderate from 0.5 to 0.6, and large from 0.7 to 1.0.

## Results

Regarding speed endurance training during a season (1 time per week), it is necessary to improve performance in IR2 test and during a match. After 12 weeks, maximal oxygen uptake and glycolytic enzyme activity improved. Every football coach and practitioner should include weekly speed endurance training production (W/R 1:5) or maintenance (W/R 1:2) to improve performance at very high intensities (>20 km/h) in their players. In our research and experience, after 12 weeks training, the difference in IR2 performance, between first trial (pre-season) and second trial (in-season) is statistically meaningful (ES: 0.48; $p<0.05$; 24%). During this period, our team perform 10 speed endurance production workouts (W/R 1:5), about once per week. For top-teams, Yo-Yo IR2 performance (28%) and sprinting distance (25%) during matches were greater ($p<0.05$) than for bottom-teams. Comparing match performance before (T1) the second trial IR2 with match performance after second (T2) trial of this test, statistically meaningful changes are present Match performance before versus after the second test is different: distance covered at high intensity > 16 km/h (D_SHI) (ES:0.55; $p<0.05$; Figure 4), and distance covered at very high intensity > 20 km/h (D_S5), (ES:0.46; $p<0.05$; Figure 5) improve.

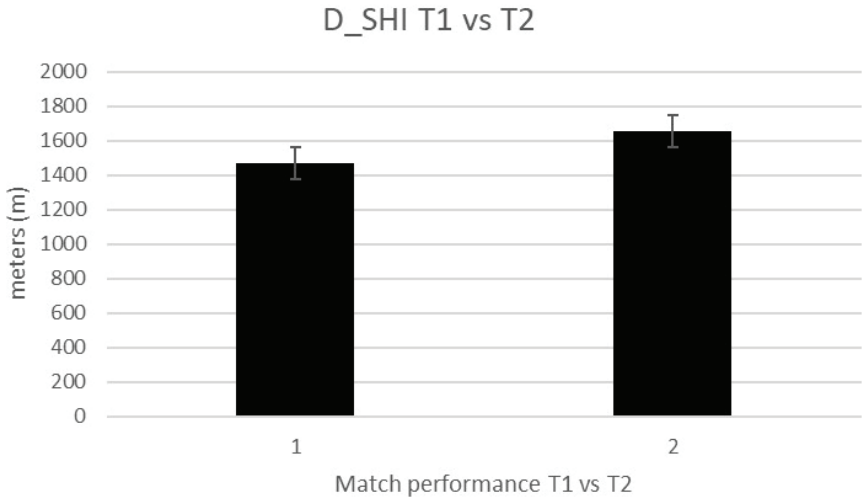


FIGURE 4. Match performance D_SHI >16Km/h T1 vs T2 (ES:0.55; p<0.05)

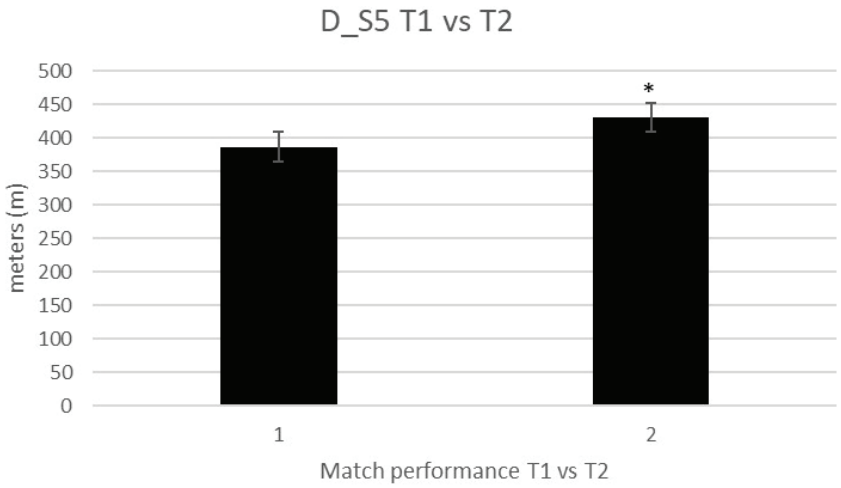


FIGURE 5. Match performance D_S5 >20 Km/h T1 vs T2 (ES:0.46; p<0.05)

At the same time, acceleration at a very high intensity (D_A8) (ES: 0.68; p<0.05; Figure 6), and the number of sprints at a very high intensity (NU_A8) improve (ES:2.67; p<0.05; Figure 7).

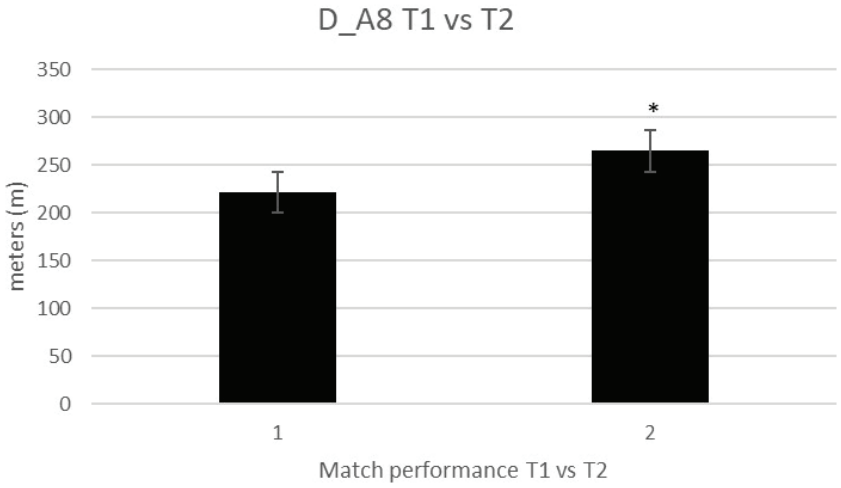


FIGURE 6. Match performance D_A8 >3m/s$^2$ T1 vs T2 (ES:0.68; p<0.05)

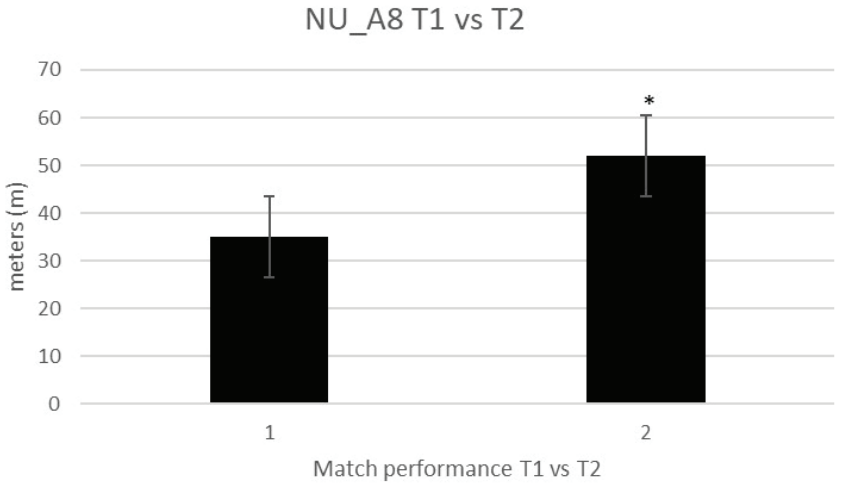


FIGURE 7. Match performance NU_A8 >3m/s$^2$ T1 vs T2 (ES:2.67; p<0.05)

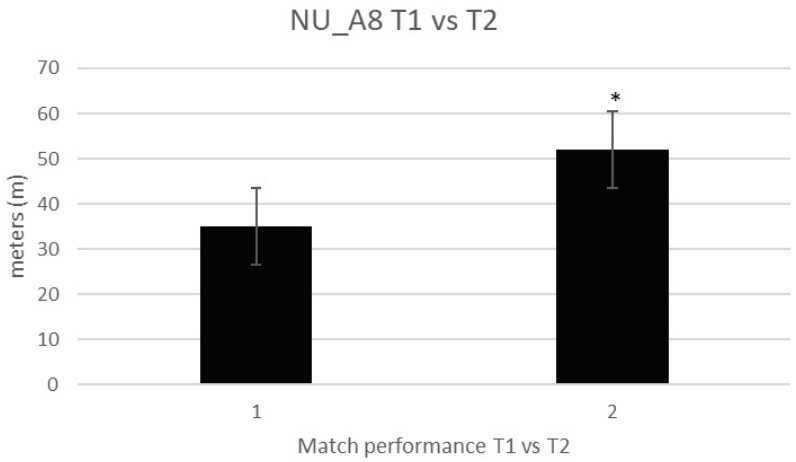


FIGURE 8. Performance IR2 T1 vs T2 (ES: 0.48; p<0.05)

## Discussion

For elite and sub-elite players, Yo-Yo IR2 performance was correlated (p<0.05) with Yo-Yo IR1 performance (r=0.74 and 0.76) and mean RSA time (r=-0.74 and -0.34). We conclude that the Yo-Yo IR2 test has a high discriminant and concurrent validity, as it discriminates between players of different within- and between-league competitive levels and is correlated to other frequently used intermittent elite soccer tests. Speed endurance training is an essential workout that enables élite football players to improve match performance throughout the year. Such training is highly recommended for high-level professional players. A very significant aspect is the very high increase in the number of accelerations per game in the mentioned period relating to the application of speed endurance training.

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**Conflict of Interest**

The authors declare that there are no conflicts of interest.

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SportMont

ORIGINAL SCIENTIFIC PAPER

# Impact of Time-Outs on Efficiency of Man-Up in Water Polo: An Analysis of the Differences between the Three Levels of Water Polo Players

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**Abstract**

In water polo, time-outs last one minute and only a team in possession of the ball can request one; although there are diverse opinions whether a time-out is advantageous for the team in possession. The aims of this study were, firstly, to identify and to explain the impact of time-out on the efficiency of man-up in water polo, and secondly, to identify and to explain the differences in the efficiency of man-up in water polo between three qualitative levels of players. The sample consisted of 132 matches of the Adriatic Water Polo League, who were observed for indicators of man-up efficiency. There was no statistically significant difference between man-up efficiency played after a time-out and man-up efficiency played without a time-out. Additionally, the Kruskal-Wallis test partially confirmed the existence of significant differences between three qualitative levels of water polo players. There is a reasonable possibility that the differences between levels are generated by the differences in tactical knowledge, motor ability, and scoring ability. Trainers can apply the results of this study for the selection of appropriate tactical solutions and the optimization of training processes among elite and sub-elite water polo players. Additionally, the study's results can be the basis for further research dealing with exploring the dynamics of water polo, observed through recent changes in the rules.

***Keywords:*** *tactical knowledge, scoring ability, tactical solutions, training process*

## Introduction

Time-outs in water polo were initially introduced around three decades ago (Hraste, Bebić, & Rudić, 2013). Until 2013, each team had the opportunity to call two time-outs during a match. However, from 2013 onward, time-out rules were modified so that each team can call a single time-out during every quarter of the match. Time-outs last one minute and only a team in possession of the ball can request it; although there are divided opinions whether a time-out is advantageous for the team in possession. Platanou (2008) observed that the percentage of the goals scored in man-up situations without time-out was significantly greater (44.7%) than the goals scored in man-up situations after time-outs (31.3%). Man-up efficiency in water polo is defined as the ability to score a goal in situations with numerical superiority (Hraste, Dizdar, & Trninić, 2008), and it is demonstrably very closely related to the shooting skill, specifically successful shooting performance in a man-up situation, which usually precipitate the execution of an open shot at goal. Given the time and skill constraints, optimal conditions for shot performance are needed (Hraste et al., 2008).

The efficiency of man-up in water polo is an important factor that influences the result of games (Takagi, Nishijima, Enomoto, & Stewart, 2005; Platanou, 2004). Some studies have reported a significant difference of man-up efficiency between different levels of competition in water polo teams (Garcia-Marin, Iturriaga, & Manuel, 2017; Tucher, Canossa, Cabral, Garrido, & De Souza Castro, 2015; Lupo, Condello, Capranica, & Tessitore, 2014). Similarly, significant differences in man-up

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efficiency between different age groups and game roles of water polo players have been identified (Hraste, Jelaska, & Lozovina, 2014). Furthermore, it has been shown that the mean number of goals in man-up situations achieved in one game in elite-level water polo games was 2.9±1.7 (Platanou, 2004). Successful man-up situations are vital to the overall performance, and the progress and development of water polo players are achieved through the acquisition of new motor skills and development of certain motor abilities (Botonis, Toubekis, & Platanou, 2016). According to current rules, the penalty time for an excluded player is twenty seconds; clearly, the team on attack has more space-time manoeuvring possibilities for goal-scoring, because even after the expiration of twenty seconds, the excluded player takes time to return to a defensive position. Coaches and players generally decide on one of the three options in the man-up situation, according to the speed of realization. The first option refers to the so-called quick realization (the first six seconds of penalty time). Another possibility relates to the realization in the time interval from the $7^{th}$ to $17^{th}$ seconds of penalty time, which is referred to as medium-speed realization. The third possibility relates to the slow realization (from 17 to 30 seconds of the duration of the attack). Quick realization is usually employed on unprepared defences with a man-down to exploit goal-scoring opportunities; however, all three types of realization are dependent on the preference of the coach, and skill-level of the players in the man-up tactics.

Following the above considerations, the aims of this study were, firstly, to identify and to explain the impact of time-out on the efficiency of man-up in water polo, and secondly, to identify and to explain the differences in the efficiency of man-up in water polo between three qualitative levels of players. Accordingly, the following alternative hypotheses were set:

$H_{1, 1}$ - a statistically significant difference between man-up efficiency played after time-outs and man-up efficiency played without time-outs exists;

$H_{1, 2}$ - a statistically significant difference between the three levels of water polo players in the efficiency of man-up played after and without a time out exists.

## Methods

*Participants*

The sample consisted of 132 games from the Adriatic Water Polo League (unofficially considered to be the highest quality league competition in the world). The Adriatic Water Polo League is a regional competition of the best Montenegrin, Croatian, and Slovenian teams. The following clubs were in this competition: Primorje, Mladost, Jug, Mornar, POSK, Jadran S, Medveščak and Šibenik from Croatia, Budva, Jadran HN and Primorac from Montenegro and Branik from Slovenia. The consensus of seven water polo experts (of which one is the author of this article), yielded a division of teams into three qualitative levels. In a regular season, there are 22 rounds during the eight months of the competition.

*Measures*

The sample of variables includes twelve indicators of efficiency:

- Total realizations in man-up situation after time-out (RAT) - the total number of goals scored in the game with a numerical superiority that are preceded by a time-out;
- Quick realizations in man-up situation after time-out (QRAT) - the total number of quick realizations in the game with a numerical superiority that are preceded by a time-out;
- Medium-speed realizations in man-up situation after time-out (MSRAT) - the total number of medium-speed realizations in the game with a numerical superiority that are preceded by a time-out;
- Slow realizations in man-up situation after time-out (SRAT) - the total number of slow realizations in the game with a numerical superiority that are preceded by a time-out;
- Extorted exclusion before time-out (EEBT) - the total number of extorted exclusions that occurred before the called time-out;
- Percentage of total realizations in man-up situation after time-out (%RAT) - the percentage of goals scored in the game with a numerical superiority that are preceded by a time-out;
- Total realizations in man-up situation without time-out (RWT) - the total number of goals scored in the game with a numerical superiority that are not preceded by a time-out;
- Quick realizations in man-up situation without time-out (QRWT) - the total number of quick realizations in the game with a numerical superiority that are not preceded by a time-out;
- Medium-speed realizations in man-up situation without time-out (MFRWT) - the total number of medium-speed realizations in the game with a numerical superiority that are not preceded by a time-out;
- Slow realizations in man-up situation without time-out (SRWT) - the total number of slow realizations in the game with a numerical superiority that are not preceded by a time-out;
- Extorted exclusion without time-out (EEWT) - the total number of extorted exclusion that occurred without a called time-out;
- Percentage of total realizations in man-up situation without a called time-out (%RWT).

*Procedures*

The data were collected from official records that are maintained during the playing of water polo games. Official staff registered all of the collected data. The reliability of the data was tested by the additional reviewing of 11 matches. Reviewing was made by two independent water polo experts, one of whom was the first author of this article. Each frequency of variable for each group of players was collected and compared to official records. Reliability coefficients for single data were calculated as the ratio of reviewed observed frequencies and official record frequencies.

*Statistical Analysis*

For the collected data, basic statistical parameters (mean, standard deviation, median, percentage, and total number of cases) were calculated. These parameters were calculated separately for each level and in total for all levels of water polo players. Differences between the realization in man-up situation after (RAT) and without time-out (RWT) for all water polo players and within groups of water polo players (high, medium, standard level) were calculated by using a Z-test for two proportions. Differences between three levels of water polo players in all 12 indicators of man-up efficiency played after and without a time out were calculated using the Kruskal-Wallis test due to the non-parametric nature of the data. When statistically significant differences were found, multiple comparisons of mean

ranks were used to determine the pairs responsible for the differences. The level of statistical significance was set to 5%. Data were processed using Statistica ver. 13.2 software (Dell Inc., Tulsa, OK, USA).

## Results

Before data collection started, seven experts were asked to assess the quality of all teams; which yielded perfect alignment with official rankings at the end of the season. The group of high-level teams in this league were in the first four places of the official ranking list: Primorje, Jug, Mladost, and Jadran HN. Teams that were in fifth to eighth place (Mornar, Budva, POŠK, and Primorac) are recognized as a group of medium level. A group of low-level teams were in the last four places: Jadran S, Medveščak, Šibenik, and Branik. The reliability of official records was nearly perfect for all variables, ranging from 0.95 to 1.00. Table 1 shows the basic descriptive parameters of all variables (means, standard deviations, percentage and the total number of cases) for twelve indicators of man-up efficiency for all three levels of water polo players, as a total, and separately for each level (high, medium, and low level). The variable QRAT was removed from the further analysis because frequencies were 0 within all teams.

A within-group comparison of the proportions between realization in man-up situations after a time-out (RAT) and without time-out (RWT) for high, medium, and low groups and for the overall sample revealed no significant differences (p=0.466; p=0.947; p=0.901; p=0.726), respectively.

**Table 1.** Descriptive statistics of variables for 11 indicators of man-up efficiency for each group (N=88) and the overall sample of water polo players (N=264)

| Variables | High level (N=88) | | | Medium level (N=88) | | | Law level (N=88) | | | All (N=264) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M±SD | % | Tot | M±SD | % | Tot | M±SD | % | Tot | M±SD | % | Tot |
| RAT | 0.52±0.73 | 46 | 46 | 0.58±0.71 | 43,1 | 51 | 0.43±0.64 | 36,2 | 38 | 0.51±0.69 | 41,6 | 135 |
| MSRAT | 0.25±0.49 | 50 | 23 | 0.22±0.47 | 36 | 19 | 0.15±0.39 | 34,2 | 13 | 0.20±0.45 | 40,3 | 54 |
| SRAT | 0.26±0.54 | 50 | 23 | 0.36±0.57 | 64 | 32 | 0.28±0.52 | 65,8 | 25 | 0.30±0.54 | 59,7 | 81 |
| EEBT | 1.15±1.00 | - | 46 | 1.32±1.11 | - | 51 | 1.19±1.09 | - | 38 | 1.22±1.07 | - | 135 |
| %RAT | 0.46±0.44 | - | - | 0.48±0.42 | - | - | 0.37±0.42 | - | - | 0.44±0.43 | - | - |
| RWT | 0.62±0.76 | 51,7 | 361 | 0.75±0.95 | 42,6 | 300 | 0.76±0.91 | 35,2 | 236 | 0.71±0.88 | 43,2 | 895 |
| QRWT | 0.56±0.74 | 13,3 | 49 | 0.50±0.74 | 14,7 | 44 | 0.35±0.64 | 13,1 | 31 | 0.47±0.71 | 13,7 | 124 |
| MSRWT | 2.14±1.64 | 52,1 | 188 | 1.74±1.58 | 51 | 153 | 1.28±1.21 | 48,7 | 115 | 1.72±1.52 | 50,7 | 454 |
| SRWT | 1.42±1.18 | 34,6 | 125 | 1.17±0.95 | 34,3 | 103 | 1.02±0.98 | 38,1 | 90 | 1.20±1.05 | 35,5 | 318 |
| EEWT | 7.94±2.46 | - | 361 | 8.01.±2.72 | - | 300 | 7.57±2.40 | - | 236 | 7.84±2.53 | - | 895 |
| %RWT | 0.53±0.25 | - | - | 0.43±0.26 | - | - | 0.35±0.18 | - | - | 0.44±0.24 | - | - |

Legend: M±SD - means and standard deviations; % - percentage; Tot - total number of cases; RAT - total realization in man-up situation after time-out; MSRAT - medium-speed realization in man-up situation after time-out; SRAT - slow realization in man-up situation after time-out; EEBT - extorted exclusion before time-out; %RAT - percentage of total realization in man-up situation after time-out; RWT - total realization in man-up situation without time-out; QRWT - quick realization in man-up situation without time-out; MSRWT - medium-speed realization in man-up situation without time-out; SRWT - slow realization in man-up situation without time-out; EEWT - extorted exclusion without time-out; %RWT - percentage of total realization in man-up situation without time-out

Table 2 presents the results of the Kruskal-Wallis test on the levels of water polo players (high, medium, and low level) in eleven indicators of man-up efficiency. The results show a statistically significant difference in the following variables:

**Table 2.** Kruskal-Wallis test and multiple comparisons of mean ranks of 11 indicators of efficiency for three levels of water polo players

| Variables | H | p | I-II | I-III | II-III |
|---|---|---|---|---|---|
| RAT | 2.07 | 0.36 | - | - | - |
| MSRAT | 2.47 | 0.29 | - | - | - |
| SRAT | 2.37 | 0.31 | - | - | - |
| EEBT | 1.07 | 0.59 | - | - | - |
| %RAT | 2.07 | 0.36 | - | - | - |
| RWT | 24.93 | 0.01 | 0.02 | 0.01 | 0.07 |
| QRWT | 4.33 | 0.11 | - | - | - |
| MSRWT | 12.34 | 0.01 | 0.25 | 0.01 | 0.26 |
| SRWT | 5.23 | 0.07 | - | - | - |
| EEWT | 2.31 | 0.32 | - | - | - |
| %RWT | 28.13 | 0.01 | - | - | - |

Legend: H - test value; p - significance level; I - high level of water polo players, II - medium level of water polo players, III - law level of water polo players

total realization in man-up situation without time-out (RWT); medium-speed realization in man-up situation without time-out (MSRWT); and percentage of total realization in man-up situation without time (%RWT).

Multiple comparisons of mean ranks for three indicators showed significant differences ($p<0.05$) among three pairs of observed groups.

## Discussion

Analysing sports events is a pragmatic tool for better coaching and interpretation of team sports, giving coaches and scientists the ability to learn more about performances (Houghes & Franks, 2004). Water polo coaches and researchers commonly use certain game statistics for performance assessment and monitoring, such as total number of shots taken and number of goals scored, man-up efficiency, number of fast breaks, turnovers, steals, and others (Hraste et al., 2008). Focusing on the efficiency of water polo man-up and competition level, the present study showed a statistically significant difference in the three variables of man-up efficiency played without time out. Several studies have indicated that the competition level has a tangible impact in relation to man-up situations (Lupo, Tessitore, Minganti, & Capranica, 2010; Escalante et al., 2013; Escalante, Saavedra, Mansilla, & Tella, 2011).

As detailed in Table 1, it is evident that in all teams, the realization in a man-up situation (RWT) was better when it did not precede the time-out (43.2%), as compared to the realization in man-up situations after a time-out (RAT; 41.6%). Larger differences in the above-mentioned variables were recorded in a previous study (Platanou, 2008); however, it should be noted that between these two studies the water polo rules have changed in the number of permitted time-outs (two to four time-outs). The extorted exclusion before time-out (EEBT) averaged 1.22 times per match, compared to 7.84 times per match in the extorted exclusion without time-out (EEWT), which are similar to the findings of previous research (Platanou, 2004; Takagi et al., 2005). High-quality teams had significantly better realization of man-up scenarios, which were not preceded by a time-out, as compared to the realization of man-up after a time-out (RWT vs RAT). Therefore, it is plausible that the coaches of high-quality teams who called a time-out inadvertently reduced the odds of successful man-up realization, by permitting recovery and preparation of tactics by the opposing team defence. Based on these results, it is evident that some of the coaches mistakenly believe that time-out helps to achieve more successful man-up realization.

In the present study, there were no quick realizations after the time-out (QRAT) in any team, and it was, therefore, not included in the analysis of differences. It is conceivable that the time-out enabled the lower-ranked teams to prepare, so they did not concede a goal in the first six seconds of the man-down situations. After a time-out, high quality teams uniformly deploy medium-speed realization and slow realization (MSRAT and SRAT), while middle and low-quality teams prefer slow implementation. The observed differences are most likely because high-quality teams need less time for realization, while lower quality teams need more time to seek optimal conditions for realization, consistent with the findings of earlier studies (Takagi et al., 2005).

It is interesting that the structure of man-up realization without time-out according to the speed of realization for each water polo level was almost identical. For all three levels of water polo, the least represented was fast realization (QRAT; 13.7%), followed by slow realization (SRAT; 35.5 %,) and finally, medium-speed realization (MSRAT; 50.7%). Looking at the number of man-up realizations after a time-out, it is noticeable that high quality teams have a better realization compared to the remaining two team levels. Moreover, the medium quality teams performed better than the lower quality teams. Statistically significant differences were observed in three of twelve indicators of man-up efficiency. These differences are present in the total number of realizations in man-up situations without time-out (RWT), in the number of medium-speed realization in man-up situations without time-out (MFRWT), and in the percentage of total realization in man-up situations without time-out (%RAT). The importance of man-up efficiency in water polo has already been demonstrated in several studies, as well as in the present study (Takagi et al., 2005; Platanou, 2004; Lupo et al., 2014). Statistically significant differences in the number of realizations in man-up situations without time-out (RWT) between the high and low level, and between the medium and low level, water polo teams are likely attributable to the weaker performance of the players in the teams of the lower levels, and an inability to take advantage of the forced numeric advantage. Moreover, the lack of quality in medium-speed realization in the lower-ranked water polo players appears to be the greatest differentiator between high and low-ranked teams.

This research confirmed the hypothesis that there are no statistically significant differences between man-up efficiency played after a time-out and man-up efficiency played without a time-out for all water polo players within high, medium, and low-quality rankings. In this study, the range of the parameters that describe the man-up efficiency played after and without a time out of different levels of water polo players are established and explained. The hypothesis that there are significant differences between three levels of water polo players in man-up efficiency was confirmed for three of the twelve variables. Statistically significant differences were noted in the following variables; the number of realizations in a man-up situation without time-out (RWT), the number of medium-speed realization in a man-up situation without time-out (MFRWT), and the percentage of total realization in a man-up situation without time-out (%RWT).

From the above observations, it can be concluded that, on the basis of time-out man-up efficiency parameters, it is possible to differentiate three groups of water polo players, according to skill level. The differences are likely attributable to the varying degrees of tactical knowledge, motor ability, and scoring ability. The results of this study can be utilized in the selection of adequate man-up/man-less training methods to achieve the best results in situations with numerical superiority/inferiority.

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

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ORIGINAL SCIENTIFIC PAPER

# Formation of Health and Fitness Competencies of Students in the Process of Physical Education

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**Abstract**

The technology of forming the health and fitness competencies of students of higher educational institutions is reviewed in the present paper, which includes designing the highly efficient educational activity of students and the management activity of a teacher with the principal orientation to the content and forms of the educational process in the personal-development technologies of training. The study aims to substantiate, implement, and verify the efficiency of the original methodical system of physical education of students of Ukrainian higher educational institutions. A total of 87 students, aged 18–22, including 46 males and 41 females, participated in the study. The research methods were conceptual-comparative analysis, questionnaires and surveys, pedagogical observations, expert assessments, testing, pedagogical experiment, and statistical methods. It has been determined that the original methodical system, implemented in the educational process of physical education, contributes to improving the quality of the physical education of students, forming highly-developed health and fitness competencies that are required during professional activity to maintain a high level of physical fitness and working capacity.

***Keywords:*** *physical education, methodical system, health and fitness competencies, students*

## Introduction

The efficiency of the system of physical education of students of higher education institutions is determined by the adequate choice of the purpose and tasks, organizational forms, methods, and means of teaching, health promotion, and education in rational combination (Azhyppo et al., 2018; Mozolev, Halus, Bloshchynskyi, & Kovalchuk, 2019). The orientation towards the innovative technologies of physical education of students leads to significant changes in its content and procedural components, determines the modernization of the traditional physical education system, as well as the development of a new methodical system that is the theoretical and methodical foundation of the educational process. The physical education functions often are aimed at providing services that have the purpose of good leisure time, ensuring a healthy lifestyle; they thus have a social dimension (L. Shuba, & V. Shuba, 2017; O. Zavydivska, N. Zavydivska, & Khanikiants, 2016).

Physical education classes are a complex pedagogical entity in which the didactic and organizational-methodical processes are universally linked to the patterns of muscular performance and the analytic-synthetic function of the brain (Bliznevsky et al., 2016; Bosenco, Samokih, Strashko, Orlik, & Petrovsky,

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2013; Prysiazhniuk et al., 2018). Without concerning this relationship, the efficient solving of educational, pedagogical, and wellness problems can be quite complicated when forming students' readiness for future professional activity. An efficient system of physical education must meet the following requirements: a) to ensure purposeful motor activity of all segments of the population and, on this basis, to promote the increase of physical fitness, health improvement, and the prevention of diseases; b) to guarantee the accessibility and quality of motor health services; c) to carry out the formation of the necessary human, financial, material, and technical resources and their rational use (Rus 2017; Prontenko et al., 2019; O. Kharchenko, N. Kharchenko, & Shaparenko, 2019; Melnyk, 2019).

The traditional system of physical education of the students of higher education institutions is characterized by: a) no specific social order of production and employers for the physical readiness of graduates and, as a result, a lack of understanding of the necessity of physical education by the directors and students of higher education institutions; b) insufficient humanistic and professional orientation of the physical education process, inefficient management of this process; c) ineffective theoretical and methodological training of students concerning personal physical culture; d) a limited range of practical and activity components that ensure the totality of physical culture functions; e) a low efficiency of didactic filling of the practical sections of the programme of physical education; f) the inadequacy of the organization forms of physical education process for the present-day mentality and motivational maturity of students; g) the lack of the students' motivation for their own physical education and its improvement (Mozolev et. al., 2019; Griban et. al., 2018). All of these factors determine the relevance of our research.

The research aims to substantiate, implement, and verify the efficiency of the original methodical system of physical education of students of Ukrainian higher educational institutions.

## Methods

The pedagogical experiment was conducted at Zhytomyr National Agroecological University; 87 students, including 46 males and 41 females, of the faculties of veterinary medicine, ecology and law, engineering and energy, accountancy and finance participated in it. They were divided into control (CG) and experimental (EG) groups by the method of the even distribution of groups. Thus, the experimental group included 44 students (24 males, 20 females); the control group included 43 students (22 males, 21 females). Physical education classes in all groups were held twice a week in the first half of the day. The purpose of the experiment was to substantiate and introduce a methodical system of physical education to the educational process of the experimental group students. The control group students studied according to the curriculum for higher education institutions. Control tests were conducted at the end of the first term (December) and at the end of the academic year (May-June) during two years of study.

The efficiency of the functioning of the methodical system of physical education, in addition to mastering the general tasks of physical education, was considered to be the students' health and fitness competencies as some internal, potential, latent psychological indicators: knowledge, motives, preferences, interests, skills, programmes of actions, systems of values, attitudes to physical and health-improving activity, which are manifested in the methodical competence to introduce and transfer them to other members of society, in particular in the process of professional activity.

The criteria of the readiness of future specialists to use and implement the means of physical education in the further life after graduation were the motivational, cognitive, and activity components. All criteria were rated as high, sufficient, middle, and low, with regards to the levels of expression.

A high level of readiness implies a student's developed system of skills and abilities, the ability to select the methods and means of physical education appropriately. A student actively uses the acquired knowledge and skills in everyday life, has a strong interest in physical, wellness and sports activities expressed, is systematically engaged in physical culture and sports, takes an active part in organizing and conducting competitions, and is able to choose the methods and means of physical education to implement in life.

A sufficient level is achieved when a student has a formed system of knowledge, skills, and abilities, masters a complex of methods, makes the full use of the means of physical education. A student with this level of readiness uses knowledge and skills in everyday life, has a steady interest in physical and fitness activities, is engaged in systematic physical activity and sports, is aware of the need to improve one's sportsmanship, does not require external stimulation, and is ready to introduce the developed knowledge and skills in professional activity.

A middle level is achieved when certain abilities and skills in physical and wellness activity are formed, but they are not systematic. A student with such a level has a steady interest in the use of acquired knowledge, abilities and skills in physical and fitness activities, is systematically engaged in physical culture or sports, and has an interest in improving his/her sportsmanship.

A low level implies the certain skills and abilities of a student are formed; he/she has individual methods but does not fully use the means of physical education. A student is characterized by fragmentary ideas in the field of theory and practice of physical education, requires external stimulation of activity for self-education, is not systematically engaged in physical exercises and sports, is not interested in physical culture and sports, and only occasionally uses the means of physical education.

A motivational criterion of the students' readiness for physical and wellness activity is defined as a system of conscious and personally acquired needs and motives for a healthy lifestyle, the improvement of life activity based on self-realization in the field of physical culture and sports that allows realizing an individual programme of self-development and self-education with regards to an objectively created programme of professional and personal development. A cognitive criterion of the readiness for health and fitness activity is defined as a system of mastering knowledge of the theory and methodology of physical education, the practice of organizing and conducting sports and wellness events, the result of which is knowledge, abilities, and skills. An activity criterion of students' readiness for fitness and health-promoting activity is a complex of personally acquired ways to form an individual range of motor skills necessary in life and to teach to apply the acquired knowledge and skills in everyday life and in professional activity.

The following methods of investigation were used: conceptual-comparative analysis, structural and system analysis, modelling, questionnaire, and survey analysis, pedagogical observations, expert assessments, testing, self-assessment, pedagogical experiment, and mathematical statistics. When

the research was conducted, the reliability of the difference between the indicators of students was determined by means of a student's t-test. The significance for all statistical tests was set at $p<0.05$.

This study complies with the ethical standards of the Act of Ukraine "On Higher Education" No. 1556-VII dated 01.07.2014 and the Letter from the Ministry of Education and Science of Ukraine "On Academic Plagiarism Prevention" No. 1/11-8681 dated 15.08.2018, and also the principles of the Helsinki Declaration of the World Medical Association regarding ethical principles for medical research involving human subjects. Informed consent has been obtained from all individuals included in this study.

## Results

Based on many years of research and taking into account the results of the works of many scientists, we substantiated the original experimental methodical system of physical education, which is considered as an ordered set of interrelated and interdependent methods aimed at the formation of health and fitness competencies in the process of physical education.

The methodical system aims to provide a sufficient educational level, the necessary motivational value-based attitude to physical culture and a healthy lifestyle, harmonious development of the body, high physical performance, and a stable need for physical improvement in the further life after graduation. The implementation of the original methodical system involves three stages.

At the first stage (adaptive), the solution of the following fundamental pedagogical tasks is ensured: a) the adaptation to the educational process (intensive mental activity) at the higher educational institutions by means of physical education; b) the education of the students' stable interest, motives, positive attitude, and need for physical activity; c) an increase of the general level of physical fitness, the development of physical abilities, reserve functional capabilities of a human body, health improvement, the promotion of inclusive development; d) the formation of knowledge on following a healthy lifestyle and engaging in independent exercise, conducting active leisure.

At the second stage (the achieving of comprehensive development), the following pedagogical tasks are achieved: a) the use of different forms of physical education and mastering wellness fitness technologies; b) the formation of psychophysical qualities and readiness for viability.

At the third stage (the formation of the need for a healthy lifestyle), the following pedagogical tasks are achieved: a) harmonious development of an organism and a significant increase in physical performance; b) the education of a students' stable need for physical self-improvement, self-knowledge, and self-esteem; c) gaining experience in the use of fitness and health activities to achieve professional and life skills; d) mastering the methodology of organizing and conducting sports and health-promoting events in the society.

The introduction of the methodical system into the process of physical education significantly influenced the overall level of formation of the motivational component in the experimental group, which was significantly increased, in comparison to the training according to the traditional system. Thus, a high level of motivational component formation accounted for 20.5%, sufficient 34.1%, middle 31.8% and low only 13.6% in the EG (Table 1). Concerning the CG, 4.6% of students were observed to have a high level of formation, 16.3% sufficient, 37.2% middle and 41.9% low.

The monitoring in the cognitive direction during training according to the original methodical system of physical education revealed the positive dynamics of the acquired knowledge and skills necessary for the organization of physical health-improving and sports-mass activities after graduation. The indicators of the level of knowledge and skills are a) the general theory and methodology of physical health education; b) the organization and conducting sports competitions and physical health-improving events; c) competition judging; d) the creation of a complex of sports facilities and equipment for physical education classes and its material and technical supply. Thus, a high level of knowledge and skills accounted for 18.2% in the EG, and 2.4% in the CG. A sufficient level of acquired knowledge and skills accounted for 29.6% in the EG, and 13.9% in the CG. A middle level of knowledge and skills was also better in the EG 38.6%; it accounted for 34.9% in the CG. A large difference was observed in the indicators of a low level, which were 13.6% in the EG and 48.8% in the CG.

The results of the study by activity component showed the improvement of the results in the EG concerning the level of mastering special knowledge, skills, and abilities to control physical fitness and health status, to properly apply the means and methods of physical education in practice for the development of physical qualities during life, to plan physical health-improving and sports process in the further life. At the same time, 22.7% EG students and only 9.3% of CG students showed a high level of readiness to introduce the means of physical culture and sports during their professional activity and life. Concerning a sufficient level of knowledge and skills, the EG students' results also prevailed: the indicators accounted for 34.1% in the EG and 16.3% in the CG. A middle level accounted for 36.4% in the EG and 37.2% in the CG. A low level in the EG and CG accounted for 6.8% and 37.2%, respectively, which indicates the high efficiency of the implementation of the original methodical system of physical education (Table 1).

**Table 1.** The level of health and fitness competencies of students after the pedagogical experiment (EG=44; CG=43)

| The criteria for evaluation | Groups | The level of health and fitness competencies | | | |
|---|---|---|---|---|---|
| | | High (%) | Sufficient (%) | Middle (%) | Low (%) |
| Motivational | EG | 20.5 | 34.1 | 31.8 | 13.6 |
| | CG | 4.6 | 16.3 | 37.2 | 41.9 |
| Cognitive | EG | 18.2 | 29.6 | 38.6 | 13.6 |
| | CG | 2.4 | 13.9 | 34.9 | 48.8 |
| Activity | EG | 22.7 | 34.1 | 36.4 | 6.8 |
| | CG | 9.3 | 16.3 | 37.2 | 37.2 |

The methodical system also helps to determine the requirements for the training of a specialist according to the criteria of organizational, communicative, perceptive, speaking, didactic abilities and inclinations for physical health-promoting and sports activities, creativity, general cultural level, social activity, and self-esteem. The basic requirements for the development of fitness and health competencies influence the formation of the content of the main components of the methodical system of physical education.

The studies also confirmed that theoretical knowledge is the basis for activating students' consciousness, and they determine the level of the needs for physical and wellness activities. The conducted pedagogical experiment showed that the initial level of theoretical knowledge concerning all studied parameters is quite low (1.84–2.15 points) in both the EG and CG, and it is rated as unsatisfactory. The methodical system introduced in the process of physical education of the EG students significantly improved all comparative indicators in the EG – 2.06, and 2.44 points ($p<0.001$). The analysis of the results in the CG showed that the improvement of the indicators was lower, and it occurred only because of the low initial points (Table 2).

**Table 2.** The dynamics of theoretical knowledge during the period of the pedagogical experiment

| The indicators estimated | Groups | Before the experiment | After the experiment | The difference | The reliability of the difference | |
|---|---|---|---|---|---|---|
| | | Mean±SD (points) | Mean±SD (points) | | t | p |
| General basics of physical culture | EG | 2.11±0.27 | 4.17±0.32 | 2.06 | 4.92 | <0.001 |
| | CG | 2.15±0.26 | 3.24±0.30 | 1.09 | 2.75 | <0.01 |
| Special knowledge, skills, and abilities to apply them | EG | 1.84±0.23 | 4.28±0.31 | 2.44 | 6.32 | <0.001 |
| | CG | 1.91±0.21 | 2.77±0.27 | 0.86 | 2.51 | <0.05 |

Legend: Mean-arithmetical average; SD-standard deviation; t-test; p-significance of difference of testing indicators before and after the experiment due to the t-test.

It can be stated that the methodical system of physical education significantly improves the level of theoretical training of students in the discipline of Physical Education, which positively influences the level of formation of health and fitness competencies of students. The acquired knowledge will allow the EG students to easily orient towards the issues of physical culture and be able to apply them during independent classes and the organization of a healthy lifestyle.

The analysis of the indicators of physical fitness of students, obtained in the process of the pedagogical experiment, convincingly showed the high efficiency of the implementation of the original methodical system in the process of physical education. The EG students significantly improved their performance in all six tests that were used to assess the level of physical fitness (Table 3).

**Table 3.** The dynamics of the indicators of physical fitness of male students during the pedagogical experiment

| Tests | Groups | Before the experiment | After the experiment | The difference | The reliability of the difference | |
|---|---|---|---|---|---|---|
| | | Mean±SD | Mean±SD | | t | p |
| The 100 m race (s) | EG | 14.41±0.24 | 13.52±0.18 | 0.89 | 2.97 | <0.01 |
| | CG | 14.39±0.22 | 14.18±0.19 | 0.21 | 0.72 | >0.05 |
| The 3000 m race (min, s) | EG | 14.21.7±0.29 | 13.11.3±0.22 | 1.10 | 3.02 | <0.01 |
| | CG | 14.32.4±0.31 | 14.03.9±0.28 | 0.28 | 0.69 | >0.05 |
| Pull-ups (reps) | EG | 7.06±0.65 | 11.83±0.49 | 4.77 | 5.86 | <0.001 |
| | CG | 7.38±0.59 | 8.64±0.54 | 1.26 | 1.58 | >0.05 |
| Push-ups (reps) | EG | 28.54±2.13 | 37.28±1.96 | 8.74 | 3.02 | <0.01 |
| | CG | 28.02±2.17 | 32.41±2.25 | 4.39 | 1.40 | <0.05 |
| Standing long jump (cm) | EG | 213.67±2.51 | 236.78±2.48 | 23.11 | 6.55 | <0.001 |
| | CG | 211.44±2.47 | 217.39±2.38 | 5.95 | 1.73 | >0.05 |
| Sit-ups (reps) | EG | 27.53±2.09 | 39.61±2.01 | 12.08 | 4.15 | <0.001 |
| | CG | 28.13±1.93 | 33.56±1.85 | 5.43 | 2.03 | <0.05 |

The EG male students showed the best indicators of physical fitness at the end of the experiment in the 3000 m race ($p<0.01$), pull-ups ($p<0.001$), push-ups ($p<0.001$), sit-ups ($p<0.01$), and other exercises. At the same time, the results of the CG male students were significantly improved only in push-ups and sit-ups ($p<0.05$), which indicates that the traditional physical education system is not able to provide the required level of physical fitness of students during their studies.

The EG female students also significantly improved the performance of all tests. The best results were achieved in standing long jump, angled position, push-ups, sit-ups ($p<0.001$) and other tests ($p<0.05$). In the CG, female students showed a significant improvement of the results in only two tests: push-ups and sit-ups ($p<0.05$) (Table 4).

A low level of physical fitness of female students is accompanied by uncertainty in their actions, depression, discomfort,

**Table 4.** The dynamics of the indicators of physical fitness of female students during the pedagogical experiment

| Tests | Groups | Before the experiment | After the experiment | The difference | The reliability of the difference | |
|---|---|---|---|---|---|---|
| | | Mean±SD | Mean±SD | | t | p |
| The 100 m race (s) | EG | 18.06±0.21 | 17.04±0.23 | 1.02 | 3.28 | <0.01 |
| | CG | 18.17±0.26 | 17.94±0.28 | 0.23 | 0.60 | >0.05 |
| The 2000 m race (min, s) | EG | 11.54.9±0.27 | 10.46.3±0.29 | 1.08.6 | 2.73 | <0.01 |
| | CG | 11.36.8±0.30 | 11.21.4±0.32 | 15.4 | 0.34 | >0.05 |
| Push-ups (reps) | EG | 8.97±0.98 | 15.36±1.03 | 6.39 | 4.49 | <0.001 |
| | CG | 8.24±0.83 | 11.46±0.92 | 3.22 | 2.60 | <0.05 |
| Standing long jump (cm) | EG | 161.86±2.34 | 175.53±2.41 | 13.67 | 4.07 | <0.001 |
| | CG | 163.35±2.42 | 168.74±2.38 | 5.39 | 1.59 | >0.05 |
| Sit-ups (reps) | EG | 27.14±1.71 | 38.29±1.92 | 11.15 | 4.34 | <0.001 |
| | CG | 28.03±1.82 | 33.68±1.83 | 5.65 | 2.19 | <0.05 |
| Angled position (cm) | EG | 10.92±0.98 | 17.63±1.12 | 6.71 | 4.51 | <0.001 |
| | CG | 11.10±1.02 | 13.59±1.15 | 2.49 | 1.62 | >0.05 |

and deterioration of recovery processes during physical and mental activity that, in general, negatively influences the formation of health and fitness competencies.

## Discussion

The organizational and pedagogical basis of the model of the efficient physical education of students should be provided by the physical readiness of the graduates of higher educational institutions for productive work and active life, that is a) theoretical, methodical and practical training, based on educational and extracurricular activities of the generally-conditioned and vocationally-applied psychophysiological and psychophysical improvement, sports training, physical rehabilitation, physical exercises in the regime of the day; b) didactic, which mainly involves the use of the physical education means and methods and physical exercise systems, traditionally popular among students: athletics, gymnastics, swimming, sports games, power sports, fitness technologies, etc.; c) the use of the socially efficient set of methods of the students' motivation for physical education: semester credit, the screening for prestigious job taking into account the level of physical fitness, promotion of physical improvement, regular diagnostics of physical condition, annual state testing of physical fitness, current and final certification after graduation (Bergier et al., 2017; Mehmeti, & Halila, 2018; Ostafijchuk, Prezliata, & Mytskan, 2013; Altin, & Demir, 2019; Batilani, Belem, & Both, 2018; Leuciuc, 2018; Bolotin, & Bakayev, 2015).

The original methodical system of physical education includes a) a holistic reflection of the tasks of forming a comprehensively developed personality of a future specialist in the content of teaching; b) a high scientific, methodical and practical level of the content of the training classes; c) the correspondence of the complexity of the content of educational process to the student's capabilities: health status, the level of physical development and physical fitness, abilities and technical skills in performing exercises; d) the correspondence of the educational material content volume to the time allowed for its mastering or implementation; e) the conformity in the content of educational material with the material and technical base of higher educational institutions and the specialists in this area.

The results of the pedagogical experiment show that the original methodical system of physical education contributes to the improvement of the quality of physical education, which is revealed in the improvement of the motivational value-based attitude of students to physical and wellness activities, theoretical knowledge, physical fitness, the development of physical qualities, and in the complexity of the formed health and fitness competencies required in professional activity.

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SportMont

ORIGINAL SCIENTIFIC PAPER

# Effects of a Programme of Intensive Training of Alpine Skiing Techniques on Some Motor Abilities

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**Abstract**

Learning skiing, especially in the conditions of initially learning alpine skiing techniques, is quite tense and takes place over a longer period, with physical and psychological loads, caused by adaptation to new equipment and demanding conditions. This research aimed to determine the effects of a short-term experimental programme of intensive training of alpine skiing techniques to particular motor abilities of students. The sample is divided into an experimental group of beginners who were skiing for the first time and a control group. The results of ANCOVA within variables for the evaluation of motor abilities show statistically significant effects of applying the experimental programme in three out of eight variables. The contribution to these effects is seen in the Hexagon agility assessment test (p=.001) and in tests of static strength of legs: left leg squat endurance test (p=.017) and right leg squat endurance test (p=.013). From the mean value results (M), it is obvious that the experimental group achieved better results compared to the identical tests applied to the control group. The data obtained in this research are of great importance to everyone responsible for the transfer of knowledge and positive developmental effects of physical exercise.

***Keywords:*** *ski training, students, agility, static strength*

## Introduction

Alpine skiing is classified as a sport dominated by cyclic movement patterns (turn after turn), but compared to other cyclical movements in running or cycling, external circumstances (snow conditions, slope inclination, track settings, etc.) cause a high level of variability (Kröll, Birklbauer, Stricker, & Müller, 2006). Learning skiing, especially in the conditions of initially learning alpine skiing techniques, is quite tense and takes place over a longer period, with physical and psychological loads caused by adaptation to new equipment and demanding external conditions. Successfully learning skiing techniques is related to practical training in which the skiers form images of movement and movement habits. Learning a setup method must always contain precise settings that allow one to perform the tasks correctly (Ćurić et al., 2018). Skiing is a very dynamic sport and recreational activity, which, in addition to technique, is strongly influenced by the anthropological characteristics of skiers, among which, motor abilities are highly significant (Cvetković, Radosav, Matić, Jakšić, & Orlić, 2010). As researchers state (E. Mujanović, Atiković, & Nožinović Mujanović, 2014), coordinated action of the whole body of the skiers in which work of the legs, upper body and hands is equally important. Theoretically, balance dominates, but the other motor skills described in this paper are significant. It should be emphasized that agility and static strength contribute the most in learning the specific motor knowledge of alpine skiing – parallel turns (Cigrovski, Božić, & Prlenda, 2012). Mujanović and Krsmanović (2008) state that students with higher levels of motor abilities, such as balance, agility, flexibility and repetitive strength, have more success in mastering dynamic short radius turns.

Accordingly, this research aimed to determine if there are effects of a short-term experimental programme of intensive

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training of alpine skiing techniques to particular motor abilities of students.

## Methods

*Participants*

The test sample included 65 male students enrolled in the second and third year of study at the Faculty of Physical Education and Sport at the University of Tuzla. The sample is divided into an experimental group (31 students, age 21.4±1 and body height 180.7±6.3cm) and control group (34 students, age 20.6±.8 and body height 180.3±6.8 cm). Students who participated in the study were healthy, not excused from physical education for health reasons, and they gave their written consent to participate in testing. The study was carried out according to the principles of the Helsinki Declaration on experimentation on living subjects (WMA, 2017).

*Variables*

Based on previous studies, tests were selected, which correspond to characteristic movements when performing the basic elements of alpine skiing, on the basis of which relevant indicators can be drawn on the effects of the intensive training programme for alpine skiing, and because of their good metric characteristics (Semenick 1990; Reid, Johnson, Kipp, Albert, & White, 1997; Bosco, 1997;)

For the assessment of motor abilities, the tests were Hexagon, agility T-Test, squat jump, counter-movement jump, left leg counter-movement jump, right leg counter-movement jump, left leg squat endurance, and right leg squat endurance.

*Procedure*

The assessment of motor abilities selected for this research was conducted two days before and after the end of the experimental programme, which lasted six days. The programme was implemented on a daily basis during the period 09:00-16.00h for 33 hours over 6 days (4 hours of training with instructors and 2 hours of free practice for 5 days; and on 3 hours of free practice the 6th day).

The experimental programme is designed for beginners to learn the basic techniques of alpine skiing. It (Table 1) was precisely determined by the predetermined number of repetitions of a particular methodical exercise or the ski technique itself and was formed on the basis of current knowledge in the training of motor activity of alpine skiing. It has been proven that the number of repetition and training of a particular element of ski technique and the way it is presented affects the higher level of the adopted knowledge of alpine skiing (Grouios, Kouthouris, & Bagiatis, 1993; Almåsbakk, Whiting, & Helgerud, 2004).

During the period of experimental treatment, the control group performed the regular duties prescribed by the curriculum (training of their choice for a practical exam in judo, handball and dances).

**Table 1.** Design of experimental programme elaborated on a daily basis

| Learning day | Design of experimental programme |
|---|---|
| 1st | Determining the initial knowledge of alpine skiing and forming homogeneous groups of skiers by the quality of knowledge; overview of equipment and attachment and removal of skis; walking with and without ski poles on the platform, turning around the tops and tails, falling and lifting; climbing the slope, turning on a slope, falling and lifting; gliding straight down the gentle slope (on flat terrain and over uneven terrain), with different ways of stopping (at the end of a slope, in a plow, by a transient step); the use of ski lifts; traversing the slope traversing the slope with sliding and stoping; gliding wedge (speed control and stopping in the plow); wedge turns. |
| 2nd | Repeat alpine skiing technique elements from the previous day; ski curves with wedge turns; gliding wedge on a steeper slope (speed control and stopping); wedge turns on a steeper slope; parallel turn towards the slope (with sliding and carving the skis); wedge parallel turn. |
| 3rd | Repeat alpine skiing technique elements from the previous days; advanced wedge turns with pole plant; wedge parallel turns on a steeper slope; parallel turns on a gentle slope. |
| 4th | Repeat alpine skiing technique elements from the previous days; parallel turns on a steeper slope; basic parallel turns on a gentle slope. |
| 5th | Repeat alpine skiing technique elements from the previous days; wedge turns; wedge parallel turns; basic parallel turns. |
| 6th | Free practice. |

*Data analysis*

To determine the effects of an experimental programme on some motor abilities of students, a univariate covariance analysis was applied (ANCOVA). As a preliminary analysis (assumption) for ANCOVA, Levene's test was used to evaluate the equality of variances between the compared groups.

## Results

Preliminary testing tested the assumption of variance homogeneity; no perceived contingency was noted in the applied variables. The statistical significance of Levene's test in all variables is $p>.05$, indicating that observed variance, two groups of respondents, are similar in these variables, which means that there are no significant differences between the variants. The zero hypothesis is accepted, and we conclude that the condition of homogeneity is met. Therefore, differences in the size of the experimental treatment effect between the groups can be attributed to the differences due to the treatment.

Results of ANCOVA within the variables for the evaluation of motor abilities show statistically significant effects of the applied experimental programme in three of the eight used variables at the level of significance $p<.05$. The contribution to these effects is evident in the hexagon test HEX - $p=.001$, left leg squat endurance test LSE - $p=.017$, and right leg squat en-

**Table 2.** Levene's test for both groups of respondents in variables for estimating motor abilities

| Dependent Variable | F | df1 | df2 | p |
|---|---|---|---|---|
| HEX | 3.775 | 1 | 63 | .056 |
| T-Test | .006 | 1 | 63 | .937 |
| SJ | .466 | 1 | 63 | .497 |
| CMJ | 3.921 | 1 | 63 | .052 |
| LCMJ | 3.738 | 1 | 63 | .058 |
| RCMJ | 3.776 | 1 | 63 | .056 |
| LSE | 1.859 | 1 | 63 | .178 |
| RSE | .001 | 1 | 63 | .975 |

Legend: F - Fisher's F ratio; p – level of statistical significance; HEX - Hexagon; T-Test - agility test; SJ - squat jump; CMJ - counter-movement jump; LCMJ - left leg counter-movement jump; RCMJ - right leg counter-movement jump; LSE - left leg squat endurance; RSE - right leg squat endurance

durance test RSE - p=.013. If we look at the results of the mean values (M) in the mentioned variables, we can see that the subjects of the experimental group achieved better results on the tests than the identical tests applied with the control group.

**Table 3.** Results of ANCOVA within the variables of motor abilities

| Dependent Variable | | Control group M±SD | Experimental group M±SD | ANCOVA | |
|---|---|---|---|---|---|
| | | | | F | p |
| HEX | I | 11.99±1.607 | 12.72±1.81 | 11.793 | .001 |
| | F | 12.01±2.23 | 11.44±1.24 | | |
| T-Test | I | 9.60±.79 | 10.07±.70 | 1.193 | .279 |
| | F | 9.78±.79 | 10.01±.75 | | |
| SJ | I | 32.46±4.42 | 31.41±6.24 | .023 | .881 |
| | F | 33.26±4.82 | 32.73±4.59 | | |
| CMJ | I | 34.34±5.47 | 33.20±6.16 | .319 | .574 |
| | F | 34.60±6.03 | 34.10±5.85 | | |
| LCMJ | I | 16.56±3.66 | 16.48±4.16 | .021 | .885 |
| | F | 16.91±3.53 | 16.74±4.46 | | |
| RCMJ | I | 16.77±2.93 | 15.63±5.08 | .907 | .345 |
| | F | 17.11±3.24 | 16.83±4.23 | | |
| LSE | I | 33.59±17.03 | 33.99±16.95 | 6.062 | .017 |
| | F | 34.49±16.26 | 38.87±15.99 | | |
| RSE | I | 35.05±18.29 | 33.63±15.92 | 6.507 | .013 |
| | F | 36.69±19.52 | 39.99±14.45 | | |

Legend: I – initial testing; F – final testing; M–arithmetic mean; SD–standard deviation; F - Fisher's F ratio; p – level of statistical significance

## Discussion

The primary aim of the presented research was to determine the effects of the short-term experimental programme of intensive training of alpine skiing techniques to particular motor abilities of students. As we see in the results, the programme was effective on the hexagon test, left leg squat endurance test and right leg squat endurance test. Those effects are reflected in the improvement of the results in the aforementioned tests in the subjects of the experimental group compared to the identical variables tested in the control group.

In a study of determining the effects of a ten-day skiing course at students of the Faculty of Sports and Physical Education, with respect to certain motor abilities, the authors (Cvetković, Radosav, Matic, Jaksic, & Orlic, 2010) found statistically significant changes in the transformation of variables for estimation of agility and flexibility, while no statistically significant changes were found in the variable for the estimation of the explosive power of the lower extremities and coordination.

In research (Camliguney, Ramazanoglu, Atilgan, Yilmaz, & Uzun, 2012) that was aimed to observe the effects of intensive ski training, for a period of six days, the authors state that there was an improvement in the results of the experimental ski group compared to the control group in the dynamic-isometric leg strength test. As possible causes of these changes, the authors stated that while performing skiing, balance and movement controls represent the foundation of skiing for the lower extremities. This is especially true when, while training on skis, the centre of gravity approaches the ground, and there are frequent dynamic and isometric contractions of the mus-

cles, leading to an increase in leg strength. Cigrovski, Bilić, Prlenda, and Martinčević (2010), state that research on competitors in alpine skiing has shown that the explosive power of the lower extremities is highly correlated with the result, whether among young alpine skiers or older skiers and also added that motor ability explosive strength is not crucial in the initial phases of the adoption of ski knowledge and does not represent a significant link for beginners when acquiring the basics of the sport.

Cigrovski et al. (2012) conducted a study on a sample of 86 male respondents of average age 22.76±1.15, beginners with no previous skiing experience, which is aimed at determining the impact of some motor abilities on the success in learning alpine skiing. The results obtained in their study indicate the positive impact of agility, static leg strength and balance on learning the initial alpine skiing technique. Accordingly, they recommend to all future recreational skiers to optimize the level of motor abilities listed before going to the ski slopes.

In contrast, Mujanovic (2008) in his research to determine the prognosis of results in alpine skiing in the basic variable parallel turns based on motor abilities, concluded that the prediction of results in the criterion variable based on motor abilities is better with the help of the whole system of predictor variables and that the prognosis of the results is only possible when adequate and complete physical preparation has been carried out to increase motor abilities to the optimum level for easier mastering of the basic elements of alpine skiing technique. Furthermore, Mujanović and Krsmanović (2008) indicate that for successful mastering of the ski elements short turns and basic turns is required adequate physical preparation of all motor abilities equally.

In the study by Hydren et al. (2013), which aimed to determine the acute impact of exposure to higher altitudes during ski camp on the specific abilities of ski competitors age 13.7±0.5, the results revealed improved balance and reaction time during the first three days; on the sixth day, there was an improvement in vertical jumps, flexibility, agility in the T-test and push-ups.

Based on the aforementioned results of the previous research as well as the results obtained in this research, the general conclusion is that there is a causal relationship between mastering skiing technique and motor abilities, or that an increase in the level of motor abilities, agility and static leg strength during learning skiing, if sufficiently trained, can affect the success of mastering skiing techniques. This study and all previous ones emphasize agility, static leg strength and balance as the key to achieving success in skiing; however, while learning skiing contributes to better management of agility, static leg strength and balance, it is necessary to include exercises that enhance these abilities in fitness training.

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ORIGINAL SCIENTIFIC PAPER

# Differences in an Organization's Cultural Functions between High and Low-Performance University Soccer Teams

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**Abstract**

The purpose of this study was to analyse the differences in cultural functions between high- and low-performance university soccer teams in South Korea. First, this study focused on the cultural functions of university soccer teams, such as managing change, achieving goals, coordinated teamwork, and cultural strength. Second, each cultural function of university soccer teams was investigated in relation to team performance. Using random cluster sampling, 316 players from four high- and four low-performing university soccer teams registered with the Korean Football Association (KFA) participated in the study. The Organizational Culture Assessment Questionnaire (OCAQ, Sashkin, 2001) was used as an instrument to measure the organization's cultural functions. The results of the study showed that there were significant differences in cultural functions between high- and low-performance teams. High-performance teams were good at adapting changes in their environment, were effective in achieving goals, had coherent and aligned goals and shared values, and agreed on those values. It can be concluded that cultural functions are strong factors that make a difference in team performance.

***Keywords:*** *cultural functions, team performance, OCAQ, university soccer teams*

## Introduction

Guus Hiddink is a phenomenal soccer coach in the South Korean soccer industry. He removed all the scepticism initially originating from successive defeats and established a remarkable outcome in the 2002 Korea and Japan World Cup, which remains the best record in Korean soccer history. The impressive point is that he created an environment in which players do not perceive the hierarchical Confucianism tradition. For example, he set up a rule that when calling an older player, the latter's title should not be used, which is considered rude or awkward in Korean society as a whole. Shaping a new cultural paradigm in the South Korean National Team, he accomplished the best result in Korean soccer history and is considered to be the successful creator of a new organizational culture in the field of sport.

Creating a new culture is not a simple matter. Schein (2010) mentions that organizational culture is the well-established beliefs, values, and assumptions through which organizational members view a situation, and it can shape the identity and behavioural modes of the organization. He also emphasizes that leaders should be insightful in order to communicate as well as create new visions, which will inspire the follower willing to follow the visions. In this sense, Schein (2010) noted that "the unique and essential function of leadership is the manipulation of culture". In addition, he described "culture is both a dynamic phenomenon that surrounds us at all times, being constantly enacted and created by our interactions with others and shaped by leadership behavior, and a set of structures, routines, rules, and norms that guide and constrain behavior". Slack and Parent (2006) emphasized the "power" element, noting that "those who hold the power in an organization will choose a set of structural arrangements that will maintain or increase their power".

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*Concept of organizational culture*

Many organizational culture theorists define organizational culture as the deep-rooted values and beliefs held and practised by members of an organization (Schein 2010). Cultures exist within organizations. Choi (2015) defines organizational culture as the basic value system that organizational members share to adapt to changing environments, and it can affect the behavioural modes of the people in it. Choo and Bae (2016) additionally state that organizational culture is composed of widely shared values, symbols, behaviours, and assumptions. It is about how the business is managed in the system. Culture researchers have not only asserted the importance of a deep understanding of underlying assumptions (Schein, 2010) but also have suggested that sport organizations operate within stable cultures develop their own thick culture rather than adapt to the external environment (Slack & Parent, 2006).

*Elements of organizational culture*

Culture is composed of several different levels. "Level" means the degree to which a cultural phenomenon is visible to the observer. The level of culture tends to be easy to observe and very difficult to decipher: major levels include artefacts, espoused beliefs and values, and underlying assumptions (Schein, 2010).

The level of artefacts is situated at the surface and tangible. It includes phenomena that one can see, hear, and feel when one meets an unfamiliar culture, such as architecture, language, technology, products, artistic creations, style, published lists of values, observable rituals and ceremonies, and similar. (Schein, 2010). Young (2000) asserted that artefacts are quite easy to understand compared to other cultural levels. Artefacts bring immediate insight. Schein (2010) asserted that it is dangerous to infer the culture of an organization from artefacts alone because one's interpretations associated with feelings and reactions always exists.

Champoux (1996) mentioned that there are two different types of values: espoused values and in-use (enacted) values. The espoused values guide what veteran members say in a given situation, and the in-use (enacted) values guide the behaviour of organization members. Schein (2010) referred to espoused values as "a way of dealing with the uncertainty of intrinsically uncontrollable or difficult event".

When members of an organization are in congruence with espoused values, it can be said that basic assumption is held in an organization. Schein (2010) said basic assumptions are values taken for granted, non-confrontable, nondebatable; therefore, they are difficult to change. Young (2000) explained basic assumptions are "the visible but identifiable reason why group members perceive, think, and feel the way they do about external survival and internal operational issues such as a mission, means of problem solving, relationships, time and space". Nelson and Quick (2003) summarized elements in basic assumptions as "relationship to environment, nature of reality, time and space, nature of human nature, nature of human activity, and nature of human relationships". Alvesson, Karreman, and Ybema (2017) explain that the individual chooses a strategy for action to solve problems using the culture of the organization in which he/she is.

Choi (2005) summarized culture into five levels. First, things physically manifested and products made as a result of cultural activity (e.g., logo and symbols) are called artefacts. Second, structural patterns of activities such as decision-making, communication and coordination are reflected through patterns of behaviour. Outsiders can observe those activities, and they help solve basic organization problems. Third, behavioural norms are established through members' beliefs about which are acceptable or unacceptable. Members come to predict norms of behaviour mutually. Fourth, values should be prioritized to certain states or outcomes, such as innovation versus predictabilities and risk-seeking versus risk avoidance. Finally, even organizational members are not directly aware of fundamental assumptions.

The different values or assumptions in an organization can influence the assessment of organizational culture. Therefore, the measures of organizational culture have moved "from a systems theory framework toward qualitative measurement of subjective variables, such as rituals and stories from the workplace" (Colyer, 2000). Furthermore, Schein (2010) stated, "I have not found a reliable, quick way to identify cultural assumptions".

*Effect of culture*

Nelson and Quick (2003) summarized four basic functions of organizational culture. First, culture enables the members to have a sense of identity that encourages them to be more committed to the organization. Second, culture helps employees better interpret what the events of the organization mean. Third, culture strengthens the values in the organization. Lastly, culture helps in shaping the behaviour of the organization members.

Robbins (1994) asserted that there is a strong relationship between organizational culture and satisfaction, but individual differences moderate the relationship. Figure 1 demonstrates how organizational culture impacts performance and satisfaction. Robbins (1994) argued that satisfaction is highest if individual needs and organizational culture coincide. The strength of organizational culture ranges from low to high. High satisfaction yields good performance. Defining the boundaries of the organization to facilitate individual interaction and limiting the scope of information processing to appropriate levels helps organizations build cultures that create higher performance.

Kotter and Heskett (1992) reviewed three perspectives to see the relationship between organizational culture and performance: The strong culture perspective, the fit perspective, and the adaptation perspective. A strong culture is "an organizational culture with a consensus on the values that drive the company and with an intensity that is recognizable even to outsiders. Thus, strong culture is deeply held and widely shared. It is highly resistant to change". They asserted that strong cultures facilitate performance because, first, all employees share common goals, second, strong cultures generate high motivation, and third, strong cultures can control organizations with no domination of bureaucracy. The fit perspective means that a culture is good only when it fits the organization's strategy. The fit perspective is useful in explaining short-term performance but is inappropriate for long-term performance. The adaptation perspective means that once a culture is established in an organization, it tends to self-perpetuate and be stable. However, this does not mean that culture never changes. Kotter and Heskett (1992) state, "turnover of key members, rapid assimilation of new employees, diversification into very different businesses, and

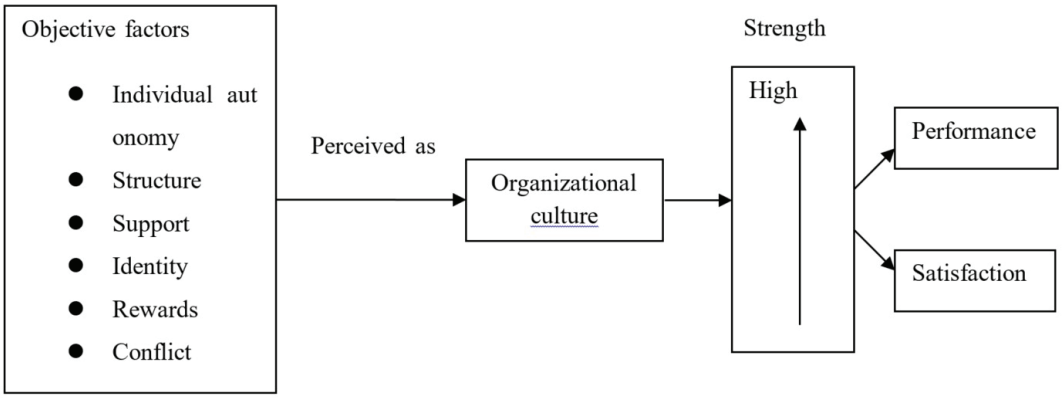


FIGURE 1. How organizational culture impacts performance and satisfaction. Adapted from Robbins (1994)

geographical expansion can weaken or change a culture".

Jon, Carolin, and James (2016) describe three dimensions in corporate culture; symbolic reminders (entirely visible artefacts), keystone behaviours (recurring acts that trigger other behaviours and that are both visible and invisible), and mind-sets (attitudes and beliefs that are widely shared but exclusively invisible). They emphasize that behaviours should be regarded as the most powerful factors for real change. To change the cultural situation in the organization by affecting positive influences, changing the most critical behaviours is imperative. Then, the mind-sets will follow. If behaviour patterns and habits are altered, better results will be produced.

Research suggests that organizational culture is a factor that contributes to team performance. However, there has been an apparent lack of information about how a team's cultural functions and their performance are interrelated. Will there be any difference between high- and low-performance teams in organization cultural functions and, if so, how great is the difference? This study investigates whether there are differences in cultural functions between high- and low-performance university soccer teams in South Korea.

## Methods

*Participants*

The population of this study was all the players in 72 teams in the U-league. Considering there were around 35 to 45 players per team, the population was about 2600. Among 72 teams, only 36 teams can advance into the championship competition. After initially advancing, the 36 qualifying teams compete in a single-elimination so that they are narrowed down into 16, 8, 4, 2, and the one final winner. To determine the differences between high and low performing teams, samples of high performing teams were chosen from the teams in the championship competition, and samples of low performing teams were chosen from the players of the teams which failed to qualify for the championship competition.

To ensure better representativeness of the samples, the researcher selected four teams in each of high- and low-performing teams using a random cluster sampling method. The number of participants in high and low performing teams was 157 and 159 each. Out of 350 questionnaires distributed, 332 were collected with 16 incomplete answers, so 316 questionnaires in total were retained for the study. Figure 2 describes the sampling procedure briefly.

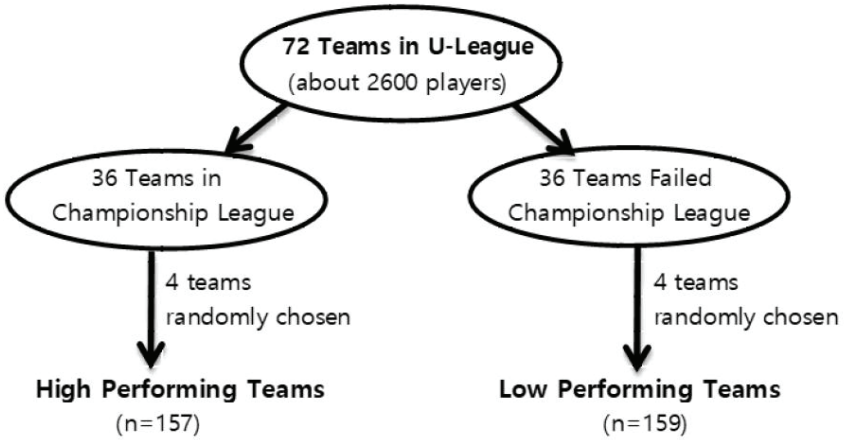


FIGURE 2. Selection process of high performing teams and low performing teams

*Measurement*

Among many methods, the present study used the Organizational Culture Assessment Questionnaire (OCAQ) by Sashkin (2001) as a primary instrument to collect data about team culture because it is efficient in identifying the problems in an organization and helps define desirable organizational culture. It is composed of five factors: managing change, achieving goals, coordinated teamwork, customer orientation, and cultural strength. Each of the five OCAQ scales includes six items, and each item is scored on a 5-point Likert

scale ranging from 5 "completely true", 4 "mostly true", 3 "partly true", 2 "slightly true", to 1 "not true." For the present study, customer orientation was not included because players cannot be regarded as customers to the coach, so only 24 questions were used. The OCAQ was developed in English originally and has never been applied to U-league players in Korea. It needed to be translated into Korean to be administered in a Korean setting. The researcher adapted Song's (2002) version to fit the context of university soccer teams in Korea, and a bilingual expert back-translated them into English to ensure translation equivalence. Through this process, the researcher identified whether there were any disagreements regarding the underlying constructs that were influenced by the translation process.

*Data analysis*

At first, exploratory factor analysis (EFA) was performed to identify a viable factor structure for independent variables. In addition, Cronbach's alpha was used to assess reliability. The data were analysed using SPSS 23.0. The t-test method was used to investigate the differences between high- and low-performance teams in the U-league. Statistical significance was set at $p<.001$.

## Results

*Exploratory factor analyses and the reliability of the survey instruments*

Twenty-four items were chosen to be tested for exploratory factor analysis (EFA). Principle component analysis with VARIMAX rotation was conducted, and the results revealed four factors, which supports the OCAQ as a valid instrument for this study. To verify the degree of intercorrelations among the variables and the appropriateness of factor analysis, the Bartlett test of sphericity and the Kaiser-Meyer-Olkin were obtained. The Bartlett test of sphericity showed that the result of the EFA was statistically significant, indicating that the correlation matrix had significant correlations among variables. In addition, the Kaiser-Meyer-Olkin (KMO) measured the degree of each variable to be predicted without error. The score of .80 or above is considered to be valid, and the result of KMO showed .907. The construct seemed reliable as Cronbach's alpha for all factors were over .7. Table 1 summarizes the results of the EFA.

**Table 1.** Exploratory Factor Analysis of OCAQ

| Attributes | | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|---|---|---|---|---|
| Factor 1: Achieving Goals | Q18 | **.874** | .248 | .157 | -.020 |
| | Q2 | **.865** | .305 | .221 | .003 |
| | Q14 | **.851** | .170 | .081 | .014 |
| | Q22 | **.844** | .250 | .195 | -.037 |
| | Q10 | **.822** | .261 | .137 | -.005 |
| | Q6 | **.781** | .140 | .088 | .023 |
| Factor 2: Managing Change | Q21 | .275 | **.867** | .104 | .057 |
| | Q13 | .253 | **.863** | .090 | -.006 |
| | Q1 | .288 | **.854** | .222 | .016 |
| | Q9 | .238 | **.850** | .140 | .055 |
| | Q5 | .204 | **.783** | .135 | -.022 |
| | Q17 | .106 | **.781** | .180 | .016 |
| Factor 3: Cultural Strength | Q24 | .177 | .134 | **.857** | -.045 |
| | Q4 | .145 | .110 | **.827** | -.011 |
| | Q20 | .053 | .101 | **.825** | .008 |
| | Q8 | .196 | .188 | **.821** | -.003 |
| | Q12 | .089 | .140 | **.818** | .018 |
| | Q16 | .123 | .121 | **.763** | -.079 |
| Factor 4: Coordinated Teamwork | Q23 | -.008 | -.041 | -.005 | **.892** |
| | Q3 | .036 | .042 | .003 | **.877** |
| | Q19 | -.008 | .039 | -.024 | **.834** |
| | Q11 | -.057 | .065 | .004 | **.808** |
| | Q7 | .021 | -.021 | .072 | **.625** |
| | Q15 | .003 | .008 | -.140 | **.570** |
| KMO | | | .907 | | |
| Bartlett's Test of Sphericity | | | .000 (sig) | | |
| Initial Eigen Value | | 4.688 | 4.627 | 4.333 | 3.647 |
| Variance (%) | | 19.535 | 19.277 | 18.054 | 15.197 |
| Cumulative Variance (%) | | 19.535 | 38.812 | 56.866 | 72.063 |
| Cronbach's Alpha | | .943 | .938 | .917 | .858 |

*T-test analysis*

Table 2 shows the mean scores of cultural functions in high- and low-performance teams. The mean scores were analysed using a paired sample t-test. There were statistically significant differences (p<.001) found for three of the cultural functions: Managing Change (t=3.706), Achieving Goals (t=6.351), and Cultural Strength (t=1.091). No statistically significant differences were found for Coordinated Teamwork

**Table 2.** Differences in Cultural Functions between High- and Low-Performance Teams

| Cultural Functions | High Performance (N=157) | Low Performance (N=159) | t | p |
|---|---|---|---|---|
| | M±SD | M±SD | | |
| Managing Change | 3.840±.710 | 3.436±1.173 | 3.706 | .000*** |
| Achieving Goals | 4.709±.768 | 3.406±1.090 | 6.351 | .000*** |
| Coordinated Teamwork | 2.743±.873 | 2.794±.905 | -.504 | .723 |
| Cultural Strength | 3.300±.692 | 3.191±1.029 | 1.091 | .000*** |

Legend: *** - p<.001

## Discussion

Scott (2000) contended that, "a strong positive culture is what separates the most effective organizations from those that are less effective". To this end, this study sought to determine how cultural functions are different according to team performance in high-and low-performing university soccer teams in Korea. In the present study, "performance" meant team rank in the league as this was the most obvious tangible and accessible outcome available. Advancement into championship competition was used as a barometer to separate between high and low performance.

It turned out that there were substantial differences in cultural functions between high- and low-performance teams. As Kotter and Heskett (1992) pointed out, there was a significant relationship between organizational culture and performance. Specifically, high-performance teams were better in adapting to changes in their environment, were effective in achieving goals, had coherent and aligned goals and shared values, and agreed on those values. It can be concluded that cultural functions are strong factors making differences to team performance.

Many sport teams in Korea tend to have hierarchical leader-centred cultures. However, it is suggested from the findings of this study that a strong leader-centred hierarchical culture needs to be ameliorated for team members in order to create better cultural functions of the team, which can trigger change in what has been a more rigid and inflexible university sport team culture in Korea. An organization with a strong, positive culture shares values widely, and it moves in a positive direction, so team identity tends to be high. However, soccer teams in Korea are generally lack of positive shared values by their members. Therefore, they are criticized as being unable to realize their full potential. Many Korean soccer players perform better in European leagues than they do in Korean domestic ones. Why does this happen?

It is suggested that carefully merging multi-levels of cultural functions can create an environment that is more creative, flexible, and considerate for individual differences, which will be more desirable for school sport than simply achieving high rank in leagues. As a researcher and as an administrator in a soccer association in Korea, I suggest that a school sport team does not simply exist for the discipline of sporting technique but also for helping athletes envision their potential for future life through their experience participating in sport. Therefore, achievement relative to winning should not serve as the only goal or outcome. It is also important to acknowledge that a more empowering and considerate environment can be created by positive organizational culture.

As mentioned in the introduction, Hiddink was one of the most famous soccer coaches in Korea because he was influential in helping South Korea win its first World Cup. Many people attribute the unprecedented achievement in the 2002 Korea-Japan World Cup to the cultural change caused by his different leadership style. What is noticeable is the fact that ever since he left Shout Korea, it has never accomplished as successful a record as in 2002 even with better soccer infrastructure. There are more fans, soccer clubs, and soccer stadiums, but the internal processes, cultural functions representatively, do not work appropriately. Sport team culture in Korea stills put too much emphasis on controls and conformity to hierarchical communications without shared values or beliefs to shape team identity.

Nowadays, sport organizations do not operate in a stable environment. Players and coaches come and go internationally, and the spectrum of fans has broadened. Kotter and Heskett (1992) argued that leaders in an adaptive organizational culture strongly value people and processes that create useful changes, but leaders in a nonadaptive organizational culture care mainly about immediate group work or products. As Hiddink adapted the culture of the South Korean national representative soccer team and created strong cultural functions with transformational leadership (Kim, 2010), the Korean soccer industry needs to understand the soccer team environment and should create and develop cultural functions that would promote team performance in the long run.

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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

# Investigation of Physical Fitness According to Gender among Older Adults with Similar Physical Activity Levels

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**Abstract**

This research aimed to investigate the physical fitness of older adults with similar physical activity levels according to gender. The Physical Activity Scale for the Elderly (PASE) (Turkish version) was used to assess their physical activity levels, and the Senior Fitness Test was used to measure physical fitness based on performance. The Mann Whitney U test was used to compare the non-parametric data between the genders, and the t-test was used for the parametric data. No significant difference was found in age, height and weight between older women and older men ($p>0.05$). There were significant differences in the chair stand test, arm curl test, get-up-and-go test and two-minute step test between older women and older men ($p<0.05$). There were no significant differences in the back-scratch test and the chair sit-and-reach test between older women and men ($p>0.05$). There is a gender-related difference between physical fitness components of men and women with similar levels of physical activity, except flexibility. Older men had stronger arms and legs, better dynamic balance, and better agility and aerobic capacities compared to older women in this research.

***Keywords:*** *older adult, physical activity level, physical fitness*

## Introduction

Physical activity level reduces with advancing age, which is linked to a reduction in work activities, the progression of biological age, and a reduction in movement amount inside or outside the house. It is also known that activity levels and exercise habits do not increase maximum life expectancy but do increase functional performance in older adults and contribute to their quality of life (Toraman & Şahin, 2004). Physical activity in older adults is necessary for reducing health problems, making daily activities easier, and for improving the quality of life (Nelson et al., 2007). Physical activity levels display individual differences among older adults (Notthoff, Reisch, & Gerstorf, 2017). According to some research, among the factors affecting the physical activity levels of older adults are previous exercise experience, health status, the presence of situations preventing physical activity, motivation, environment, and relatives and/or neighbours (Lee, 2005).

Physical fitness comprises the necessary physical fitness components (strength, power, flexibility, balance and aerobic capacity) to perform daily activities safely, independently, and without excessive tiredness. Physical fitness appears to have similar correlations with morbidity and mortality as physical activity; however, it provides a stronger estimation related to health (Wannamethee, Shaper, & Walker, 1998; Blair, Cheng, & Holder, 2001; Williams, 2001). Additionally, the risk of death is lower among women and men with high physical activity level and fitness, as well as a weekly energy expenditure of 1000 kilocalories on physical activity or 1 MET (metabolic value); increased physical fitness is reported to reduce mor-

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tality by nearly 20%. An increase in physical fitness reduces early death risk, while a reduction increases the early death risk (Warburton, Nicol, & Bredin, 2006). Globally, women live four to ten years longer than men. Researchers have stated that increased fitness is effective to explain this difference between men and women, along with other social behaviour differences (Spirduso, Francis, & MacRae, 2005). Clear differences between women and men are revealed by physical activity levels (Lee, 2005; Sun, Norman, & While, 2013; Şahin, 2017).

Assessments of physical fitness are not applicable or practical for large population-based research. However, it is possible to perform a more objective assessment, as it is a better determinant. The difference of this research from the other research that this research aims to investigate the physical fitness of older adults with similar physical activity levels according to gender.

## Methods

The research was conducted from October 2017 to June 2018 at the Canakkale Golden Years Living Center. The research included a total of 112 older adults: 74 older women and 38 men (65-69 years: n=55, 70-74 years: n=44, 75 years and older: n=13). The study was approved by the Review Board of Committee of the Golden Years Living Center. This research was conducted according to the Declaration of Helsinki recommendations: after the study design was described to the participants, signed informed consent to participate in the study was obtained. The research included individuals attending the centre, without health problems or chronic pain, who independently completed daily living activities without requiring support, who volunteered, were retired or did not have regular work, who participated, for the previous year in breathing exercises, posture training, muscle resistance, balance, flexibility and fall-prevention exercises and who participated in regular activities, such as handiwork, painting, choir, chess or computer courses. To assess physical activity levels, the Physical Activity Scale for the Elderly (PASE) (Turkish Version) was used (Washburn, Smith, Jette, & Janney, 1993; Ayvat, Kılınç, & Kırdı, 2017). To measure physical fitness, the Senior Fitness test battery (including get-up-and-go test, the chair sit-stand test, the back-scratch test, the sit-and-reach test, the arm curl test, and the two-minute step test) was used (Rikli & Jones, 2001). Statistical analysis was performed using IBM SPSS 20.0. An independent samples t-test was applied to the between-gender differences for parametric physical fitness parameters, while the Mann Whitney U test was applied to the non-parametric physical fitness parameters. For all the analyses, 95% confidence intervals are presented, and $p<0.05$ was considered statistically significant.

## Results

The research included 74 older women (mean age = 70.34±4.27 years, mean height = 157.88±6.38 cm, mean weight = 72.26±11.83 kg) and 38 older men (mean age = 70.39±4.46 years, mean height = 168.82±6.60 cm, mean weight = 76.45±8.42 kg). There was no significant difference between the mean age, height and weight between the genders ($p>0.05$). The physical activity level in older men was higher than women; however, the difference was not significant (Female = 115.65±42.82, Male = 129.98±67.72, z=-0.793, $p>0.05$, Figures 1, 2).

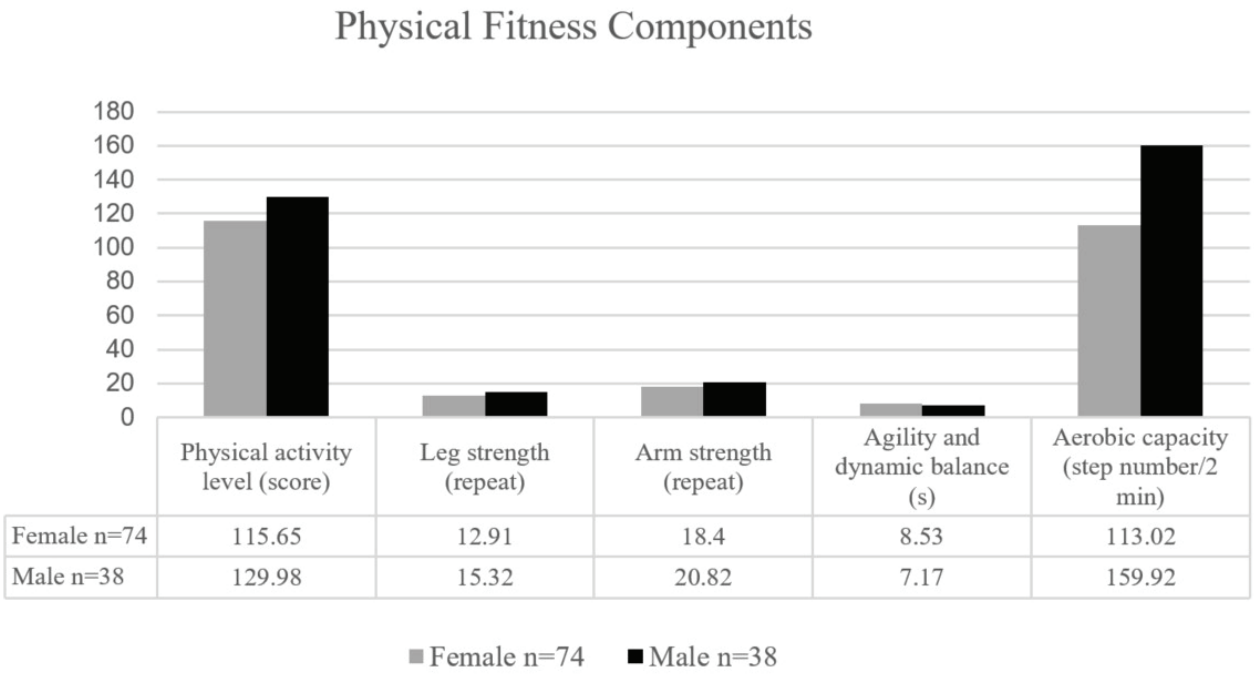
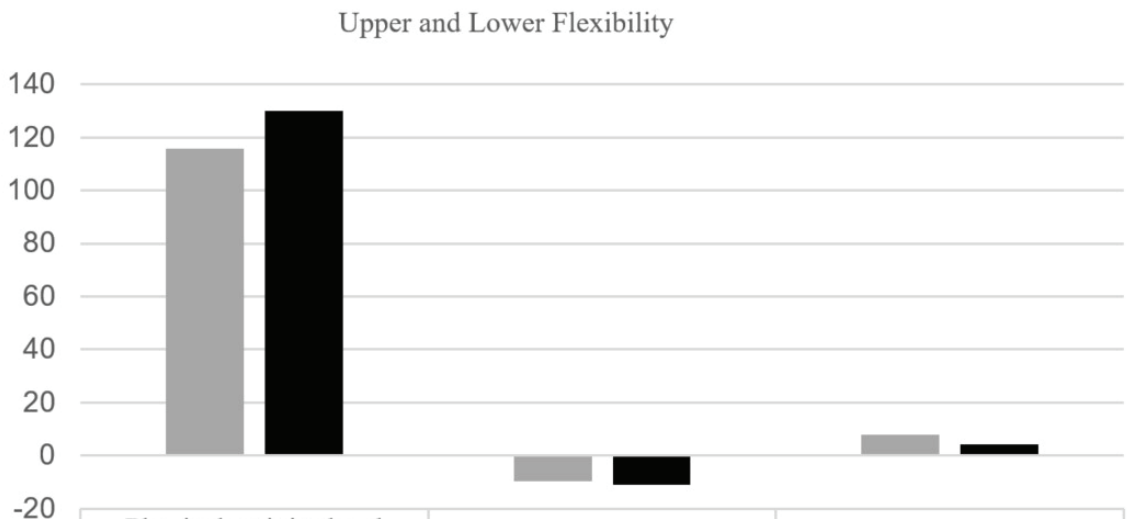



FIGURE 1. Physical fitness components statistically significant between genders

The leg strength (Female = 12.91±3.09, Male =15.32±5.31, p=0.004)*, arm strength (Female =18.40±3.18, Male = 20.82±4.47, p=0.003)*, agility and dynamic balance (Female = 8.53±2.00, Male = 7.17±1.51, p=0.002)* and aerobic capacity (Female = 113.02±54.23, Male = 159.92±50.67, p=0.000)* were higher in men. The differences between means were statistically significant ($p<0.05$, Figure 1).

Upper (Female = -9.79±11.42, Male = -10.85±14.84) and




| | Physical activity level (score) | Upper flexibility(cm) | Lower flexibility(cm) |
|---|---|---|---|
| Female n=74 | 115.65 | -9.79 | 7.98 |
| Male n=38 | 129.98 | -10.85 | 4.35 |

FIGURE 2. Physical fitness components and physical activity level with no statistical significance between genders

lower (Female = 7.98±7.61, Male = 4.35±10.69) body flexibility were better in older women; however, there was no significant difference between the means (p=0.702, p=0.059, p>0.05, Figure 2).

## Discussion

First, some research shows that older men have significantly higher physical activity levels than older women do (Washburn & Ficker, 1999a) and that older women have higher PASE scores than men do (Schuit, Schouten, Westerterp, & Saris, 1997; Ku, Sun, Chang, & Chen, 2013). In our research, although the mean was in favour of men, the difference between the genders may have been reduced by men engaging with activities outside the home, women engaging with activities within the home and both genders participating in regular physical activities at the centre. When the physical activity total score of older women and men in this research is compared to the other research (Ayvat et al., 2017; Washburn, McAuley, Katula, Mihalko, & Boileau, 1999b; Vaughan & Miller, 2013; Bean et al., 2002; Hagiwara, Ito, Sawai, & Kazuma, 2008), it is similar to some studies but shows lower physical activity levels when compared to others. In their research on cultural validity and reliability, Ayvat et al. (2017) identified the mean PASE score of individuals from 65 to 80 years of age as 121.79±54.71 (Ayvat et al., 2017). The results from their research group of 80 older women and older men are similar to the results of the present paper. However, the limited amount of research using the same physical activity scale in the elderly Turkish population prevents a broad comparison from being made.

The correlation of physical fitness to disease and death rates appears similar to physical activity; however, the assessment of physical fitness ensures a stronger estimation related to health (Wannamethee et al., 1998; Blair et al., 2001; Williams, 2001). The basic aim of our research was to investigate physical fitness according to gender. Accordingly, the leg strength, arm strength, agility and dynamic balance and aerobic capacity between older men and older women were statistically different (p<0.05). Upper and lower body flexibility were better in favour of older women; however, the difference between the means was not statistically significant (p>0.05).

Individuals who preserve their physical mobility by participating in a sport or working in strength-based jobs are better compared to inactive individuals, which supports the view that age-linked reductions in muscle strength are linked to activity amounts and type (Aniansson, Sperling, Rundgren, & Lehnberg, 1983; Frontera, Meredith, O'Reilly, Knuttgen, & Evans, 1988). However, with ageing, strength begins to decline. The changes in strength caused by ageing are affected by the measurement type of strength, the location of the measured muscle groups, physical activity status and diseases. Generally, as the muscle mass of individuals is different, there are differences in strength. As a result, as men have more muscle mass, men are 50% stronger in the upper body and 30% stronger in the lower body compared to women (Spirduso et al., 2005). When physical activity levels are assessed by a survey, though there are no differences between the genders, there are differences in some performance-based physical fitness components. Similar to the literature results, the arm and leg strength of older men was better compared to older women, and the difference between these means was statistically significant (p<0.05). In other words, the difference in leg and arm strength between women and men exists despite women being active.

In their study researching the effect of exercise and detraining on young-older and older individuals, Toraman and Ayçeman (2005) obtained similar results to our study for the arm curl, the chair sit-stand, the back-scratch test, and the chair sit-and-reach test. Positive comparisons may be made

between this research performed on the elderly Turkish group and our research results (Toraman & Ayçeman, 2005). In research investigating the correlation between the income levels and physical fitness of elderly Korean individuals with a mean age of 71.81 years, Ahn and So (2018) stated the sit-stand result for men was 16.94, while it was 15.54 for women. In our research, though the mean age of men and women was 70 years, these values appear to be slightly low (Figure 1).

The duration required to complete the agility and dynamic balance test is significantly correlated with limitations of activities common to daily life and the fear of falling. The get-up-and-go test is used to assess agility and dynamic balance, which are important for activities such as making rapid manoeuvres, getting on buses, working in the kitchen, going to the bathroom or answering the telephone (Rikli & Jones, 2001). This parameter of physical fitness was identified as being higher in older men. This situation may indicate that older women have less capacity to stand rapidly from sitting and make rapid and balanced movements compared to older men. Accordingly, it is possible to say that even though they are physically active, the older women in this group are not as fast as their male peers. In other research, the identified values for older men were 60-69 years (6.41±1.44) and 70-80 years (7.46±1.62) and for older women were 60-69 years (6.67±1.48) and 70-80 years (7.27±1.42). Compared with our older subjects, agility and dynamic balance appear to have similar values, especially for men (Milanovic et al., 2013).

Aerobic capacity reduces with ageing (Şahin, Toraman, & Muratlı, 2002). In this research, the two-minute step test was used to determine aerobic capacity. The aerobic capacity was higher in older men compared to older women; this difference was also statistically significant ($p<0.05$). Although older women were active, their aerobic capacities were significantly lower compared to older men. In an American study, it was found that the two-minute step test for older make golfers with a mean age of 70.7±7.1 years was 103.2±23.4, while it was 159.92±50.67 steps in our research (Thompson, Cobb, & Blackwell, 2007). This situation appears to show that our older women and men displayed better performance than their golfing peers. However, it can be said that agility and dynamic balance were weaker in our subjects.

In contrast, upper and lower body flexibility was better for women though no statistically significant difference was determined ($p>0.05$), although it is known that flexibility is less in men compared to women. This difference did not appear to be significant. Research by Ahn and So (2018), stated that the lower body flexibility was 5.36±9.02 for older Korean men and 11.64±8.76 cm for women, with upper body flexibility of -12.83±13.71 cm for men and -5.51±12.69 cm for women. According to these results, the lower body flexibility of our older women and older men was less compared to Korean women and men, while for upper body flexibility, our older women were worse while our older men were better (Figure 2).

Apart from flexibility, there were differences in the physical fitness of older females and males with similar physical activity levels and mean age of 70 years. Older men had stronger arms and legs, better dynamic balance, and better agility and aerobic capacities compared to older women in this research.

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**Conflict of Interest**
The authors declare the absence of conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

# The Effect of Training in Military Pentathlon on the Physiological Characteristics of Academy Cadets

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**Abstract**

The physiological characteristics of the students of two military academies of the same age and sports qualification were studied, using the data of 60 men at the age from 20.6 to 23.4 years, 30 from each military academy. In one sample, 30 students trained and participated in pentathlon competitions; in the other sample were 30 students who were athletes in other sports. Physiological characteristics were related to the activity of the cardiovascular, respiratory, neuromuscular systems; the necessary data were obtained using well-known functional tests. Their physical preparation was studied according to the results in tests for the display of motor abilities; tests that are recommended by physical education specialists were used. We established that among the students engaged in military pentathlon, the level of development of absolute muscular strength of the dominant hand and non-dominant hand, aerobic endurance, speed force of the muscles of the lower extremities, and strength endurance in various motor activities were significantly ($p<0.05$) higher than among those students who were engaged in other sports. A similar result was obtained by comparing the ability to differentiate power and time parameters of motion, as well as all indicators of special physical preparation. The obtained data indicate that each student of the military academy must necessarily engage in a chosen sport. However, the most significant positive effect in the development of various physical qualities, physiological characteristics, special physical preparation is achieved with the military pentathlon.

***Keywords:*** *students, military academy, sport activities, physical preparation, physiological characteristics*

## Introduction

The current system of physical training of soldiers, formed at the Ukrainian Armed Forces is not sufficiently effective (Iedynak & Prystupa, 2012; Roliuk, 2016). The traditional approach to professional-applied physical training does not contribute to the quality of education in terms of the future motor experience formation in combat training and combat activities and training of military men with sustainable motivation to improve their professional level (Afonin, 2012). The need for the special (in particular, physical) training of soldiers for conducting combat operations has been indicated by some authors (Sliusarchuk & Iedynak, 2015; Klymovych, Oderov, Romanchuk, Lesko, & Korchagin, 2019). Research and experience of combat training show that the use of exercise that similar in its impact on physical activity and professional actions of soldiers of different military specialities can be an effective way of improving specialized physical training (Borodin, 2005; Kontodimaki, 2014). Among the means that contribute to the necessary physical and special qualities, forming the necessary applied skills and professional techniques with great

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success, exercises of military-applied sports and several different sports can be used but united by one criterion, which is to hold competitions in a particular sport in areas with different terrain and with military ammunition, which significantly complicates the issue (Romanchuk, Popovych, & Fedak, 2010). In a complex situation with the need to counteract high mental stress and overcome the maximum physical load that is characteristic for competitive activities in sports, the improvement of professional skills of soldiers, cadets, future officers is provided (Afonin & Semenova, 2012; Prystupa & Romanchuk, 2012). With the growth of military skills and the accumulation of professional experience, the intensity of muscle tension when performing the necessary military operation at a certain qualitative level is somewhat reduced (Korobeynikov, Korobeinikova, Mytskan, Chernozub, & Cynarski, 2017).

However, in the case of the use of competitive activities during the improvement of various professional activities, as well as running competitions in various sports, soldiers (cadets, future officers) are encouraged to overcome further difficulties. In this regard, they perform with courage, resolution, discipline, and desire to win (Borodin, 2005; Popovich & Afonin, 2011). This is one of the main reasons that the use of different sports, but above all in complex areas with different terrain and with military ammunition, is currently considered to be a promising direction for achieving a high level of professional preparation of soldiers, cadets and future officers.

The purpose of the study is to show the important role of specialized physical training in shaping the readiness of a soldier, cadet or officer of the Armed Forces to effectively perform official tasks.

## Methods

*Participants*

The study involved 30 students from two military academies, men at the age from 20.6 to 23.4 years with the same sports qualification, but in various sports. Two samples were formed: one with 30 students (15 from each military academy), who trained in military pentathlon; in the other sample were 30 students, namely in groups of three from each military academy, who attended sections on hand-to-hand fighting, arm wrestling, lifting weights, as well as free-style and Greco-Roman wrestling. Such sports were chosen because the physical exercise parameters and most of the motor actions used in these sports are very similar to those that form the basis of military pentathlon. The research was conducted during the fifth-sixth terms of the academic year. The study was conducted in compliance with the World Medicine Association Declaration of Helsinki: Ethical principles for medical research involving human subjects, 2013. The study protocol was approved by the Ethical Committee of the National Academy of the State Border Guard Service of Ukraine named after Bogdan Khmelnytskyi and National Academy of Armed Forces of Ukrainian named after Petro Sahaidachnyi.

*Procedure*

We determined the magnitude of the display of physical qualities, physiological and individual morphological characteristics in each sample of students. To obtain the necessary data on physical qualities, we formed a battery of tests. These tests met the established requirements (Turvey & Fonseca, 2009; Klymovych, Olkhovyi, & Romanchuk, 2016) and contained the most common practices of physical education motor tasks. The battery included tests that allowed studying such physical qualities: 100 m race - speed endurance; 3000 m race - aerobic endurance; standing long jump - speed force of muscles of the lower extremities; of leading and non-dominant hands (using the Camry dynamometer handgrip) - absolute muscle strength.

Moreover, the battery contained tests to assess the strength of endurance in the various motor activities of students of military academies (Regulation on physical training in the Armed Forces of Ukraine, 2014), including pressing two 16 kg kettle balls, lifting the body from the lying position on the back (an additional weight of 10 kg is on the chest and held with two hands), keeping of 20 kg weight in front of oneself with both hands (hands are not bent in the elbow joints), and pull-up on a high crossbar.

We studied the morphological characteristics of students, namely body length and body weight (using an RGZ-120 mechanical platform scale). The following physiological characteristics were also determined: heart rate (HR) at quiescent; HR after 30 squats during 45 seconds; HR after 3 minutes rest; vital capacity (VC); the ability to differentiate power parameters of motion; the ability to differentiate the time parameters of motion (Klymovych, & Olkhovyi, 2016). To determine the ability to differentiate the power parameters of motion, we used the Camry handgrip dynamometer; to determine the ability to differentiate the time parameters of motion, we used a stopwatch. Definition of both indicators was made according to the standard procedure (Omorczyk & Lah, 2009). We also offered students the tests used in the Ukrainian Army to establish a level of special physical preparation. By content, these tests are very similar to those used in the armies of NATO alliance countries. The tests were exercises on the obstacle course, 5000 m race in military equipment, 100 m swimming, throwing grenades at a distance, shooting from a machine gun, 6×100 m shuttle run.

*Data analysis*

Results of descriptive statistics in this study were presented as an arithmetic mean of the sample, standard error of the mean. The comparison established whether there is a statistically significant difference between the two averages. The data were normally distributed in each test, which allowed using the t-test for related samples; a 0.05 probability level was used to indicate statistical significance. All statistical analyses were performed using SPSS Version 21.

## Results

Comparison of data among samples indicated that the values of morphological characteristics in each sample of students were practically similar. The difference between the values of body length in the samples was very small, at 0.8 cm. The difference between body weight values was also inconspicuous, namely 2.7 kg. This was verified by the value of the t-test, which in both cases was at the level of $p>0.05$ (Table 1).

A similar result was obtained when comparing the values of all physiological characteristics, as well as the indicators of such physical qualities: speed endurance, strength endurance of the upper extremity muscles during pull-ups on the crossbar, strength endurance during keeping of 20 kg weight. As for other indicators, then when comparing their values, the result in all cases was similar. It consisted in the fact that Sample 1 had an advantage over Sample 2 by the level of development of physical qualities, which was evidenced by the value of the

**Table 1.** Display of morphological and physiological characteristics of students in different samples

| Indicator | Sample 1 (n=30) Mean±SD | Sample 2 (n=30) Mean±SD | t-test |
|---|---|---|---|
| Body height (cm) | 178.7±1.8 | 177.9±1.9 | p>0.05 |
| Body weight (kg) | 73.4±1.6 | 70.7±2.8 | p>0.05 |
| 3000 m race (s) | 735.1±18.1 | 798.3±33.2 | p<0.05* |
| 100 m race (s) | 13.8±0.52 | 14.1±0.8 | p>0.05 |
| Pull-ups (number of times) | 13.9±1.1 | 13.5±1.5 | p>0.05 |
| Standing long jump (cm) | 217.2±2.2 | 202.4±3.3 | p<0.05* |
| Dynamometry (dominant hand) (kg) | 50.4±2.3 | 42.3±5.1 | p<0.05* |
| Dynamometry (non-dominant hand) (kg) | 46.6±3.1 | 37.1±4.2 | p<0.05* |
| 2 weights press (16 kg each) (number of times) | 14.5±3.4 | 5.7±2.8 | p<0.05* |
| Body lifting (number of times) | 22.4±±2.1 | 15.5±3.6 | p<0.05* |
| Keeping of 20 kg weight (s) | 60.7±2.2 | 59.0±2.2 | p>0.05 |
| Muscular sensations (error) (%) | 13.6±3.8 | 20.3±4.3 | p<0.05* |
| Time sense (error) (%) | 25.1±4.8 | 34.4±5.2 | p<0.05* |
| Heart Rate - HR at quiescent (bpm) | 70.8±1.7 | 72.6±2.5 | p>0.05 |
| Heart Rate - HR after 30 squats (bpm) | 147.0±3.4 | 150.6±3.5 | p>0.05 |
| Heart Rate - HR after 3 minutes rest (bpm) | 78.6±2.4 | 83.5±2.6 | p>0.05 |
| Vital Capacity - VC (ml) | 4215.0±185.0 | 3723.0±215.0 | p>0.05 |

Note: Sample 1- cadets who attended military pentathlon classes; Sample 2 - cadets who attended classes in other sports; *p <0.05

t-tests, because they were p<0.05. This concerned the absolute muscular strength of the dominant hand and non-dominant hand, aerobic endurance, speed force of the muscles of the lower extremities, strength endurance in various motor activities. Also, in Sample 1, the students' ability to differentiate the force and time parameters of motion was much better developed than in Sample 2.

Consequently, students who were preparing for the military pentathlon competitions had a higher level of physical preparation and physiological characteristics than those who trained to compete in hand-to-hand fighting, arm wrestling, weight lifting, free-style or Greco-Roman wrestling.

To confirm or refute such a conclusion, these students performed test tasks that are used to determine the level of readiness of the soldier of the Army of Ukraine (cadet, future officer) to carry out professional activities. The obtained data indicated that the results of students in both samples in each test corresponded to the higher-than-the average level. However, higher results were noted for Sample 1. The difference in the test results ranged from 7.5% to 13.5%. Only the results of shooting a gun and 6×100 m shuttle run were not different (Table 2).

**Table 2.** Display of indicators of special physical preparation of students in different samples

| Indicator | Sample 1 (n=30) Mean±SD | Sample 2 (n=30) Mean±SD | t-test |
|---|---|---|---|
| Special exercise on the obstacle course (s) | 121.0±2.3 | 135.0±3.4 | p<0.05* |
| 5000 m race (min) | 25.1±0.6 | 28.2±2.1 | p<0.05* |
| 100 m swimming (s) | 102.5±3.2 | 111.7±5.1 | p<0.05* |
| Throwing grenades at a distance (m) | 42.0±4.3 | 37.0±5.1 | p<0.05* |
| Shooting from a machine gun (points) | 4.3±0.23 | 4.0±0.34 | p>0.05 |
| 6×100 m shuttle run (s) | 134.0±3.1 | 144.0±3.8 | p>0.05 |

Note: *p <0.05

## Discussion

Specialized physical training has a leading place in the formation of the readiness of a soldier, cadet, or officer of the Armed Forces to carry out performance targets effectively. However, at the stage of formation of professional competence, the majority is convinced that the physical preparation they have is sufficient for the successful completion of training and combat tasks, including in the context of combat operations (Romanchuk et al., 2010; Sliusarchuk & Iedynak, 2015). To a certain extent, the above-mentioned is confirmed by data that the development of all the basic physical qualities does not lead to an increase in the combat readiness of the students of the military academy (Iedynak & Prystupa, 2012; Prystupa & Romanchuk, 2012; Roliuk, 2016). In this regard, other researchers point out that at the stage of the formation of professional competence during the physical training of students of military academies, it is necessary to form the motivation to exercise in their spare time (Hao, & Yin-shan, 2015; Korobeynikov et al., 2017); use only specific physical exercises (Klymovych, Olkhovyi, & Romanchuk, 2016), which should be those that are very similar according to the biomechanical structure to motor activities that will form the basis of their professional activities (Afonin & Semenova, 2012; Koryahin et al., 2018). The above-mentioned is promising in the aspect of improving the content of the physical training of future officers while studying at the military academy, which is based on the fact that the current content of physical training is practically the same in all academies. Specifically, this content virtually ignores the peculiarities of the future professional activity of students; In the military sphere, the latter is designated as a certain type of troops (Prystupa & Romanchuk, 2012).

Such an approach to the formation of the content of physical training of student youth is not new. However, at present, it is not sufficiently used in practical activities (Popovich &

Afonin, 2011). Consequently, the achievement of the science of physical education of various groups of the population, including the use of advanced devices and information technologies during physical training, also predetermines the need to find new ways of organization, formulation, and implementation of the content (Kontodimaki, 2014).

In connection with this, it is proposed to provide classes on the physical training of sports orientation of students of military academies (Borodin, 2005). Other researchers emphasize the promise of the integrated content of physical training. The key feature of such content is that its implementation contributes to the development not only of all the basic physical qualities but above all of the special qualities, that is, those which determine the successful performance of future professional activities (Romanchuk et al., 2010; Bloshchynskyi, 2017; Sliusarchuk & Iedynak, 2015). In connection with the latter, taking into account typological peculiarities of development of physical qualities, and the physiological and morphological characteristics of young men is recommended.

As for the data obtained when comparing the results in the samples, this was due to complex reasons. One of the main reason was the content of the military pentathlon. It involves five types of motor activity, namely shooting from an automatic machine, overcoming obstacles, swimming with obstacles, throwing grenades at range and accuracy, 8000 m race. The high result in each type of motor activity depends on different physical qualities. Therefore, during the training sessions, the sportsman develops each such quality, in particular: accuracy, aerobic-anaerobic endurance in overcoming the obstacles and swimming, explosive strength and accuracy, and aerobic endurance. In Sample 2, students in the training sessions developed a smaller number of physical qualities, namely those needed for a high result in hand-to-hand fighting, arm wrestling, lifting weights, as well as free-style and Greco-Roman wrestling. One of the main reasons for higher special physical preparation in Sample-1, compared with Sample-2, is due to the development of aerobic-anaerobic endurance (Prystupa & Romanchuk, 2012). The high level of its development precisely in cyclic forms of motor activity (swimming, running) provides the transfer of this effect to other cyclic types of motor activity.

Of the above-mentioned kinds of sports, aerobic-anaerobic endurance is the basic physical quality only for free-style wrestling and, to a certain extent, hand-to-hand fighting. However, these types of motor activity are inherently acyclic; the transfer of the training effect is much less pronounced in this case than in the cyclic kinds of motor activity (Klymovych & Olkhovyi, 2016). It is emphasized that the high level of development of aerobic-anaerobic endurance is the basis for the professional activity of soldiers and military officers (Romanchuk et al., 2010).

The absence of differences in the results of the shooting from the automatic machine in both samples was associated, primarily, with the specifics of this type of motor activity, which is based on coordination. For this reason, the result does not directly depend on the level of development of special physical preparation (Omorczyk & Lah, 2009).

In military academies, students must necessarily engage in specific kinds of sport, which is essential for the development of physical qualities and physiological characteristics, which are an essential element in the structure of the professional preparation of future military officers. The most significant positive effect is achieved if the student attends training sessions and takes part in military pentathlon competitions. The effect involves achieving a higher level of development of the basic physical qualities, namely: absolute muscular strength of the dominant hand and non-dominant hand, aerobic endurance, speed strength of the muscles of the lower extremities, strength endurance in various motor actions, the ability to differentiate force and time parameters of motion. Additionally, systematic training of military pentathlon provides a higher level of special physical preparation. Such a result is one of the essential preconditions for the professional competence of a future military officer.

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ORIGINAL SCIENTIFIC PAPER

# A Study on the Relationship of the Motivation to Use Individual Internet Sports Broadcasting, Social Media Engagement, and Social Presence

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**Abstract**

Although social presence is, in concept, the individual subjective experience that users feel in the media-based, virtual communication environment, a discussion of the relationship between the social factors, the psychological factors, and the social presence of users of individual internet broadcasting is insufficient. Therefore, looking at users of sports broadcasting of AfreecaTV, which is an internet broadcasting platform, this study has empirically analysed the influence of media use motivation and social media engagement on the social presence of the user. For this study, a survey was conducted using a convenience sampling method with a sample of 300 users in Seoul, South Korea, who watched individual internet sports broadcasting through AfreecaTV. The main results obtained through multiple regression analysis are as follows. First, the motivation to pursue social relations, which is a subfactor of media use motivation, was found to have a significant, positive influence on functional engagement, while the motivation to pursue social relations and a broadcasting jockey's attractiveness were found to have a significant positive influence on emotional and communal engagement. Second, information acquisition and broadcasting a jockey's attractiveness (i.e., contents among the subfactors of media use motivation) were found to have a significant positive influence on social presence. Third, among the subfactors of users' engagement with individual internet sports broadcasting, only communal engagement was found to have a significant, positive influence on social presence.

***Keywords:*** *media use motivation, social media engagement, social presence, individual internet sports broadcasting*

## Introduction

Due to changes in the media environment as a result of advancements in digital technology, the number of people participating in personal broadcast production and viewing is gradually increasing. The main form of personal broadcasting in recent years is real-time, internet broadcasting. Unlike traditional media, the main feature of individual internet broadcasting is that interactive communication between a broadcasting jockey and users and between users is possible through real-time chat services during a broadcast (D. Lee, & S. Lee, 2014). Because interpersonal communication that occurs in such individual internet broadcasting is media-based, users can experience social presence (Short, Williams, & Christie, 1976), which is the extent to which users feel as if they are meeting and talking to each other in a media-based virtual communication environment (Fulk, Steinfield, Schmitz, & Power, 1987). With a high level of social presence leading to immersion in broadcasting channels (Hwang & Lim, 2015) and loyalty (Lim, Hwang, Kim, & Biocca, 2015), it is very important in terms of media effect

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that users experience a high-level social presence in individual internet broadcasting.

In general, the technical attributes of communication media play an important role in forming social presence (Daft & Lengel, 1986; Biocca & Harms, 2002). For example, according to the literature review of Oh, Ballenson and Welch (2018) on the determinants of social presence, it was found that people who use media that offers functions, such as a high-level of interactivity, high definition, high sound quality, and a widescreen picture format, can experience a greater level of social presence than they otherwise would. It is also known that text-based communication media might have a lower level of social presence due to the lack of nonverbal cues and social cues compared to video-based communication media (Whiteside, Dikkers, & Swan, 2017).

In this context, the technical attributes that individual internet broadcasting provides to users are important factors that can have a positive influence on a user's social presence experience, which is because, with internet broadcasting, the real-time chat-service function enables interaction between the broadcasting jockey and users and between users; thus, the users can experience a high level of social presence, such as having face-to-face communication (D. Lee, & S. Lee, 2014). However, because social presence is conceptually an individual's subjective experience felt by users in the media-based virtual communication environment, it seems to be necessary to discuss how the social and psychological factors of individual internet broadcasting users might influence one's social presence experience in addition to the technical attributes (Hwang & Park, 2007; Oh et al., 2018).

The first internal factor that this study examined is one's motivation to use media, which can affect the social presence of an individual internet broadcasting user. According to the theory of use and gratification, which is widely used in studies of media use to identify the media use motivation by individuals, it is presupposed that the media user is active and that a particular media fulfils a user's needs by selecting and using a particular media (Lariscy, Tinkham, & Sweetser, 2011). Based on the theory of use and gratification, one can watch individual internet broadcasting because of other needs from existing media use and can feel satisfied when the needs are fulfilled. In this regard, the use motivation of individual internet sports broadcasting might influence one's social presence (Hwang & Park, 2007).

In addition to motives for media use, social media engagement can be considered to be another internal factor that can affect the social presence of users of individual internet broadcasting. Engagement generally entails a degree of involvement (Wang, 2006); a level of immersion (Rothbard, 2001); and passion, attachment, and commitment to an individual's object, such as company, brand, product, or media (Kang, 2014). In the present study, social media engagement refers to the degree of participation, attachment, and commitment with which individual users want to interact with content, a broadcasting jockey, and other users in individual internet sports broadcasting. Attaching and immersing oneself in a particular object or activity means that the user focuses attention somewhere (Witmer & Singer, 1998). The centralized attention of media users can double the feeling of face-to-face communication despite being a virtual space by immersing themselves in the virtual experience of a media's visual, auditory, and tactile sensations (Witmer & Singer, 1998).

In a study by Lim et al. (2015), which empirically verified the relationship between social media engagement and social presence of users, the causality between the two variables was confirmed. The study found that the higher the functional engagement of Social Networking Service (SNS) users, such as sharing opinions with other users regarding Olympic broadcasting through SNS and sharing opinions related to broadcasting videos, photos, and broadcasts through SNS, the more the experiences of social presence increased (Lim et al., 2015). This theoretical basis shows that users' engagement with individual internet broadcasting can have a positive effect on users' social presence experience.

In contrast, the particular use motivation of an individual internet broadcasting user might affect the engagement of the user to the broadcasting. Khan (2017) empirically analysed the impact of YouTube users' motivation to use YouTube engagement based on the theory of use and gratification. The motivation for pursuing pleasure, for pursuing social relations, and for providing information were found to be the most influential factors on a response of likes and dislikes, writing comments, and video uploads, respectively. The motivation for pursuing pleasure and the motivation for providing information were found to be the most influential factor on YouTube viewing and on reading comments, respectively (Khan, 2017). This result suggests that the particular use motivation of individual internet broadcasting might influence a user's engagement with individual internet broadcasting.

As discussed above, the discussion about social presence in the situation of frequent interpersonal interaction through personal broadcasting is very meaningful in terms of media effects. However, empirical studies on the factors that can influence social presence in the individual internet broadcasting that is a representative type of personal broadcasting are highly insufficient (Cho & Lim, 2019). In addition, even though the concept of social presence is a subjective experience that the user realistically feels the content embodied in the media (Hwang & Park, 2007; Oh et al., 2018), there is a dearth of discussion of the internal factors of users that influence the social presence. Therefore, this study has empirically analysed the influence of the media use motivation and social media engagement on a user's social presence on the users of sports broadcasting of AfreecaTV, one of the most popular real-time individual internet broadcasting platforms in South Korea.

Based on the theoretical discussion of the relationship between the use motivation of individual internet broadcasting, social media engagement, and social presence, the hypotheses for this study are as follows:

Hypothesis 1: The motivation to use individual internet sports broadcasting will affect a user's engagement with individual internet sports broadcasting.

Hypothesis 2: The motivation to use individual internet sports broadcasting will affect a user's social presence.

Hypothesis 3: User engagement for individual internet sports broadcasting will affect a user's social presence.

## Methods

*Participants*

To analyse the internal factors influencing the social presence of individual internet sports broadcasting users, this study selected users who had experience watching in-

dividual internet sports broadcasting through AfreecaTV in Seoul, South Korea. Data were obtained using the convenience sampling method, and 300 questionnaires were distributed to participants in the study; 293 of them were used as the final analysis data; seven were unreliable-responsive or unresponsive.

*Measures*

Structured questionnaires were used to investigate the relationship between the use motivation of individual internet sports broadcasting, social engagement, and social presence. All of the questionnaires were measured on a five-point Likert scale. Based on the questions used in the preceding study (Kim, 2017; Kim, 2018; Lim & Kim, 2018; Hwang & Lim, 2015), the survey questionnaire on the media use motivation were extracted from a total of 31 items, 25 of which were used; six did not suit the purpose of the study. The exploratory factor analysis and the reliability of the media use motivation questionnaire is shown in Table 1.

The social media engagement questionnaire was used by

**Table 1.** Factor and Reliability Analysis of the Media Use Motivation Questionnaire (N=293)

| **Item** | | | **Loadings** | **α** |
|---|---|---|---|---|
| Broadcasting jockey's attractiveness | | | | 0.864 |
| Because broadcasting jockeys worked well together | | | .769 | |
| Because broadcasting jockey has rich knowledge associated | | | .728 | |
| Because broadcasting jockey has good ability to explain game situations | | | .700 | |
| Because broadcasting jockey is sexually attractive | | | .679 | |
| Because broadcasting jockey communicates well | | | .656 | |
| Because broadcasting jockey has good pronunciation and voice | | | .635 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 3.576 | 14.305 | 14.305 | |
| **Item** | | | **Loadings** | **α** |
| Pursuit of convenience | | | | 0.863 |
| To know immediately what happened on the field | | | .782 | |
| Because I can quickly see the important situation of the whole game without having to watch the game from start to finish. | | | .758 | |
| Because I can directly hear the news posted by the viewers on the playing field | | | .737 | |
| Because the information about the game or player is quick | | | .732 | |
| Because many people can easily see various reactions through SNS | | | .682 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 3.356 | 13.423 | 27.728 | |
| **Item** | | | **Loadings** | **α** |
| Pursuit of social relations | | | | 0.898 |
| To find material and topics to talk to someone later | | | .837 | |
| To watch a game with someone else | | | .821 | |
| Because I can talk to other people watching the broadcast | | | .806 | |
| To talk with friends on SNS | | | .736 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 3.269 | 13.074 | 40.802 | |
| **Item** | | | **Loadings** | **α** |
| Pursuit of information acquisition | | | | 0.842 |
| To share my thoughts about the game with others | | | .748 | |
| Because it's efficient to get various points of view regarding the game situation | | | .736 | |
| To get more information about situations that occurred in the game | | | .727 | |
| To learn other people's opinion when controversy arises | | | .683 | |
| Because I can get photos or video information regarding my favourite players | | | .632 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 3.065 | 12.262 | 53.064 | |

*(continued on next page)*

*(continued from previous page)*

| **Item** | | | **Loadings** | **α** |
|---|---|---|---|---|
| Pursuit of fun | | | | 0.825 |
| Because it's more fun to watch the game | | | .783 | |
| Because watching the game becomes more interesting | | | .774 | |
| Because I can enjoy watching the game more | | | .631 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 2.346 | 9.386 | 62.450 | |
| **Item** | | | **Loadings** | **α** |
| Pursuit of contents | | | | 0.818 |
| Because of broadcasting jockey's sensory dialogue and fun | | | .850 | |
| Because of various materials of sports game | | | .819 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 1.727 | 6.907 | 69.357 | |

modifying a questionnaire developed by Lim et al. (2015) to meet the purpose of this study. The exploratory factor analysis and the reliability of the engagement questionnaire are shown in Table 2.

**Table 2.** Factor and Reliability Analysis of the Social Media Engagement Questionnaire

| **Item** | | | **Loadings** | **α** |
|---|---|---|---|---|
| Functional engagement | | | | .910 |
| Videos or photos associated with the broadcasting of sports broadcasting jockey were uploaded on my SNS | | | .832 | |
| Opinions about sports broadcasting jockey were left or spread on my friend's account, which is popular on SNS | | | .789 | |
| When posting on SNS, related searches or (Twitter) hashtags (#) about sports broadcasting jockey were often used | | | .775 | |
| Comments on other people's opinions regarding the sports broadcasting jockey's broadcasting were written or spread | | | .733 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 3.487 | 29.055 | 29.055 | |
| **Item** | | | **Loadings** | **α** |
| Emotional engagement | | | | .937 |
| When the quality of broadcasting (screen, subtitle composition, etc.) jockeyed by sports broadcasting jockey was good, encouragement or praise was sent | | | .805 | |
| Sports broadcasting jockey's impressive comments were spread on SNS | | | .790 | |
| Good feelings were expressed to sports broadcasting jockey | | | .754 | |
| The feeling of agreement (or opposition) was expressed to the comments of the sports broadcasting jockey | | | .717 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 3.407 | 28.392 | 57.447 | |
| **Item** | | | **Loadings** | **α** |
| Communal engagement | | | | .900 |
| I shared opinions and sympathized with people watching the same broadcast | | | .804 | |
| I tried to convey better information to the group with which I wanted to communicate | | | .749 | |
| I shared the opinions on the sports broadcasting jockey's broadcasting on SNS | | | .680 | |
| I communicated with same-minded people through the search term (e.g., Twitter hashtag) provided by the sports broadcasting jockey | | | .531 | |
| | Total | % of Variance | Cumulative % | |
| Eigenvalue | 2.758 | 22.987 | 80.447 | |

The social presence questionnaire was used by modifying and supplementing the questionnaire used in the study by Lim et al. (2015) to meet the purpose of this study. Social presence questionnaires included three items as a single factor. The contents and reliability of the social presence questionnaire are shown in Table 3.

**Table 3.** Contents and Reliability Analysis of the Social Presence Questionnaire

| Item | α |
|---|---|
| | .797 |
| I felt I was communicating directly with other people while watching sports broadcasting jockey's broadcasting | |
| I felt I was watching the same game with my friends or acquaintances at the same time while watching sports broadcasting jockey's broadcasting | |
| I felt that countless people were watching together at the same time while watching sports broadcasting jockey's broadcasting | |

*Data analysis*

Data collected in this study were analysed using SPSS 23.0. Reliability analysis was conducted to verify the reliability of the measurement items, and the validity of the measurement tool was verified through exploratory factor analysis. In addition, the study hypothesis was verified through multiple regression analysis. All statistical significance verification in this study was verified at the level of α=.05.

## Results

Table 4 shows the results of the verification of the relationship between the use motivation of individual internet sports broadcasting and social media engagement.

**Table 4.** Influence of Media Use Motivation on Social Media Engagement

| Variable | Functional | | | Emotional | | | Communal | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***B*** | ***SEB*** | ***β*** | ***B*** | ***SEB*** | ***β*** | ***B*** | ***SEB*** | ***β*** |
| Pursuit of information | .152 | .082 | .131 | .157 | .089 | .126 | .150 | .088 | .122 |
| Pursuit of convenience | -.105 | .081 | -.089 | -.149 | .087 | -.116 | -.087 | .086 | -.070 |
| Social relations | .202 | .068 | .207** | .220 | .073 | .208** | .213 | .072 | .206** |
| Broadcasting jockey's attractiveness | .140 | .092 | .107 | .199 | .099 | .141* | .208 | .098 | .151* |
| Pursuit of contents | .027 | .057 | .030 | .088 | .061 | .090 | .073 | .060 | .077 |
| Pursuit of fun | .131 | .079 | .120 | .088 | .085 | .075 | .035 | .084 | .030 |
| $R^2$ | | .176 | | | .187 | | | .174 | |
| F | | 10.185*** | | | 10.976*** | | | 10.027*** | |

Legend: *p < .05. **p < .01. ***p <.001

The motivation for pursuing social relations was found to have a significant positive influence on the functional engagement, while the motivation for pursuing social relations and the broadcasting jockey's attractiveness were found to have a significant positive influence on emotional and communal engagement. The media use motivation was found to explain 17.6% of the total variants of the functional engagement, 18.7% of the total variants of the emotional engagement, and 17.4% of the total variants of communal engagement.

Table 5 shows the results of the verification of the relationship between the use motivation of sports broadcasting and social presence. The pursuit of content, information acquisition, and the broadcasting jockey's attractiveness were found to have a significant positive influence on social presence. The motivation for watching sports broadcasting was found to explain 25.2% of the total variants of social presence.

**Table 5.** Influence of Media Use Motivation on Social Presence

| Variable | Social presence | | |
|---|---|---|---|
| | ***B*** | ***SE B*** | ***β*** |
| Pursuit of information | .161 | .078 | .141* |
| Pursuit of benefits | .098 | .077 | .084 |
| Social relations | -.050 | .064 | -.052 |
| Broadcasting jockey's attractiveness | .304 | .087 | .236** |
| Pursuit of contents | .230 | .053 | .257*** |
| Pursuit of fun | -.050 | .074 | -.046 |
| $R^2$ | | .252 | |
| F | | 16.043*** | |

Table 6 shows the results of verifying the relationship between a user's engagement with individual internet sports broadcasting and social presence. Only communal engagement was found to have a significant positive influence on social presence. The level of a user's engagement with individual internet sports broadcasting was found to explain 24.8% of the total variants of social presence.

**Table 6.** Influence of Social Media Engagement on Social Presence

| Variable | Presence | | |
|---|---|---|---|
| | ***B*** | ***SE B*** | ***β*** |
| Functional | -.059 | .082 | -.060 |
| Emotional | .123 | .091 | .135 |
| Communal | .398 | .092 | .426*** |
| $R^2$ | | .248 | |
| F | | 34.900*** | |

## Discussion

First, it was found that the higher the motivation to pursue social relations, the higher the levels of functional, emotional, and communal engagements, while a higher level of broadcasting jockey attractiveness contributed to higher levels of emotional and communal engagements of the users. Forming a high level of emotional and communal engagement not only helps users maintain a high level of psychological or emotional immersion in individual internet sports broadcasting but also contributes to creating a series of communities that can enhance interactions among users, ultimately helping users prefer and continuously use individual internet sports broadcasting over other forms of broadcasting (Lim et al., 2015). Thus, it seems that service providers of individual internet sports broadcasting need a strategy to discover and foster the attractive elements of the broadcasting jockeys, which the users of the broadcasting desire, along with efforts to enhance social interaction between users and between users and broadcasting jockeys to improve the level of emotional and communal engagement among users in broadcasting.

Second, a user's social presence was found to increase when watching sports broadcasting because of the broadcasting jockey's attractiveness, the pursuit of information, and the pursuit of content. The content of personal sports broadcasting on the internet depends on the situation of the game, not on a scripted outcome and can share the feeling of the situation with the broadcasting jockey and other users through real-time chatting, so users can feel as if they are sitting in the bleachers in the stadium, even if they are watching a sports game in a virtual space over the internet.

In this study, pursuers of information can be classified as active participants in real-time internet broadcasting in that they ask other viewers what they want through comments and develop their own ideas about the ebb and flow of the game, triggering other viewers' information-pursuing behaviour (Khan, 2017). An active behaviour-related study of SNS users (Chen, Lu, Cha, & Gupta, 2014) found that active actions, such as posting comments or disseminating videos or photos on SNS, have a positive connection to the affective and continuance commitment of SNS users. In a media-mediated environment, a person immersed in a particular object or activity might experience a high sense of social presence that embraces the communicated presence as a real presence by concentrating their focus on the virtual experience (Witmer & Singer, 1998).

In this context, information-pursuing motivations give individual viewers of individual internet sports broadcasting a high emotional engagement to active information-pursuing behaviour through social interaction with other viewers, which could make them feel like they are getting or exchanging information in a face-to-face environment. Thus, to enhance users' experience in social presence, service providers of individual internet sports broadcasting need to meet users' motivation to pursue information by creating a broadcasting environment in which users can ask and share much of the information they seek and can voice their views on the situation of the game.

In contrast, the positive causality of the broadcasting jockey attractiveness of the individual internet sports broadcast and social presence identified in this study can be explained by the concept of pseudo-social interaction. A pseudo-social interaction occurs when the interaction between the media user and the characters (e.g., actors, celebrities, announcers) (Horton & Wohl, 1956) creates a strong affinity with the user and the characters (Rubin, Perse, & Powell, 1985). The formation of intimacy is enhanced by continuous interaction with characters appearing in the media (Perse & Rubin, 1989), the similarity between media users and characters (Turner, 1993), and characters' physical attractiveness (Hoffner, 1996). These pseudo-social interactions formed through intimacy between media users and characters cause users to feel emotional engagement with the characters in the media, which can affect the social presence of the media environment to the extent that individuals feel they are in the presence of others while interacting with them (Lombard & Ditton, 1997).

In this regard, due to a broadcasting jockey's physical attractiveness and professionalism in this study, people who watch personal sports broadcasts on the internet experience a pseudo-social interaction with the moderator, which is seen as having a positive impact on a user's social real-life experience. Thus, to improve users' sense of social presence, service providers of individual internet sports broadcasting need to make efforts to enhance the broadcasting jockey's attractiveness.

Finally, only communal engagement among social media factors has a positive impact on social presence. Communal engagement is classified as the highest level of engagement among the factors involved in social media, and users with a high level of communal engagement in social media have a great emotional engagement with the involvement and participation of social media and form a series of communities while actively interacting with other users of social media (Lim et al., 2015). These communities have the characteristics of online brand communities in that they are based on social relationships between people with interests and affection for social media (Lim et al., 2015).

Online brand communities are communities of people with an online-based passion for a particular brand (Dessart, Veloutsou, & Morgan-Thomas, 2015). Those identified by a particular brand have a continuing interest in the brand and try to maintain and develop their engagement to the online communal experience through active social interaction, such as sharing information about the brand and personal experience (Algesheimer, Dholakia, & Herrmann, 2005). In an online

communal formed by a particular brand, the engaged people tend to show "enhanced satisfaction, empowerment, connection, emotional bonding, trust and commutation" (Brodie, Ilic, Juric, & Hollebeek, 2013, p. 105). Thus, people with high levels of engagement with online brand communities form trust and emotional bonds through active social interaction with members of the communal, giving participants a sense of solidarity and belonging to the communal. The formation of emotional bonds and communal feelings among members in an online communal will have a positive effect on social presence, which is communication via media but feels like meeting each other in person.

In this light, users with a high level of communal engagement in individual internet sports broadcasting will form a series of communities and more actively participate in broadcasting content, with broadcasting jockeys, and interactions with other users. Thus, to improve users' sense of social presence, service providers of individual internet sports broadcasting need to improve users' level of communal engagement in broadcasting.

The results of this study suggested basic data on media use motivations and types of social media engagement that have a positive effect on the social presence of users of individual internet sports broadcasting. Despite the implications of this study, limitations of the following studies and future direction of research may be presented. First, the analysis targets of this study are limited to users of sports broadcasting among content areas of individual internet broadcasting. Different results could be derived from a study of users who watch broadcasting, such as users who watch games, food shows, and beauty/fashion competition, in which the relationships between the three variables surveyed in this study differ. Therefore, further research needs to look into the relationships among the three variables for users watching other content areas of individual internet broadcasting. Second, this study selected media use motivations and social media engagement as social and psychological factors of users that influence social presence. In addition to these factors, further studies need to investigate the relationship between personal characteristics and social presence, such as "individual personality, tendency to immerse in media-based environments, positive or negative attitudes toward social interaction" (Oh et al., 2018).

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

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SportMont

REVIEW PAPER

# Injury Prevention Strategies in Football: A Systematic Review

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**Abstract**

Football is perhaps the most physically-demanding sport in the world, as players are obliged to play a high number of games in one season, with recovery breaks being short and mostly insufficient. As a consequence, injury rates are high among players, and their participation in the games is adversely affected, which, in turn, adds a tremendous financial and psychological burden for players and clubs alike at all levels (amateur, semi-professional, elite). This study reviews the most effective contemporary injury prevention strategies in football and the scientific evidence behind them. It also aims to determine the benefits and the applicability of these strategies in youth, men, and women at all performance levels. The standard systematic review methodology was modified and adapted for this review, and electronic search tools were used to locate the papers needed. A total of 44 studies were analysed. We have isolated five injury prevention strategies developed by researchers as the most effective to reduce the number of injuries and even to enhance performance to a certain degree: Fifa 11+, foam-rolling techniques, strength training for injury prevention, pre-activation routines, and core training. We evaluated these in relation to their scientific substrate and to their applicability in the training programmes introduced by sports scientists as well as strength and conditioning coaches on the pitch. In conclusion, our present systematic review revealed these five main injury prevention strategies as the most effective and popular ones at present.

***Keywords:*** *injury prevention, methods, soccer, strength and conditioning*

## Introduction

Football is perhaps the most popular sport on earth, with many people taking part either as amateurs or professionals. At the same time, football has one of the highest rates of injury events, in both amateur and professional championships (Junge, & Dvorak, 2004). Due to this phenomenon, players are not healthy and able to attend training sessions or games; as a result, football clubs lose injured players from their squad, which can affect their performance. Many studies around the world claim that serious injuries affect not only players but also the finances of football clubs. Studies from England (Woods, Hawkins, Hulse, & Hodson, 2002), Switzerland (Junge et al., 2011) and Netherlands (Letsellast Model, 2008) demonstrate the substantial financial cost that football clubs have to face regarding their players' injuries. Thus, regarding injury incidents in football, the problem is twofold: a) players do not remain healthy and b) football clubs have to spend a considerable amount of money for their rehabilitation (Hickey, Shield, Williams, & Opar, 2014; Pritchett, 1981).

Injury prevention strategies are some of the most efficient tools for every strength and conditioning (S&C) coach when he wants to protect his players from upcoming injuries and help them be healthy and available for every game throughout the season. The purpose of this paper review is to present the effectiveness of five different injury prevention methods as part of the training session and how these methods can help S&C coaches to protect their players from injury events.

## Individual injury prevention methods

*FIFA 11+*

Before the 1980s, no injury prevention programs had been in-

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troduced in football until Jan Ekstrand presented some opinions about injury prevention (Ekstrand, Gillquist, & Liljedahl, 1983). Two decades later, sports scientists and F-MARC published the first studies that demonstrated the effectiveness of the implementation of basic injury prevention strategies. A new programme was introduced by the FIFA Medical and Assessment Research Centre (F-MARC), which was called "11" and involved ten sets of exercises, which were designed to reduce the most common injury incidents in soccer (i.e., ankle and knee sprains/hamstring and groin strains) (Junge, Rosch, & Peterson, 2002). The exercises used for this warm-up program were focused on eccentric hamstring strength, balance, dynamic stabilization and core stability. The effectiveness of that programme became obvious and recently led a number of global medical sport organizations to collaborate and develop a new injury prevention program called "11+".

"Fifa 11+" is a complete warm-up program developed by F-MARC in collaboration with the Oslo Sports Trauma Research Centre and the Santa Monica Orthopaedic and Sports Medicine Research Foundation. The goal of this program is to increase the strength levels of the athlete and decrease the injury rates in both amateur and professional football players (Bizzini, Junge, & Dvorak, 2013).

This program has been evaluated and proved to be efficient regarding injury prevention, in all types of sport participants (amateur, semi-professional, professional) both male and female (Soligard, Myklebust, & Steffen, 2008; Steffen, Myklebust, Olsen, Holme, & Bahr, 2008; Owoeye, Akinbo, Tella, & Olawale, 2014). This program is usually used as a warm-up routine and consists of three different phases. Phase One is the "running phase", Phase Two deals with "strength, plyometrics and balance" including three levels of difficulty (beginner-intermediate-advanced), and Phase Three involves high-intensity runs and agility exercises. Regarding organization, this injury prevention program requires a minimum of equipment, it is time-efficient as it replaces the regular warm-up and helps players to remain injury-free. Table 1 summarizes the benefits of using the "11+" as a warm-up program according to the scientific literature. It must be emphasized that in those studies, subjects of all kinds were involved regarding age and gender. In the majority of studies, the program was applied twice a week.

**Table 1.** Summary of Some Studies and their Results, after the Implementation of "11+" as a Warm-up Routine

| Results | Percentage | Subjects | Study |
|---|---|---|---|
| Fewer overall injuries | -46% | N=396 NCAA Div. I,II Mens | Granelli et al. 2015 |
| | -41% | African Junior Laos League | Owoeye et al. 2014 |
| Fewer injuries during training | -37% | N=1892 female players aged 13-17 | Soligard et al. 2008 |
| Fewer injuries during games | -29% | | |
| Reduced injury risk | -72% | N=226 Canadian youth football players | Steffen et al. 2013 |
| Improvement in static and dynamic balance | +10.9% (eyes opened) +12.4% (eyes closed) | N=36 U21 soccer players | Daneshjoo et al. 2012 |
| Improvement in the conventional strength ratio | +8% | N=36 Male professional soccer Players | Daneshjoo et al. 2012 |
| Improvement of the fast/slow speed ratio | +8% | | |

*Foam Rolling*

During a football season, many players face crucial muscle injuries due to the insufficient recovery time available between games and between high-intensity training sessions. Many players are obliged to train or play games despite reporting feelings of muscular pain (Owen, Wong, Dellal, & Daren, 2013). These pains are a result of disruption of the muscle structure, which leads to prolonged impairment of muscle function and delays onset muscle soreness (DOMS) (Byrne, Twist, & Eston, 2004). The intensity of DOMS increases the first 24 hours post-exercise and peaks between 48-72 hours afterwards. If there is no proper rehabilitation after training and between training sessions or games, damage regarding muscle functions and joint mechanisms may ensue (Rowlands, Eston, & Tilzey, 2001). It has been suggested that DOMS results in adverse effects on sprint, jump height, power, abilities that are crucial during a football game (Byrne et al., 2004). In addition, DOMS can result in decreased joint proprioception, overestimation of force production, decreased range of joint motion and decreased strength and power measurements (Saxton et al., 1995; Brown, Child, Day, & Donnelly, 1997; Behm, & Chaouachi, 2011). Some other authors suggest that there are even more detrimental effects regarding players' performance, such as alteration in agonistic and antagonistic strength ratios, changes in recruitment patterns and, finally, increased risk of injury (Smith, 1992; Orchard, Marsden, Lord, & Garlick, 1997; Cheung, Hume, & Maxwell, 2003). Considering all the dangers arising from DOMS, foam rolling routines aim to help athletes avoid injuries.

Foam rolling is a form of massage that physiotherapists and S&C coaches can use as a tactic to aid in the recovery of athletes. The purpose of its use is to alleviate DOMS and treat or prevent soft tissue restrictions. Athletes use their body mass on a foam roller to release the tension that exists on the soft tissue. During foam rolling, there are both direct and swiping pressures on the muscle; consequently, the soft tissue of the muscle is lengthening (Pearcey et al., 2015). It has been proved that foam rolling can be used as part of the warm-up, before the stretching stage or as a post-exercise recovery strategy (Zainuddin, Newton, Sacco, & Nosaka, 2005; Pearcey et al., 2015; Macdonald, Button, Drinkwater, & Behm, 2014).

It has also been proved that the use of foam rollers as a pre or post-exercise routine improves an athlete's performance in many ways both directly and indirectly. The benefits from the implementation of a foam-rolling routine before or after training in athletes are: Alleviates DOMS; Reduces DOMS; Corrects muscle imbalances, Promotes soft tissue extensibility; Improves neuromuscular efficiency; Relieves joint stress (Macdonald et al., 2014; Pearcey et al., 2015; Owen, 2016; Rey et al., 2019; Drinkwater, Latella, Wilsmore, Bird, & Skein, 2019).

*Strength training for hamstrings*

Hamstring injuries are the most common type of injury during soccer games (Ekstrand et al., 206). Owen et al. (2013) supported Zakas, Mandroukas,Vamvakoudis, and Christoulas (1995) viewpoint that hamstrings play a crucial role during running and stability exercises. These types of exercise are inherently and consistently involved in intermittent (stop and start) team sports, such as football, which include many explosive actions, direction changes, and decelerations.

It has been suggested from the scientific literature that hamstring injury rates can decline after the implementation of a systematic and consecutive program, which focuses on increasing hamstring strength (Small, McNaughton, Greig, & Lovell, 2009; Petersen, Thorborg, Nielsen, Budtz–Jorgensen, & Holmich, 2011; Van Der Host et al., 2015). Table 2 presents such a program, suggested in 2011 by Petersen et al., which aims to prevent hamstring injuries in soccer players. It is crucial to note that the load is increased when the subject can withstand the fall for a more extended period. If the subject can stand the whole range of motion (ROM) for twelve repetitions, the load can be increased by accelerating the starting phase of the motion or by pushing the back of the shoulders.

**Table 2.** The Protocol of Eccentric Strength Training Applied (Petersen et al., 2011)

| Week | Sessions per week | Number of sets | Number of repetitions per set |
|---|---|---|---|
| 1 | 1 | 2 | 5 |
| 2 | 2 | 2 | 6 |
| 3 | | | 6-8 |
| 4 | 3 | | 8-10 |
| 5-10 | | | 12-10-8 |

Nevertheless, it should be mentioned that over the previous decade other sport scientists suggested that hamstrings' strength training should be more of a holistic approach, than a purely eccentric strength training routine. According to this suggestion, hamstring strength training programmes should include hip- and knee-dominant exercises with regards to elite-level football (Bahr, Thorborg, & Ekstrand, 2015; Oakley, Jennings, & Bishop, 2018). This opinion is based on the eccentric function of hamstring muscles during the late swing phase of running, at which they resist hip extension and decelerate knee extension (Higashihara et al., 2015). These exercises include single leg bridge (SLB), single-leg deadlift (SLDL), leg curls, deadlift, hip thrusts, glute bridge, Romanian deadlift (RDL), and lunges. Table 3 presents the most efficient hip dominant and knees dominant exercises.

**Table 3.** Knee-dominant and hip-dominant exercises for hamstring injury prevention (Mendez et al., 2016; Bourne et al., 2017)

| Target short head of biceps femoris muscle | Target long head of biceps femoris muscle |
|---|---|
| Single leg deadlift | Nordic hamstring exercises |
| Hip extension | Flywheel leg chair |
| Romanian deadlift | Side leg lunge |
| Supine bridge | |

The combination of both knee and hip-dominant exercises targets all heads of the hamstrings; thus, this kind of approach seems more efficient. As can be seen, some exercises target more the long head of biceps femoris (BF), where most injuries happen), and other exercises target the short head of BF, semitendinosus and semimembranosus muscles. A combined injury prevention program that involves those exercises seems to be much more efficient with regard to hamstring injury prevention.

*Strength Endurance Training*

According to sports scientists, the implementation of a strength-endurance training program has many benefits for injury prevention in soccer players. It has been suggested that this kind of training helps soccer players to prepare their tendons, ligaments, and muscle tissue for high-intensity training (Swinnen, 2016). Another benefit of this type of training routine is its low intensity, which allows athletes to use different movement variations during training; this results in a better balance between what sports scientists call "opposite movement patterns" and fewer injuries (Swinnen, 2016). Finally, the form of this kind of training increases short work capacity as well as strength levels of the connective tissue, which results in an improvement of the players' ability to recover faster, avoid long-lasting fatigue, and remain healthy (Bomba, & Haff, 2009). Table 4 presents Brawn Swinnen's suggestions regarding the program design of this kind of training.

**Table 4.** Strength Endurance Training Planning Suggestions (Swinnen, 2016)

| | |
|---|---|
| Organization: | Circuit |
| Intensity: | 50–70% of RM |
| Total volume (sets in total) : 5–15 sets | 5–15 sets |
| Volume: | 2–3 sets/exercise |
| Rest | 60–90 secs |
| Exercise selection: | Variety of movement patterns, Exercise complexes |

Legend: RM - repetition maximum

*Pre activation routines and core stability*

Pre activation routines are mostly regular routines that aim to engage the body's nervous system and activate the muscles that will be used during training sessions or games. According to the scientific literature, these routines aim to increase joint stability, to improve the ability to generate optimal muscle firing patterns and finally to improve postural control and side-to-side imbalances in the lower body area (Caraffa, Cerulli, Projetti, Aisa, & Rizzo, 1996; Soderman et al., 2000; Heitkamp, Horstmann, Mayer, Weller, & Dickhuth, 2001). Additionally, it has been proved that these programs decrease ankle sprains and ACL injuries as well as hamstring injuries (Mandelbaum et al., 2005). It has been suggested that the implementation of these programs improves stability, technical skills, and movement control (Riva, Bianchi, Rocca, & Mamo, 2016). The exercises used for this purpose are usually single-leg stability activities, dynamic joint stability exercises plyometric exercises, agility drills and sport-specific exercises (Risberg, Mørk, Jenssen, & Holm, 2001; Mandelbaum et al., 2005; Hewett, & Myer, 2011).

Regarding core stability training this can help players to remain injury-free in an indirect way, as a strong core minimizes joint loads in all types of activities (Hibbs, Thompson, & French, 2008) not to mention the help it offers them in dealing with the physical contact that football requires (tackles, set-pieces). In addition, a strong and stable core is crucial in providing a foundation for the movement of the upper and lower extremities to support loads and to protect the spinal cord and nerve roots.

Football is perhaps the most popular sport around the world, played by millions of people and watched by many more. The fact that a great number of people watch it has transformed it into a high demand sport throughout the last decades, as athletes have now more competitions and, as a result of this, more games to play during one football season. This increase in the number of games led players to more injuries and created for the S&C coaches the need to design injury prevention programs that will help them reduce this phenomenon.

Injury prevention strategies can involve warm-up protocols (FIFA 11+), myofascial release methods (foam rolling), strength training programs (strength training for hamstrings and strength endurance training) and finally neuromuscular proprioceptive intervention programs. It has been suggested that all those interventions before or (sometimes) after training, can help football players to avoid injuries and remain healthy and fit. Thus it is prevalent that S&C coaches need to apply those strategies to their daily, weekly and yearly periodization.

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The authors declare that there are no conflicts of interest

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# Guidelines for Authors

Revised September 2019

*** Please use the bookmark function to navigate within the guidelines. ***

When preparing the final version of the manuscripts, either NEW or REVISED authors should strictly follow the guidelines. Manuscripts departing substantially from the guidelines will be returned to the authors for revision or, rejected.

## *1. UNIFORM REQUIREMENTS*

### 1.1. Overview

The *Sport Mont* (SM) applies the Creative Commons Attribution (CC BY) license to articles and other works it publishes.

The submission with SM is free of charge but author(s) has to pay additional 190 euros per accepted manuscript to cover publication costs. If the manuscript contains graphics in color, note that printing in color is charged additionally.

SM adopts a double-blind approach for peer reviewing in which the reviewer's name is always concealed from the submitting authors as well as the author(s)'s name from the selected reviewers.

SM honors six-weeks for an initial decision of manuscript submission.

Authors should submit the manuscripts as one Microsoft Word (.doc) file.

Manuscripts must be provided either in standard UK or US English language. English standards should be consistent throughout the manuscripts accordingly.

Format the manuscript in A4 paper size; margins are 1 inch or 2.5 cm all around.

Type the whole manuscript double-spaced, justified alignment.

Use Times New Roman font, size eleven (11) point.

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.

Include line numbers (continuous) for the convenience of the reviewers.

Apart from chapter headings and sub-headings avoid any kind of formatting in the main text of the manuscripts.

### 1.2. Type & Length

SM publishes following types of papers:

Original scientific papers are the results of empirically- or theoretically-based scientific research, which employ scientific methods, and which report experimental or observational aspects of sports science and medicine, such as 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. Descriptive analyses or data inferences should include rigorous methodological structure as well as sound theory. Your manuscript should include the following sections: Introduction, Methods, Results, and Discussion.

☑Open Submissions ☑Indexed ☑Peer Reviewed

Original scientific papers should be:

- Up to 3000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 30;
- Maximum combined total of 6 Tables/Figures.

Review papers should provide concise in-depth reviews of both established and new areas, based on a critical examination

of the literature, analyzing the various approaches to a specific topic in all aspects of sports science and medicine, such as 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.

☑Open Submissions ☑Indexed ☑Peer Reviewed

Review papers should be:

- Up to 6000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 100.

Editorials are written or commissioned by the editors, but suggestions for possible topics and authors are welcome. It could be peer reviewed by two reviewers who may be external or by the Editorial Board.

☐Open Submissions ☑Indexed ☑Peer Reviewed

Editorials should be:

- Up to 1000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 10.

Short reports of experimental work, new methods, or a preliminary report can be accepted as two page papers. Your manuscript should include the following sections: Introduction, Methods, Results, and Discussion.

☑Open Submissions ☑Indexed ☑Peer Reviewed

Short reports should be:

- Up to 1500 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 15.

Peer review - fair review provides authors who feel their paper has been unfairly rejected (at any journal) the opportunity to share reviewer comments, explain their concerns, and have their paper reviewed for possible publication in SM.

☑Open Submissions ☑Indexed ☐Peer Reviewed

Peer review - fair review should be:

- Up to 1500 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 15.

Invited papers and award papers include invited papers from authors with outstanding scientific credentials. Nomination of invited authors is at the discretion of the SM editorial board. SM also publishes award papers selected by the scientific committee of the International Scientific Conference on Transformation Processes in Sport.

☐Open Submissions ☑Indexed ☐Peer Reviewed

Invited papers and award papers should be:

- Up to 3000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 30;
- Maximum combined total of 6 Tables/Figures.

## 1.3. Submission

SM only accepts electronic submission to the e-mail of the Journal Office: **sportmont@ucg.ac.me**.

Submitted material includes:

- A manuscript prepared according to the Guidelines for the Authors;
- A signed form that states the study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere, that states that all of the authors are in agreement with submission of the manuscript to SM, and that, for studies that use animal or human individuals, authors must include information regarding their institution's ethics committee, and which identifies the official approval number;
- A signed form that there is no conflict of interest.

Name the files according to the family name of the first author. Authors submitting revised versions of the manuscript can use the identification number of their manuscript as provided by the Journal Office. *See* example:

- ✓ FAMILY NAME-manuscript.doc – (main manuscript file)
- ✓ FAMILY NAME-statement.PDF – (authorship statement)
- ✓ FAMILY NAME-declaration.PDF – (declaration of potential conflict of interest)
- ✓ FAMILY NAME-fig1.tiff – (Figure 1)

## 1.4. Peer Review Process

A manuscript submitted for publication will be submitted to the review process as long as it fits the following criteria:

- The study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere;
- All persons listed as authors approved its submission to SM;
- Any person cited as a source of personal communication has approved the quote;
- The opinions expressed by the authors are their exclusive responsibility;
- The author signs a formal statement that the submitted manuscript complies with the directions and guidelines of SM.

The editors-in-chief and associate editors will make a preliminary analysis regarding the appropriateness, quality, originality and written style/grammar of the submitted manuscript. The editors reserve the right to request additional information, corrections, and guideline compliance before they submit the manuscript to the ad-hoc review process.

SM uses ad-hoc reviewers, who volunteer to analyze the merit of the study. Typically, one or two expert reviewers are consulted in a double-blind process. Authors are notified by e-mail when their submission has been accepted (or rejected). Minor changes in the text may be made at the discretion of the editors-in-chief and/or associate editors. Changes can include spelling and grammar in the chosen language, written style, journal citations, and reference guidelines. The author is notified of changes via email. The final version is available to the author for his or her approval before it is published.

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The editors of SM consider plagiarism to be a serious breach of academic ethics. Any author who practices plagiarism (in part or totality) will be suspended for six years from submitting new submissions to SM. If such a manuscript is approved and published, public exposure of the article with a printed mark ("plagiarized" or "retracted") on each page of the published file, as well as suspension for future publication for at least six years, or a period determined by the editorial board. Third party plagiarized authors or institutions will be notified, informing them about the faulty authors. Plagiarism will result in immediate rejection of the manuscript.

SM only publishes studies that have been approved by an institutional ethics committee (when a study involves humans or animals). Fail to provide such information prevent its publication. To ensure these requirements, it is essential that submission documentation is complete. If you have not completed this step yet, go to SM website and fill out the two required documents: Declaration of Potential Conflict of Interest and Authorship Statement. Whether or not your study uses humans or animals, these documents must be completed and signed by all authors and attached as supplementary files in the originally submitted manuscript.

## 1.6. After Acceptance

After the manuscript has been accepted, authors will receive a PDF version of the manuscripts for authorization, as it should look in printed version of SM. Authors should carefully check for omissions. Reporting errors after this point will not be possible and the Editorial Board will not be eligible for them.

Should there be any errors, authors should report them to the Office e-mail address **sportmont@ucg.ac.me**. If there are not any errors authors should also write a short e-mail stating that they agree with the received version.

## 1.7. Code of Conduct Ethics Committee of Publications


SM is hosting the Code of Conduct Ethics Committee of Publications of the **COPE** (the Committee on Publication Ethics), which provides a forum for publishers and Editors of scientific journals to discuss issues relating to the integrity of the work submitted to or published in their journals.

# *2. MANUSCRIPT STRUCTURE*

## 2.1. Title Page

The first page of the manuscripts should be the title page, containing: title, type of publication, running head, authors, affiliations, corresponding author, and manuscript information. *See* example:

Body Composition of Elite Soccer Players from Montenegro

Original Scientific Paper

Elite Soccer Players from Montenegro

Jovan Gardasevic[1]

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Corresponding author:

*J. Gardasevic*

*University of Montenegro*

*Faculty for Sport and Physical Education*

*Narodne omladine bb, 81400 Niksic, Montenegro*

*E-mail: jovan@ucg.ac.me*

Word count: 2,946

Abstract word count: 236

Number of Tables: 3

Number of Figures: 0

### 2.1.1. Title

Title should be short and informative and the recommended length is no more than 20 words. The title should be in Title Case, written in uppercase and lowercase letters (initial uppercase for all words except articles, conjunctions, short prepositions no longer than four letters etc.) so that first letters of the words in the title are capitalized. Exceptions are words like: "and", "or", "between" etc. The word following a colon (:) or a hyphen (-) in the title is always capitalized.

### 2.1.2. Type of publication

Authors should suggest the type of their submission.

### 2.1.3. Running head

Short running title should not exceed 50 characters including spaces.

### 2.1.4. Authors

The form of an author's name is first name, middle initial(s), and last name. In one line list all authors with full names separated by a comma (and space). Avoid any abbreviations of academic or professional titles. If authors belong to different institutions, following a family name of the author there should be a number in superscript designating affiliation.

#### 2.1.5. Affiliations

Affiliation consists of the name of an institution, department, city, country/territory (in this order) to which the author(s) belong and to which the presented / submitted work should be attributed. List all affiliations (each in a separate line) in the order corresponding to the list of authors. Affiliations must be written in English, so carefully check the official English translation of the names of institutions and departments.

Only if there is more than one affiliation, should a number be given to each affiliation in order of appearance. This number should be written in superscript at the beginning of the line, separated from corresponding affiliation with a space. This number should also be put after corresponding name of the author, in superscript with no space in between.

If an author belongs to more than one institution, all corresponding superscript digits, separated with a comma with no space in between, should be present behind the family name of this author.

In case all authors belong to the same institution affiliation numbering is not needed.

Whenever possible expand your authors' affiliations with departments, or some other, specific and lower levels of organization.

#### 2.1.6. Corresponding author

Corresponding author's name with full postal address in English and e-mail address should appear, after the affiliations. It is preferred that submitted address is institutional and not private. Corresponding author's name should include only initials of the first and middle names separated by a full stop (and a space) and the last name. Postal address should be written in the following line in sentence case. Parts of the address should be separated by a comma instead of a line break. E-mail (if possible) should be placed in the line following the postal address. Author should clearly state whether or not the e-mail should be published.

#### 2.1.7. Manuscript information

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

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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.

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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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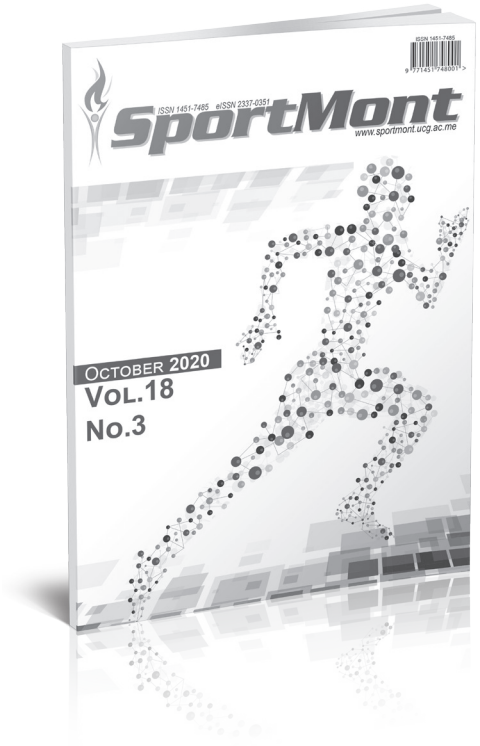


ISSN 1451-7485

Sport Mont (SM) is a print (ISSN 1451-7485) and electronic scientific journal (eISSN 2337-0351) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

- Open-access and freely accessible online;
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- Peer review by expert, practicing researchers;
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- Community-based dialogue on articles;
- Worldwide media coverage.

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SM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

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**Dusko BJELICA**, *Editor-in Chief – dbjelica@ucg.ac.me*
**Zoran MILOSEVIC**, *Editor-in Chief – zoranais@eunet.rs*
**Jovan GARDASEVIC**, *Managing Editor – jovan@ucg.ac.me*

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Autumn issue – October 2021

# University of Montenegro

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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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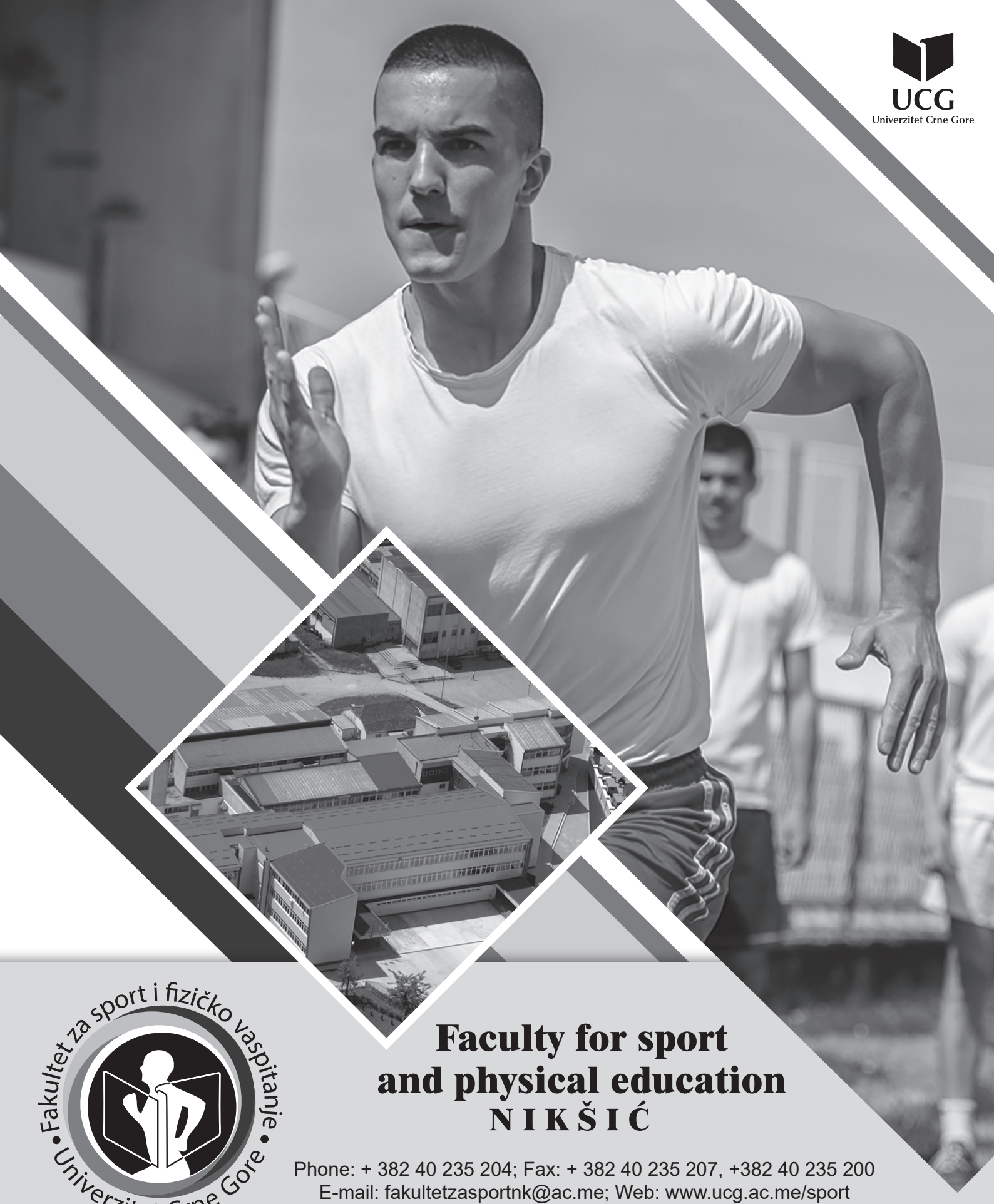

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Fakultet za sport i fizičko vaspitanje
Univerzitet Crne Gore

# Faculty for sport and physical education
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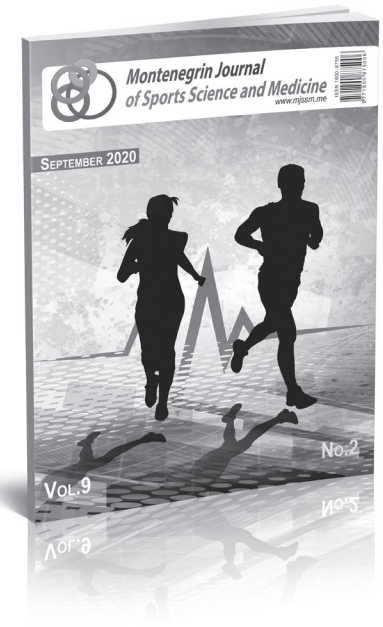
MONTENEGRIN JOURNAL OF SPORTS SCIENCE AND MEDICINE

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# CALL FOR CONTRIBUTIONS

Montenegrin Journal of Sports Science and Medicine (MJSSM) is a print (ISSN 1800-8755) and electronic scientific journal (eISSN 1800-8763) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

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MJSSM is published biannually, in September and March of each year. MJSSM publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

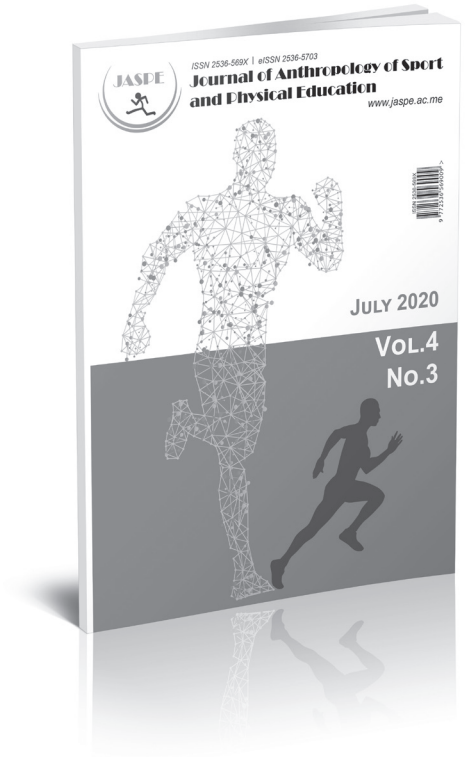
MJSSM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the MJSSM website: http://www.mjssm.me/?sekcija=page&p=51. Contributors are urged to read MJSSM's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to office@mjssm.me or contact following Editors:

**Dusko BJELICA**, Editor-in Chief – dbjelica@ucg.ac.me
**Stevo POPOVIC**, Editor-in Chief – stevop@ucg.ac.me
**Selçuk AKPINAR**, Executive Editor – sakpinar@nevsehir.edu.tr

**Publication date:** Spring issue – March 2021
Autumn issue – September 2021

# Journal of Anthropology of Sport and Physical Education




ISSN 2536-569X

Journal of Anthropology of Sport and Physical Education (JASPE) is a print (ISSN 2536-569X) and electronic scientific journal (eISSN 2536-5703) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

- Open-access and freely accessible online;
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- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
- Worldwide media coverage.

JASPE is published four times a year, in January, April, July and October of each year. JASPE publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Anthropology of Sport and Physical Education, as well as it can function as an open discussion forum on significant issues of current interest.

JASPE covers all aspects of anthropology of sport and physical education from five major fields of anthropology: cultural, global, biological, linguistic and medical.

Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the JASPE website: http://www.jaspe.ac.me/?sekcija=page&p=51. Contributors are urged to read JASPE's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to jaspe@ucg.ac.me or contact JASPE's Editor:

**Bojan MASANOVIC**, *Editor-in Chief – bojanma@ucg.ac.me*

**Publication date:** Autumn issue – October 2020
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Spring issue – April 2021
Summer issue – July 2021

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# UNIVERZITET CRNE GORE
# PRAVNI FAKULTET – PODGORICA

UNIVERZITET CRNE GORE
PRAVNI FAKULTET PODGORICA

Faculty of Law was founded on October 27th, 1972 in Podgorica as a scientific and artistic educational institution, in which educational and research work was organized in the area of law and similar social studies. While making into law the establishment of this institution, Assembly of 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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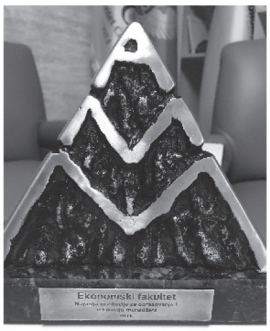
# Faculty of Economics
# University of Montenegro

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.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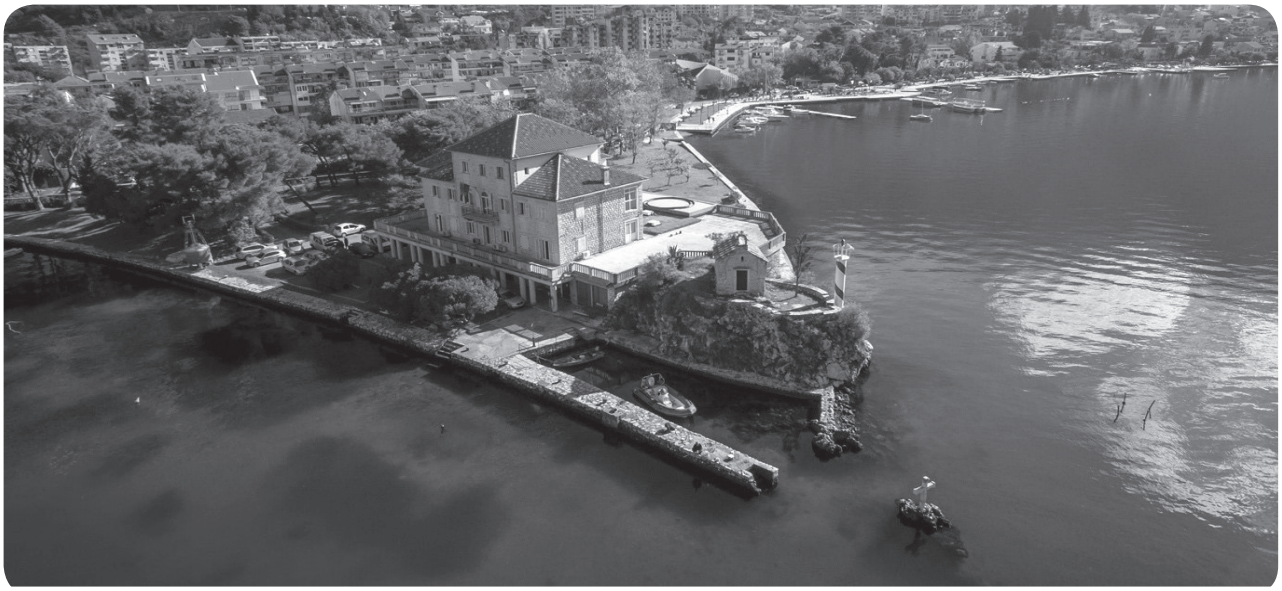
# UNIVERZITET CRNE GORE
# INSTITUT ZA BIOLOGIJU MORA

INSTITUT ZA BIOLOGIJU MORA



University of Montenegro – Institute for marine biology is located in Kotor, Montenegro. Since its establishment in 1961, the Institute performed comprehensive research of the marine and coastal area, which has its wide impact to the environmental protection, pollution-prevention and practical application. Core competencies of the Institute are focused on research in the fields of marine conservation, ichthyology and marine fisheries, marine chemistry, aquaculture, plankton research, neuro and eco-physiology. The main research area is investigating and protection of Adriatic sea with special interest of South Adriatic area. Institute for marine biology have a wide range of international cooperation with Marine research institutions and Universities all over Mediterranean area 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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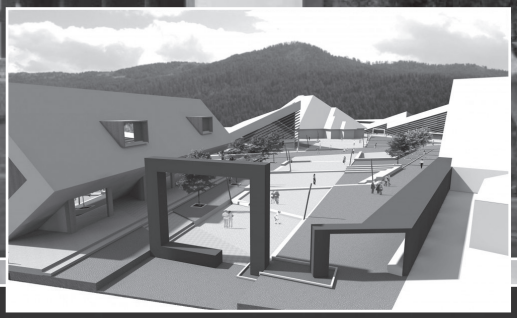
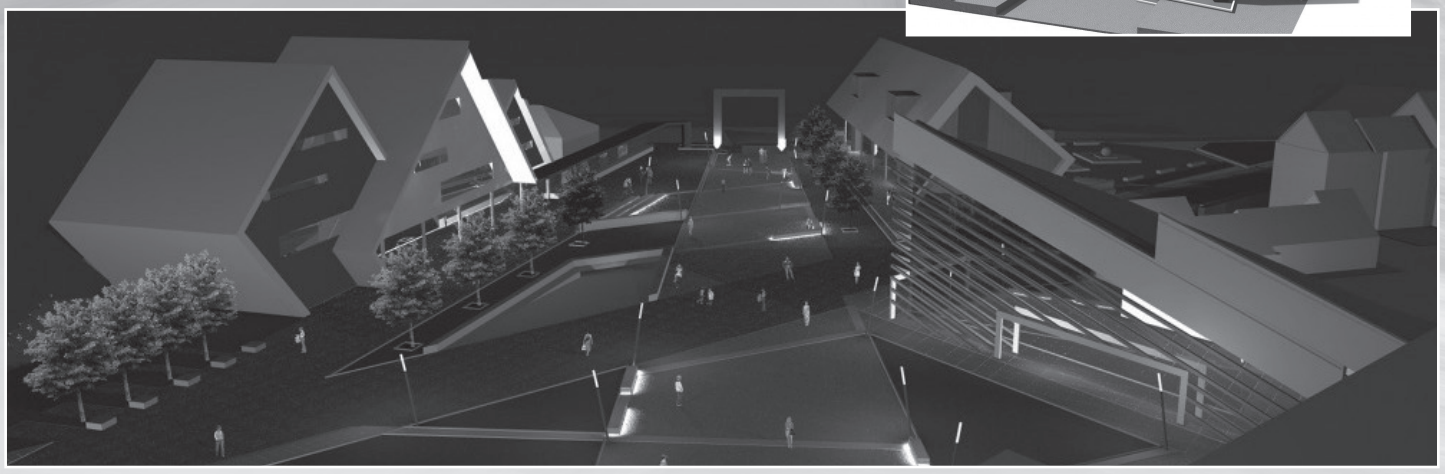
# FACULTY OF ARCHITECTURE





The goal of establishment of our institution is the education highly qualified professional cadre based on the best knowledge of the theory and practice in the world, and its application to the development and implementation of plans and projects in the space - as a basic condition for the quality valorization, programming, management and protection of natural and inherited built environment. In this way conceptualized school forms internationally experts in all areas of creativity - in the field of urban planning, architecture, construction and design - which includes the ability to create useful objects, architectural forms of all categories, urban and vacant space at different levels. Such qualified cadre are the spiritus movens of development of culture and technology in the modern world.

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# Look Inside!


## Sport Mont Journal

Editors-in-Chief: **Dusko Bjelica**, Montenegro; **Zoran Milosevic**, Serbia
Managing Editor: **Jovan Gardasevic**, Montenegro

*Volume 18, 2020, 3 issues per year; Print ISSN: 1451-7485, Online ISSN: 2337-0351*

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## Montenegrin Journal of Sports Science and Medicine

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Executive Editor: **Selcuk Akpinar**, Turkey
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*Volume 9, 2020, 2 issues per year; Print ISSN: 1800-8755, Online ISSN: 1800-8763*

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# UNIVERSITY OF MONTENEGRO
# FACULTY OF MECHANICAL ENGINEERING
## Podgorica

www. ucg.ac.me/mf

Mechanical engineering studies in Montenegro started during the school year 1970/71. On April 15th, within the Technical Faculty, the Department of Mechanical Engineering was formed. The Department of Mechanical Engineering of the Technical Faculty was transformed in 1978 into the Faculty of Mechanical Engineering, within the University "Veljko Vlahović". Since 1992 the Faculty of Mechanical Engineering is an autonomous University unit of the University of Montenegro. It is situated in Podgorica.

The University of Montenegro is the only state university in the country, and the Faculty of Mechanical Engineering is the only faculty in Montenegro from the field of mechanical engineering.

Activities of the Faculty of Mechanical Engineering can be divided into three fields: teaching, scientific-research work and profes- sional work.

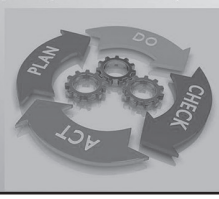
Two study programmes were accredited within the Faculty of Mechanical Engineering:

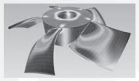
- Academic study programme MECHANICAL ENGINEERING
- Academic study programme ROAD TRAFFIC

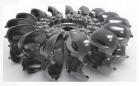
The study programmes are realised according to the Bologna system of studies in accordance to the formula 3+2+3.

On the study program Mechanical Engineering it is possible to study next modules:

- Mechanical Engineering – Production
- Applied Mechanics and Construction
- Energetics
- Energy Efficiency
- Mechatronics
- Quality

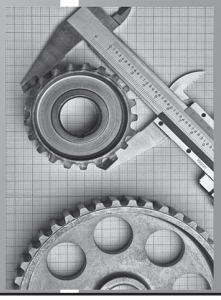




At the Faculty of Mechanical Engineering, as organisational units, there are centres and laboratories through which scientific-re- search and professional work is done:

- Centre for Energetics
- Centre for Vehicles
- Centre for Quality
- Centre for Construction Mechanics
- Centre for Traffic and Mechanical Engi- neering Expertise
- Centre for transport machines and metal constructions
- 3D Centre
- Didactic Centre – Centre for Automation and Mechanomics training
- European Information and Innovation Centre
- Cooperation Training Centre
- Laboratory for Metal Testing
- Laboratory for Turbulent Flow Studies
- Laboratory for Vehicle Testing
- Laboratory for Attesting of Devices on the Technical Examination Line



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