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# SPORT SCIENCE

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# DEAR READER,

As we announced in our previous issue, research on the subject of effects caused by the COVID-19 pandemic in the area of sports is becoming current, offering results which provide evidence on the changes the pandemic has caused. Papers founded on the results of research conducted under the COVID-19 pandemic conditions or related to the COVID-19 pandemic are present in this issue, and it is our belief that, in the following period, there will be more papers which will expose the stated topic.

For this issue, we selected 18 papers from 12 countries and we are grateful to all authors who have sent their papers and dedicated themselves to research during the time when it is truly neither easy nor simple. Just like in other issues, our reviewers and the Editorial Board have professionally edited this issue of the journal for publishing, which shows the readiness to address all changes and challenges which lie before us.

We rejoice in the fact that there is an increasing number of papers submitted to our journal as the result of research conducted by authors from different countries, showing the connection in the selected area of sports which we had prior to the COVID-19 pandemic. The relationship between authors from Croatia and China, Bosnia and Herzegovina and Turkey, Croatia and the Czech Republic, and Serbia and Bosnia and Herzegovina, who have jointly published their papers, is a multidisciplinary quality and an approach which we will prefer and promote in the upcoming period.

We would like to invite all of you, who follow our journal, to adopt an approach of openness and offer new research to open the areas which have so far been "closed" due to the COVID-19 pandemic so that, together, we could enrich the area of sports with new findings which will manage the changes. The present should offer a vision of the future based on scientific findings and research results in which we should participate so as to be the creators and not mute observers! Our journal will gladly support innovative approaches and publish the papers authored by those who have accepted the

challenges of the COVID-19 pandemic, all with the goal to use the research results so as to help model the new state in the area of sports which is to be expected in the future.

**Nihad Selimović, MD, MSc**  
Editor in chief



# DRAGI ČITATELJU,

Kao što smo u predhodnom broju i najavili, istraživanja na temu posljedica pandemije COVID-19 na oblasti sporta postaju aktuelna i nude rezultate koji svjedoče o promjenama koje je pandemija izazvala. Radovi autora koji su zasnovani na rezultatima istraživanja koja su provedena u uslovima pandemije COVID-19 ili se povezuju sa pandemijom COVID-19 nalaze se i u ovom broju, a vjerujemo da će naredni period ponuditi mnogo više radova koji će eksponirati navedenu temu.

Za ovaj broj odabrano je 18 radova iz 12 zemalja i zahvalni smo svim autorima koji su slali svoje radove i koji su se posvetili istraživačkom radu u vrijeme kada to zaista nije ni lako ni jednostavno. I za ovaj broj naši recenzenti i Urednički odbor na vrlo profesionalan način su uredili ovaj broj časopisa za objavu, čime pokazujemo spremnost da odgovorimo svim promjenama i izazovima koji se pred nama nalaze.

Raduje nas što dobivamo sve više radova koji nastaju kao rezultat istraživanja u kojima učestvuju autori iz različitih zemalja, što pokazuje povezanost u odabranom području sporta koju smo imali i prije pandemije COVID-19. Povezanost autora iz Hrvatske i Kine, Bosne i Hercegovine i Turske, Hrvatske i Češke Republike, Srbije i Bosne i Hercegovine, koji su zajedno objavili radove, je multidisciplinarni kvalitet i pristup koji ćemo i u narednom periodu preferirati i promovirati.

Pozivamo sve vas, koji pratite naš časopis, da budete otvorenog pristupa i da nam ponudite nova istraživanja, da otvorite do sada „zaključane“ prostore uslijed pandemije COVID-19 i da svi zajedno obogatimo prostor sporta sa novim saznanjima koja će upravljati promjenama. Sadašnjost treba da ponudi viziju budućnosti zasnovanu na naučnim saznanjima i rezultatima istraživanja u kojima trebamo sudjelovati kako bi mogli biti kreatori

a ne nijemi posmatrači! Naš časopis će rado podržati inovativne pristupe i objavljivati radove autora koji su prihvatili izazove pandemije COVID-19, a sve sa ciljem da rezultati novih istraživanja pomognu u modeliranju novog stanja u oblasti sporta koje se u budućnosti očekuje.

**Mr. sci. dr. Nihad Selimović**

Glavni urednik



# DIFFERENCES IN THE LEVEL OF PHYSICAL ACTIVITY DURING THE LOCKDOWN DUE TO THE COVID-19 PANDEMIC IN YOUNG ADULTS

Vjekoslav Cigrovski<sup>1</sup>, Mislav Škovran<sup>1</sup>, Hua Fang<sup>2</sup>, Tomislav Rupčić<sup>1</sup>, Damir Knjaz<sup>1</sup>

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## ABSTRACT

The main goal of this research was to determine the difference in the level of physical activity (PA) during the lockdown due to the COVID-19 pandemic, compared to the usual level of PA, in young adults - Kinesiology students. We included 222 participants from UNIZG and BSU. The total level of PA was assessed by an IPAQ SF questionnaire. The data, which were collected and processed by IPAQ SF, were reported as comparisons of median values and interquartile ranges. The analysis of IPAQ SF completed during the COVID-19 lockdown and the special government rules shows that UNIZG students' TOTAL PA MET-minutes/week median was 4259.00, while the TOTAL PA MET-minutes/week median for BSU students was 1805.00. After the lockdown, UNIZG students' TOTAL PA MET-minutes/week median was 5850.00, while the TOTAL PA MET-minutes/week median for BSU students was 2880.00. Our results show a remarkably higher level of PA after the lockdown than during the lockdown due to the COVID-19 pandemic in both groups. Additionally, certain differences between the groups were noticed. More specifically, the results present higher values of PA for UNIZG students in comparison to BSU students, regardless of the time during or after the lockdown. This study observed the level of PA in Kinesiology students, who are presumably a more active population compared to the general population. The results suggest a much lower level of PA during the lockdown due to the COVID-19 pandemic, and we assume the drop in the PA level in the general population to be even greater. Although the short- and long-term effects of lockdown weren't observed and require special attention, we believe there is an urgent need to create and implement exercise-based programmes on a national basis all around the world in order to increase the level of PA after lockdown for the general population.

**Keywords:** physical inactivity, isolation, quarantine, exercise, wellbeing

## INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) has swept across the world, causing a global pandemic (Zhang, 2020). The current COVID-19 pandemic has led governments to impose strict confinement rules on their citizens.

These measures have, however, had an impact on the general health of the population because of both exercise restrictions and effects on diet. Exercise restrictions have been the consequence of closed gyms and sports centres, restrictions on walking distance, a lack of space and infrastructure for home-based physical exercise, and a lack of technical knowledge of the population on appropriate training routines (Martinez – Ferran, 2020).

Before the pandemic, insufficient physical activity was already described as a global public health problem. Recent studies indicate that a reduced level of PA could have a serious negative impact on healthy individuals (Bhatia, 2020; Chen, 2020; Dixit, 2020; Kyu, 2016). Many authors point to physical inactivity as an important risk factor for the development of cardiovascular disease, type 2 diabetes mellitus and obesity (González, 2017; Longo – Mbenza, 2009; Mattioli, 2020; Sullivan, 2005). Physical inactivity may also be associated with the development of mental disorders such as depression and anxiety (Chen, 2020; Strohle, 2008; Zhang, 2020). Achieving minimum physical activity levels (i.e., 150 minutes of moderate to vigorous physical activity or 75 minutes of intensive physical activity, per week, or a combination of both) and reducing sedentary behaviour in times of social isolation have become a challenge and, at the same time, a necessity for everyone (Peçanha, 2019). All of the above indicates the importance of maintaining regular physical exercise and opens a big field in research to determine whether the level of PA has been changed drastically during the COVID-19 pandemic. Presumably, Sport Science or Kinesiology students are more likely to maintain a regular level of PA compared to the general population. Therefore, the aim of this research was to determine the difference in the PA during the lockdown due to the COVID-19 pandemic, compared to the usual level of PA, in young adults - Kinesiology students.

## METHODS

### Participants

For the purpose of this research we recruited a total of 238 Kinesiology students from the Beijing Sports University (BSU), China and the Faculty of Kinesiology, University of Zagreb (UNIZG), Croatia. For the final analysis, a total of 222 participants, who completed the questionnaire correctly, were included; 102 were from UNIZG (36 female and 66 male), with the average age of  $23.03 \pm 1.39$  years, and 120 students were from BSU (67 female and 53 male), with the average age of  $22.30 \pm 2.72$  years. The average weight of students from UNIZG was  $73.27 \pm 11.42$  kg and the average weight of students from BSU was  $63.23 \pm 13.45$  kg.

### Variables

The participants were asked to complete three parts of the questionnaire in their native language. The first part was a basic questionnaire and included questions about the participants' age, gender, body mass and subjective experience of the restrictive rules in their country during the COVID-19 pandemic. The second part was an IPAQ short-form questionnaire (IPAQ SF) which the students completed during the COVID-19 pandemic and imposition of strict rules limiting their usual habits. The third part of the questionnaire was also an IPAQ SF and this part

assessed the level of physical activities during the time after the governments eased the restrictions and people were able to continue with their usual lifestyle and activities. The specific types of activity that were assessed by IPAQ SF are walking, moderate-intensity activities and vigorous-intensity activities.

### IPAQ SF analysis

The questionnaire was processed following the procedure of "Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)". The selected MET values were derived from the work undertaken during the IPAQ Reliability Study conducted in 2000-2001. Using the Ainsworth et al. Compendium (Med Sci Sports Med 2000), an average MET score was derived for each type of activity. For example, all types of walking were included and an average MET value for walking was created. The same procedure was undertaken for moderate-intensity activities and vigorous-intensity activities. The following values continue to be used for the analysis of IPAQ data: Walking = 3.3 METs, Moderate PA = 4.0 METs and Vigorous PA = 8.0 METs. Using these values, four continuous scores are defined:

- Walking MET-minutes/week =  $3.3 * \text{walking minutes} * \text{walking days}$
- Moderate MET-minutes/week =  $4.0 * \text{moderate-intensity activity minutes} * \text{moderate days}$
- Vigorous MET-minutes/week =  $8.0 * \text{vigorous-intensity activity minutes} * \text{vigorous-intensity days}$
- Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores.

### Analysis

The age, gender and body mass were analysed by descriptive statistics and the data were presented as mean  $\pm$  standard deviation (MEAN  $\pm$  SD). The categorised score of IPAQ SF (low, moderate and high category), body weight change during the COVID-19 pandemic and subjective experience of the restrictive rules were analysed by frequency tables. The data, which were collected and processed by IPAQ SF, were reported as comparisons of median values and interquartile ranges.

## RESULTS

According to the answers gathered by the basic questionnaire, 56.86% of UNIZG students reported no change in body weight, 25.45% reported weight loss during the lockdown and 17.65% of students gained weight. 12.75% of participants gained 1-3kg and 4.9% gained more than 3kg. At the same time, 43.33% of BSU students reported no change in

body weight, 16.67% reported lower body weight than usual and 40% of BSU students gained weight, out of which 25% gained 1–3kg, while 15% gained more than 3kg during the COVID–19 lockdown. Furthermore, the participants were asked about their personal experience of the governments' restrictive rules during the lockdown in their countries. In Croatia, 32.36% of them reported their experience of restrictive rules as 'very strict' during the lockdown. At the same time, 56.84% of Chinese participants perceived lockdown rules in their country as 'very strict'.

The data presented in Table 1 shows the median values and interquartile range (25th – 75th quartile) for the time during the lockdown due to the COVID–19 pandemic. The analysis of IPAQ SF questionnaire during the COVID–19 lockdown and the special government rules suggest a surprisingly big difference in the total level of PA between the two observed groups. More specifically, UNIZG students' TOTAL PA MET-minutes/week median was 4259.00, while the TOTAL PA MET-minutes/week median for BSU students was 1805.00.

**Table 1:** Total level of PA for UNIZG and BSU students during the lockdown due to the COVID–19 pandemic

During the lockdown	UNIZG	BSU
Median values (25 <sup>th</sup> – 75 <sup>th</sup> percentile)		
MET/min vigorous	1920.00 (960.00 – 3840.00)	480.00 (0.00 – 2160.00)
MET/min moderate	1200.00 (600.00 – 1920.00)	360.00 (0.00 – 900.00)
MET/min walking	767.25 (462.00 – 2079.00)	363.00 (132.00 – 990.00)
Total level of PA	4259.00 (2730.00 – 7812.00)	1805.00 (648.50 – 3961.00)

\*PA – physical activity

Unsurprisingly, the median values of the reported PA after the lockdown were much higher for both groups (Table 2). At that time, there were no more strict rules which limited the possibilities of maintaining a regular level of exercising, so those findings were in line with the expectations. However, the differences in the level of PA between the groups were similar to the results during the lockdown due to the COVID–19 pandemic. The group of UNIZG students' median value of the total level of PA was 5850.00 MET-minutes/week, while at the same time, BSU students reported a much lower value of the total level of PA, 2880.00 MET-min/week. The reported data suggest a much lower participation in physical exercise when it comes to Chinese students.

**Table 2:** Total level of PA for UNIZG and BSU students during the lockdown due to the COVID–19 pandemic

After the lockdown	UNIZG	BSU
Median values (25 <sup>th</sup> – 75 <sup>th</sup> percentile)		
MET/min vigorous	2520.00 (1440.00 – 4800.00)	1020.00 (200.00 – 2880.00)
MET/min moderate	1320.00 (600.00 – 2520.00)	560.00 (0.00 – 1200.00)

MET/min walking	1014.75 (594.00 – 2310.00)	693.00 (297.00 – 1386.00)
Total level of PA	5850.00 (3213.00 – 9268.00)	2880.00 (1478.00 – 4875.75)

\*PA – physical activity

The results in Tables 1 and 2 show remarkable differences in the level of PA for both groups, when comparing the time during and after the lockdown. As expected, both groups reported higher values of PA after the lockdown. However, UNIZG students' values of the total level of PA were much higher regardless of the time during or after the lockdown due to the COVID-19 pandemic.

## DISCUSSION

This study investigated the level of PA during the lockdown caused by the COVID-19 pandemic in comparison to the level of PA after the lockdown when people continued with their usual lifestyle and everyday routine. The results suggest that lockdown due to the COVID-19 pandemic affected the level of PA in both groups (BSU and UNIZG), as the reported levels of TOTAL PA MET-minutes/week and average min of PA/week were significantly lower during the lockdown. Our result goes in line with other similar published studies (Gallè, 2020; Giustino, 2020; Karuc, 2020; Sekulić, 2020). However, the results indicate that the global pandemic and restrictive rules affected the two groups differently. More specifically, 56.84% of BSU students reported their experience of restrictive rules as 'very strict', while only 32.36% of UNIZG students felt the same way. Additionally, 40% of BSU students gained at least 1 kg during the lockdown, compared to only 17.65% of UNIZG students. Finally, by comparing the two groups (UNIZG and BSU), there is a certain difference in the total level of PA in favour of UNIZG students, regardless of the time during or after the lockdown due to the pandemic. The results suggest that UNIZG students were more active not only during the lockdown, but also after easing off the governments' restrictive rules. Higher values of PA for UNIZG students compared to BSU students could be explained as a consequence of stricter restrictive rules and a different lifestyle in China compared to Croatia, which could result in less options for the Chinese participants to maintain their regular level of PA. More specifically, China was affected by the pandemic first. In some regions, the government announced quarantine and people were unable to exit their homes. In most cities and regions, the government limited peoples' outdoor activities with only a few hours per day, even after the lockdown due to COVID-19. In Croatia, the restrictive rules were not as strict and people weren't forbidden to spend time outdoors. However, both groups' total level of PA was several times higher than the 600 MET min/week recommended by WHO, regardless of whether it was related to the period during the lockdown or after easing off the restrictions. Those findings were expected as participants were Kinesiology students, who are presumably a more active group

compared to the general population. Currently, non-pharmacological public health measures such as isolation, social distancing, and quarantine are the only effective way to respond to the COVID-19 outbreak (Nussbaumer-Streit, 2020). However, many authors are expressing their concerns about the negative effects of isolation or quarantine on health and wellbeing (Lesser, 2020; Narrici, 2020; Matioli, 2020). More specifically, inactivity, induced by bed rest, limb casting, and limb suspension or by simple sedentariness, causes a rapid loss of muscle mass, particularly of the antigravity muscles that are constantly used for sustaining an upright posture, to perform movement and for maintaining balance (Narrici, 2020). Additionally, numerous studies are emphasising the importance of maintaining regular physical exercise during the COVID-19 pandemic due to its benefits to physical and mental health (Dwyer, 2020; Goethals, 2020; Hall, 2020; Heffernan, 2020; Matias, Nyenhuis, 2020; Rodriguez, 2020). PA is well established as an essential component of healthy living medicine for the prevention and treatment of chronic diseases and for the overall maintenance of physical and mental health and wellbeing (Fletcher, 2018; Laddu, 2020). Several limitations of this study also need to be acknowledged. Firstly, PA was not measured, but it was self-reported through a questionnaire, which typically leads to recall bias. However, the IPAQ SF questionnaire used in this study has been previously shown to be a reasonably valid and reliable instrument for assessing PA (Ajman, 2015). Moreover, the nature of this research was unable to assess the short- and long-term effects of the drop in PA level during the quarantine, which would be important and needs special attention. The main strength of this study is that the participants were sports university students, presumably a homogenous group, who are more likely to be active in comparison to the general population. Therefore, if this usually more active population suffers a big drop in the level of PA during the lockdown caused by the COVID-19 pandemic, the presumed drop in the level of PA in the general population could be even greater. To conclude, this research determined the differences in the level of PA due to the COVID-19 lockdown. Unsurprisingly, the level

of PA was lower for both groups during the lockdown compared to the time after easing off the restrictions. UNIZG students had a significantly higher level of PA both during and after the lockdown due to the COVID-19 pandemic. The lower results in the Chinese group during the lockdown could be explained by the fact that Chinese restrictive rules were stricter than the rules in Croatia. However, the results suggested similar differences in the level of PA after the lockdown due to the COVID-19 pandemic, in favour of UNIZG students. Finally, the global COVID-19 pandemic completely changed our lifestyle. As of today, isolation, quarantine or social distancing are still the most common ways of preventing further infection. However, by fighting one pandemic with isolation or quarantine, we decreased the possibilities of maintaining a sufficient level of PA. The negative effects of physical inactivity on human

health and wellbeing is well documented and could lead to serious health problems. Therefore, it is important to immediately create and implement exercise-based programmes and interventions on the national level all around the world not only after, but also during the pandemic. Personalised training according to age, clinical conditions, and the level of fitness is paramount; therefore, specific recommendations to address home-based training during this time are highly needed (Dwyer, 2020). In line with the recommendations, it would be important to educate all experts included in the profession of sport and recreation on the possibilities of home-based exercises, so they would be equipped with this special knowledge, and could in turn help in maintaining the basic level of PA in the general population.

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## RAZLIKA U RAZINI TJELESNE AKTIVNOSTI ZA VRIJEME PANDEMIJE UZROKOVANE COVID-19 VIRUSOM KOD MLADIH LJUDI

Glavni cilj ovog istraživanja bio je utvrditi razliku u razini tjelesne aktivnosti tijekom uvođenja posebnih mjera ograničenja kretanja uzrokovanih pandemijom COVID-19 virusa, u usporedbi s uobičajenom razinom tjelesne aktivnosti, kod studenata kineziologije. Za potrebe istraživanja uključili smo 222 sudionika, studente Kineziološkog fakulteta u Zagrebu (UNIZG) te Fakulteta za sport u Pekingu (BSU). Ukupna razina tjelesne aktivnosti ispitana je kratkom verzijom IPAQ upitnika. Podaci prikupljeni i obrađeni putem upitnika prezentirani su kao usporedbe medijan vrijednosti i interkvartilnog raspona. Analiza upitnika za vrijeme posebnih vladinih pravila koja su ograničila kretanja i korištenja društvenih sadržaja pokazuje da je ukupna razina tjelesne aktivnosti studenata UNIZG-a bila 4259,00 MET-minuta/tjedan, dok je za studente BSU iznosila 1805,00 MET-minuta/tjedan. Nakon olakšanja mjera i povratka standardnim životnim navikama, razina tjelesne aktivnosti za studente UNIZG-a iznosila je 5850,00 MET-minuta/tjedan, dok je razina tjelesne aktivnosti za studente BSU iznosila 2880,00 MET-minuta/tjedan. Rezultati sugeriraju znatno manju razinu tjelesne aktivnosti tijekom trajanja posebnih vladinih mjera ograničenja kretanja u obje skupine. Uz to, uočene su određene razlike između skupina. Preciznije, rezultati prikazuju veće vrijednosti tjelesne aktivnosti za studente UNIZG-a u odnosu na studente BSU-a za vrijeme posebnih vladinih restriktivnih mjera. Idućeg su razlike primijećene i nakon olakšanja mjera i povratka standardnim životnim navikama. Ovo istraživanje je ispitalo razinu tjelesne aktivnosti kod studenata kineziologije, vjerojatno aktivnije populacije u odnosu na opću populaciju. Rezultati sugeriraju znatno nižu razinu tjelesne aktivnosti tijekom posebnih restriktivnih mjera zbog pandemije COVID-19, a mi pretpostavljamo da je pad razine tjelesne aktivnosti u općoj populaciji mnogo veći. Sukladno rezultatima, vjerujemo da postoji hitna potreba za stvaranjem i provedbom programa tjelesnog vježbanja na nacionalnoj razini u cijelom svijetu kako bi se povećala razina tjelesne aktivnosti opće populacije nakon, ali i tijekom globalne pandemije uzrokovane COVID-19 virusom.

**Ključne riječi:** tjelesna neaktivnost, izolacija, karantena, tjelesno vježbanje, zdravlje

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# PHYSICAL FITNESS AND BODY WEIGHT IN PRE-ADOLESCENT SCHOOL CHILDREN: THE EUROFIT MOTOR FITNESS TEST EXPLORED ON 11-12-YEAR-OLD CHILDREN

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## ABSTRACT

Nowadays, the early prevention of obesity in childhood is one of the most critical public health issues. More than half of children and adolescents worldwide do not meet the recommendation of 60 minutes of moderate to vigorous physical activity per day. This trend can reduce physical fitness and, consequently, cause a decrease in the quality of life throughout the lifespan. Physical fitness, defined as a set of abilities to perform physical activity and exercise (such as aerobic capacity, endurance, strength, flexibility), is considered one of the most important health markers in adulthood and childhood as well as adolescence. Methods: We conducted a cross-sectional study to investigate the physical fitness of pre-adolescent children of the Emilia-Romagna region. Children's anthropometric parameters (height and weight) and physical fitness levels – assessed via the EUROFIT test battery – were measured. In all of the applied EUROFIT tests, children's performance was below the sufficient age and gender values. Moreover, it was negatively associated with obesity. Our research provided evidence that the general fitness of our sample was low and the performance of overweight/obese children was lower compared to the under/normal weight students.

**Keywords:** physical activity, body mass index, obesity, pre-adolescents, physical education

## INTRODUCTION

The level of sedentariness is increasing around the world, especially in children and young people (Lobstein & Jackson-Leach, 2006; Jackson-Leach & Lobstein, 2006; Rijpstra, de Vries, Slinger, & L'Hoir, 2014). Indeed, children spend about 600 calories/day less than the children of 60 years ago (Boreham & Riddoch, 2001). In recent years, a great effort, of both local governments and the World Health Organisation (WHO), to sensitise people on the increment of physical activity across their

lifespan has been made. For instance, WHO suggests that children and adolescents should perform at least 60 minutes of moderate- to vigorous-intensity physical activities every day to have a good state of health (Hallal, Andersen, Bull, Guthold, Haskell, Ekelund, 2012; Hubbard, Economos, Bakun, Boulous, Chui, Mueller, Smith, Sacheck, 2016; WHO, 2010). This reduction of physical activity is due to a constant change of lifestyles, such as increasing the time spent on low-active video games and watching television (Datar & Nicosia, 2012; Dixon, Scully, Wakefield, White, & Crawford, 2007; Giontella,

Bonafini, Tagetti, Bresadola, Minuz, Gaudino et al., 2019; Rey-Lopez, Vicente-Rodriguez, Biosca, & Moreno, 2008). This may reduce physical fitness and, consequently, reduce the quality of life throughout the lifespan (Bize, Johnson, & Plotnikoff, 2007; Shoup, Gattshall, Dandamudi, & Estabrooks, 2008). This is of particular concern as physical fitness, defined as a set of abilities to perform physical activity and exercise without fatigue (such as aerobic capacity, endurance, strength, flexibility), is considered one of the most important health markers not only in adulthood but also in childhood and adolescence (Ortega, Ruiz, Castillo, & Sjörström, 2008). Physical fitness represents a set of abilities that an individual has to achieve in order to perform PA efficiently. A high physical fitness level in childhood is considered essential for the maintenance of good health and general well-being. According to evidence, increased physical fitness level is related to favourable body composition, improved skeletal health, protection against cardio-metabolic risk factors (e.g., hypertension and dyslipidemia), as well as improved mood, psychological health, academic performance and the quality of life (Ortega et al., 2008). Physical fitness is, in part, genetically determined, but environmental factors can significantly influence it, and regular physical activity is one of the main determinants (Ortega et al., 2008). For last issue, it is worth mentioning that obesity in infants, children and adolescents is rising in Europe (including Italy) and many children, who are not yet obese, are overweight and on the pathway to obesity. According to several investigations, it is very likely that people become obese or overweight in adulthood (Barba, Troiano, Russo, & Siani, 2006, Hruby et al., 2016; Guerra, Teixeira-Pinto, Ribeiro, Ascensão, Magalhães, Andersen et al., 2006). Thus, nowadays, the early prevention of obesity in childhood is one of the most critical public health priorities. As previously said, WHO physical activity suggestions (Matínez-Vizcaí & Sánchez-López, 2008), may contribute to increase the physical fitness and reduce the incidence of the issues mentioned above. Considering the importance of reaching high levels of physical fitness in childhood, as well as the correlation between performance and well-being, the present study aimed to investigate physical fitness and body composition on a sample of first-grade middle-school children in the Emilia-Romagna region (Italy) to compare whether their physical fitness was in line with the EUROFIT test (Adam, Klissouras, Ravazzolo, Renson, Tuxworth, Kemper et al, 1987).

Besides, we explored the relation between the performance in various physical fitness tests and anthropometric parameters (e.g., BMI). This specifically chosen sample may allow developing some acceptable practices for both primary, middle and secondary school teachers.

## MATERIALS AND METHODS

### Study design, participants and setting

We conducted a cross-sectional study to investigate the physical fitness of pre-adolescent children of the Emilia-Romagna region. The study was carried out between November 2017 and January 2018. The study was conducted according to the Declaration of Helsinki, and it was approved by the local bioethics committee, the school board and the municipality of the two cities involved in the project. The parents were asked for permission to use the children's personal data and they signed an informed consent form in order to participate in the study.

### EUROFIT battery test

The EUROFIT battery tests analysed several physical abilities such as strength, speed, endurance and flexibility. In particular, the tests included in the study were: the sit-up test, the standing broad jump test, the sit and reach test, the shuttle run test and the Cooper test.

1. In the "sit-up test", participants had to perform as many sit-ups as possible in 30 seconds. This test measures trunk strength;
2. In the "sit & reach", in a seated position with the knee completely extended and feet placed against a vertical support, the participants had to reach the toes and, if possible, to move past them. This test measures trunk flexibility and general flexibility;
3. In the "standing broad jump", the participants had to jump as far as they can from a standing position, and it measures the explosive leg power and lower limb muscle strength;
4. In the "shuttle run test", students had to perform a sprint of 10 meters for 5 times as fast as they can. This test measures running speed and agility;
5. In the "Cooper test", by contrast, they had to run for twelve minutes, trying to cover as much distance as possible. This test measures endurance abilities and cardio-respiratory fitness of the pre-adolescent.

### Procedure

Physical fitness tests were performed during the physical education lessons, and they were supervised by the researchers involved in the project. All children received the same instructions before undertaking the EUROFIT physical fitness tests. For each test, except for the Cooper test, we collected the values from three trials, and only the best one was recorded for the analysis. Anthropometric characteristics (height and weight) were collected according to standardised procedures (Weiner, Lourie, 1998).

Height was measured to the nearest 0.1 cm using a portable stadiometer (SECA 217, SECA: Hamburg, Germany). We measured the body weight to the nearest 0.1 kg (light indoor clothing, without shoes)

using a calibrated electronic scale (SECA 877: Hamburg, Germany). BMI was calculated as weight (in kilograms) divided by the square of height (metres). This index was used to assess each participant's weight status according to Cole's cut-off values considering sex and age differences, dividing the sample into underweight/normal weight and overweight/obese children (Cole & Lobstein, 2012; Cole, Flegal, Nicholls & Jackson, 2007).

#### Data analyses

Descriptive analyses, through the RStudio software (1.2.5042 - www.rstudio.com), were performed to understand the participants' general level of physical fitness. In particular, according to the age and gender, one-sample t-tests for each of the tested physical abilities were performed to match the participants' performance with sufficient value of the EUROFIT guidelines. In order to analyse the differences between overweight/obese and normal-weight students, for each physical fitness test, a linear regression analysis was run with the single-factor IOTF category (under/normal weight and overweight/obese, 2 levels). Moreover, we controlled the effect of gender, analysing the interaction of IOTF category x gender (2 levels). For multiple comparisons, when necessary, post-hoc analyses with a Bonferroni correction were performed.

## RESULTS

Five hundred and forty-nine (542) middle-school pre-adolescent children who attend the first grade were recruited (age range between 11 and 12 years old, mean age  $M = 11.46$ ,  $SD = 0.34$ ). In particular, 274 were female, and 268 were male. Children's descriptive characteristics, in total and by gender, are presented in Table 1. Stratifying the children by BMI categories, in the whole study sample, 69% of the children were under/normal weight, while the 31% were overweight/obese. The percentage of both normal-weight females and males was similar (70% VS 65%, respectively). In addition, Table 1 shows the number of participants for each physical fitness test.

#### Physical fitness tests

##### Sit-up test

One-sample t-test analysis revealed that 11-year-old female students were able to reach the sufficient EUROFIT value. In particular, students were able to perform  $M = 18.77$  ( $SE = 0.35$ ) sit-ups (19;  $t(145) = 0.65$ ,  $p = .52$ ). On the contrary, 12-year-old female students were not able to reach the discrete EUROFIT value ( $M = 17.73$ ,  $SE = 0.34$  sit-ups VS 20 sit-ups;  $t(121) = 6.57$ ,  $p < 0.001$ ). The results of 11-year-old males revealed that they were not able to reach their discrete EUROFIT value ( $M = 19.92$ ,  $SE = 0.43$  sit-ups VS 21 sit-ups;  $t(139) = 2.48$ ,  $p = 0.014$ ). On the contrary, twelve-year-old male

students were able to reach the discrete value ( $M = 20.33$ ,  $SE = 0.44$  sit-ups VS 21 sit-ups;  $t(121) = 1.51$ ,  $p < 0.001$ ).

Data analysis on the differences between under/normal weight and overweight/obese students revealed better performance for under/normal weight students than overweight/obese students ( $M = 19.96$ ,  $SE = 0.24$  sit-ups VS  $M = 17.64$ ,  $SE = 0.36$  sit-ups,  $F(1, 523) = 45.18$ ,  $\eta_p^2 = .08$ ,  $p < 0.001$ ).

Interaction of IOTF category x gender revealed a statistically significant difference ( $F(2, 520) = 13.54$ ,  $\eta_p^2 = .05$ ,  $p < .001$ ). Post-hoc analysis revealed that both under/normal weight females and males performed better than their overweight/obese counterparts (Females:  $t(523) = 3.51$ ,  $p = .003$ ;  $M = 18.92$ ,  $SE = 0.29$  sit-ups VS  $M = 16.78$ ,  $SE = 0.43$  sit-ups; Males:  $t(523) = 4.83$ ,  $p < 0.0001$ ,  $M = 21.11$ ,  $SE = 0.36$  sit-ups VS  $M = 18.31$ ,  $SE = 0.53$  sit-ups). Under/normal weight male students performed better than under/normal weight females ( $t(523) = 4.72$ ,  $p < 0.0001$ ,  $M = 21.11$ ,  $SE = 0.36$  sit-ups VS  $M = 18.92$ ,  $SE = 0.29$  sit-ups), while no differences emerged between overweight/obese females and males ( $t(523) = 4.72$ ,  $p < 0.001$ ,  $M = 16.78$ ,  $SE = 0.43$  sit-ups VS  $M = 18.32$ ,  $SE = 0.53$  sit-ups; see Table 2 for a summary of the results).

##### Standing broad jump test

The standing broad jump test revealed that both 11- and 12-year-old female children were not able to reach the sufficient value ( $t(144) = 3.72$ ,  $p = 0.0003$ ;  $M = 138.73$ ,  $SE = 1.96$  cm VS 146 cm;  $t(121) = 8.34$ ,  $p < 0.0001$ ;  $M = 134.96$ ,  $SE = 2.05$  cm VS 152 cm, respectively). Also, 11- and 12-year-old males were not able to reach the sufficient value ( $t(138) = 4.46$ ,  $p < 0.0001$ ,  $M = 144.29$ ,  $SE = 2.40$  cm VS 155 cm;  $t(125) = 7.67$ ,  $p < 0.0001$ ,  $M = 144.97$ ,  $SE = 2.35$  cm VS 163 cm, respectively).

Linear regression analysis on the single-factor IOTF category revealed better performance for under/normal weight students compared to overweight/obese ones ( $F(1, 520) = 43.39$ ,  $\eta_p^2 = .08$ ,  $p < 0.001$ ;  $M = 149.69$ ,  $SE = 1.34$  cm VS  $M = 130.48$ ,  $SE = 1.65$  cm). Interaction of IOTF category x gender revealed a statistically significant difference ( $F(2, 520) = 7.82$ ,  $\eta_p^2 = .03$ ,  $p < 0.001$ ). Post-hoc analysis revealed that both under/normal weight females and males performed better than their overweight counterparts (Females:  $t(520) = 4.75$ ,  $p < 0.0001$ ;  $M = 141.72$  cm,  $SE = 1.53$  cm VS  $M = 125.96$  cm,  $SE = 2.47$  cm; Males:  $t(520) = 5.13$ ,  $p < 0.0001$ ,  $M = 150.09$  cm,  $SE = 2.20$  cm VS  $M = 134.03$  cm,  $SE = 2.18$  cm). Under/normal weight male students performed better than under/



normal weight females ( $t(520) = 3.34, p = 0.0049, M = 150.09 \text{ cm}, SE = 2.20 \text{ cm}$  VS  $M = 141.72 \text{ cm}, SE = 1.53 \text{ cm}$ ), while no differences emerged between overweight/obese females and males ( $t(520) = 2.12, p = 0.13, M = 125.96 \text{ cm}, SE = 2.47 \text{ cm}$  VS  $M = 134.03, SE = 2.18 \text{ cm}$ ).

#### Sit and reach test

In the sit and reach test, 11-year-old female students had sufficient flexibility ( $t(149) = 1.24, p = .22; M = 5.03, SE = 0.78 \text{ cm}$  VS  $6 \text{ cm}$ ). On the contrary, twelve-year-old females were not able to reach the sufficient value ( $t(122) = 4.76, p < 0.0001; M = 2.61, SE = 0.92 \text{ cm}$  VS  $7 \text{ cm}$ ). For both 11- and 12-year-old male students, the results highlighted that they were not able to reach the sufficient value ( $t(141) = 2.12, p = 0.04, M = -3.47, SE = 0.92 \text{ cm}$  VS  $-2$ ;  $t(124) = 2.28, p = .024; M = -3.62, SE = 0.71 \text{ cm}$  VS  $-2 \text{ cm}$ , respectively).

Analysis of the difference between under/normal weight and overweight/obese students revealed significant differences ( $F(1, 528) = 6.98, \eta_p^2 = .01, p = 0.008$ ). Specifically, the sit and reach analysis revealed that under/normal weight students had better flexibility than their overweight/obese counterparts ( $M = 0.86, SE = 0.53 \text{ cm}$  VS  $M = -1.38 \text{ cm}, SE = 0.72 \text{ cm}$ ). Interaction of IOTF category x gender revealed a statistically significant difference ( $F(2, 528) = 46.31, \eta_p^2 = .15, p < 0.001$ ). Post-hoc analysis revealed that under/normal weight females performed better than overweight/obese females ( $t(528) = 2.66, p = .04; M = 4.78, SE = 0.70 \text{ cm}$  VS  $M = 1.50 \text{ cm}, SE = 1.15 \text{ cm}$ ). No differences were observed between overweight/obese and under/normal weight male students ( $t(528) = 0.064, p = 0.99, M = -3.67 \text{ cm}, SE = 0.63 \text{ cm}$  VS  $M = 3.67 \text{ cm}, SE = 0.80 \text{ cm}$ ). Both under/normal weight and overweight/obese female students performed better than normal and overweight/obese males (under/normal weight females VS under/normal weight males:  $t(528) = 8.90, p < 0.0001, M = 4.78 \text{ cm}, SE = 0.70 \text{ cm}$  VS  $M = -3.60 \text{ cm}, SE = 0.63 \text{ cm}$ ; overweight/obese females VS overweight/obese males:  $t(528) = 3.66, p = 0.002, M = 4.77 \text{ cm}, SE = 0.70 \text{ cm}$  VS  $M = -3.67 \text{ cm}, SE = 0.80 \text{ cm}$ ; see Table 2 for a summary of the results).

#### Shuttle run test

In the shuttle run test, both 11- and 12-year-old female students were slower than the sufficient value ( $t(141) = 9.63, p < 0.001; M = 22.96, SE = 0.19 \text{ sec}$  VS  $21.1$ ;  $t(117) = 12.57, p < 0.001, M = 23.17, SE = 0.19 \text{ sec}$  VS  $21$ , respectively). Similar results for 11- and 12-year-old male students were found, in which both groups were not able to reach the sufficient value ( $t(137) = 7.03, p < 0.001,$

$M = 21.95 \text{ sec}, SE = 0.17 \text{ sec}$  VS  $20.6 \text{ sec}$ ;  $t(125) = 8.13, p < 0.001, M = 21.93, SE = 0.21 \text{ sec}$  VS  $20.2 \text{ sec}$ ). Linear regression analysis on the differences between under/normal weight and overweight/obese students showed that under/normal weight students were faster than overweight/obese students ( $F(1, 513) = 24.24, \eta_p^2 = .05, p < 0.001; M = 22.19 \text{ sec}, SE = 0.12 \text{ sec}$  VS  $M = 23.25 \text{ sec}, SE = 0.18 \text{ sec}$ ). Interaction of IOTF category x gender revealed a statistically significant difference ( $F(2, 513) = 19.82, \eta_p^2 = .07, p < 0.001$ ). Post-hoc analysis revealed that both under/normal weight females and males performed better than overweight/obese students (Females:  $t(513) = 3.71, p = 0.0013; M = 22.77 \text{ sec}, SE = 0.15 \text{ sec}$  VS  $M = 23.92 \text{ sec}, SE = 0.27 \text{ sec}$ ; Males:  $t(513) = 4.23, p = 0.0002, M = 21.55 \text{ sec}, SE = 0.17 \text{ sec}$  VS  $M = 22.75 \text{ sec}, SE = 0.24 \text{ sec}$ ). Under/normal weight male students performed better than under/normal weight females ( $t(513) = 5.37, p < 0.0001, M = 21.55 \text{ sec}, SE = 0.24 \text{ sec}$  VS  $M = 22.77 \text{ sec}, SE = 0.15 \text{ sec}$ ), while overweight/obese males performed better than overweight/obese females ( $t(513) = 3.29, p = 0.006, M = 22.75 \text{ sec}, SE = 0.24 \text{ sec}$  VS  $M = 23.92 \text{ sec}, SE = 0.27 \text{ sec}$ ; see Table 2 for a summary of the results).

#### Cooper test

One-sample t-test analysis on the Cooper test revealed that both 11- and 12-year-old females were not able to reach the sufficient value ( $t(145) = 10.23, p < 0.0001, M = 1481.53, SE = 25.36 \text{ m}$  VS  $1750 \text{ m}$ ;  $t(115) = 11.07, p < 0.001, M = 1514.05, SE = 38.78 \text{ m}$  VS  $1780 \text{ m}$ , respectively), and that both 11- and 12-year-old males were not able to reach the sufficient value ( $t(138) = 8.12, p < 0.001, M = 1691.90, SE = 31.78 \text{ m}$  VS  $1950$ ;  $t(121) = 6.29, p < 0.001, M = 1716.25, SE = 38.78 \text{ m}$  VS  $1960 \text{ m}$ ). Linear regression analysis on the Cooper test revealed that under/normal weight participants were able to perform the test better than overweight/obese students ( $F(1, 511) = 47.64, \eta_p^2 = .09, p < 0.001; M = 1666.83, SE = 16.62 \text{ m}$  VS  $M = 1447.17 \text{ m}, SE = 23.97 \text{ m}$ ).

Interaction of IOTF category x gender revealed a statistically significant difference ( $F(2, 511) = 32.55, \eta_p^2 = .10, p < 0.001$ ). Post-hoc analysis revealed that both under/normal weight females and males had higher performance than their overweight/obese counterparts (Females:  $t(511) = 3.46, p = 0.003; M = 1539.76 \text{ m}, SE = 21.48 \text{ m}$  VS  $M = 1376.30 \text{ m}, SE = 21.48 \text{ m}$ ; Males:  $t(513) = 7.053, p < .0001, M = 1810.50 \text{ m}, SE = 30.47 \text{ m}$  VS  $M = 1501.75, SE = 34.21 \text{ m}$ ). Under/normal weight male students performed better than under/normal weight females ( $t(513) = 7.73, p < 0.0001, M = 1820.50, SE = 30.46 \text{ m}$  VS  $M = 1501.75 \text{ m}, SE = 34.21 \text{ m}$ ), while no differences emerged between overweight/obese male and overweight/obese female students ( $t(513) = 2.34, p = .09, M = 1810.50 \text{ m}, SE = 30.46 \text{ m}$  VS  $M = 1501.75, SE = 34.21 \text{ m}$ ; see Table 2 for a summary of the results).

## DISCUSSION

In the present study, on a sample of 11-12-year-old children in the Emilia-Romagna region, we measured physical fitness performance tests from the EURFOFIT battery and anthropometric measures (e.g., BMI) with the aim to evaluate the children's levels of physical fitness and the relation with body composition. We focused our attention on middle-school children who attend the first grade because this is the transition between primary school and middle school, and thus, it is crucial for two reasons: the first one allows understanding whether the children have been able to develop motor skills during the primary school and the second reason may allow understanding how the body composition affected the physical fitness. Our findings revealed that children have very low physical fitness compared to EUROFIT references. Moreover, our results suggested a negative relationship between physical fitness and body composition. Expressly, the results indicated that, except for the sit-up test where 12-year-old males and 11-year-old females were able to reach the sufficient value, in the other tests, students were not able to get the sufficient value. Concerning the difference between under/normal weight and overweight/obese students, our results highlighted a worse performance for overweight/obese students compared to under/normal weight students in all tests involved in the study. These differences were also found when the analysis has been categorised by gender.

Specifically, both under/normal weight females and males had better physical fitness than their overweight/obese counterparts. A single note is given by the sit and reach test where both overweight/obese and under/normal weight females had a higher performance than overweight/obese and under/normal weight males. Moreover, the performance of overweight/obese and under/normal weight males resulted in no significant differences. These results are in line with previous research: females, in general, are more flexible than males, and this is not related to the body composition (De Miguel-Etayo, Gracia-Marco, Ortega, 2014). Overall, our results suggest that physical fitness of this Emilia-Romagna sample is generally low, and this is regrettable in this age range because, in order to have adequate physical fitness, children should exceed the sufficient value of EUROFIT references.

This is a common problem around the world (Konstabel, Veidebaum, Moreno, Bammann, Tornarutum et al., 2014; Wedderkopp, Froberg, Hanse, & Andersen, 2004). If we consider the Italian situation, only the 9.5% of children meet the WHO guidelines, and the number of overweight/obese children is increasing. Even if we did not control the physical activity level, it is feasible to conclude that low physical fitness is the result of children not spending enough time to practice physical activity. Moreover, it is possible to assume that the little time spent on physical activities during school, leisure

and sport time could be at low intensity. Indeed, according to Ortega and colleagues (2008), it is important to emphasise the intensity of physical activity because it is related to the enhancement of physical fitness (Martínez-Vizcaíno, V., & Sánchez-López, 2008).

Concerning the results on the differences between normal and overweight/obese students, it is important to notice that, in the conducted tests, the excess of weight is disadvantageous and it also correlates to numerous health diseases. Beauchamp, Rhodes and Nigg (2017) suggested a rethink of the physical education at all school levels should be made to avoid some health-related issues in adulthood. The time dedicated to physical education lessons should be increased and other activities, such as the active breaks and healthy homework, should be proposed (Brown et al., 2019; Masini, Marini, Leoni, Lorusso, Toselli, Tessari et al., 2020; Duncan et al., 2019). Furthermore, another point to be considered is the role of physical activity and physical fitness in cognitive functions and psychosocial features. In particular, several investigations have suggested that some cognitive functions could be developed through physical activity alongside an increment of academic achievement (Biddle & Asare, 2011; Donnelly & Lambourne, 2011; Russo, Nigro, Raiola, & Ceciliani, 2019; Russo, Castagnoli, Babini, & Ceciliani, 2020; Sibley & Etnier, 2003). Thus, politics and local and central governments should rethink the school organisation and the role of physical activity and physical education during the school time. Moreover, to reassure parents and teachers, the increment of the physical activity time does not seem related to the detriment of academic performance (Trudeau & Shepard, 2008).

## CONCLUSION

This cross-sectional evaluation on Emilia-Romagna middle-school children confirms that the physical fitness status is quite insufficient. According to teachers, it would be necessary to increase the physical activity and physical education with a new sustainable and feasible approach. We suggest developing political plans that should increase the level of physical activity and physical fitness.

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**Table 1:** Baseline characteristics of the sample

Characteristics	Total sample (n = 542)	Male (n = 268)	Female (n = 274)
	N or mean and SD	N or mean and SD	N or mean and SD
Age	11.46, 0.34	11.48, 0.35	11.43, 0.34
Under/normal weight	375	176	199
Overweight/obese	167	92	75
<b>EUROFIT battery tests</b>	<b>Number of participants</b>	<b>Male</b>	<b>Female</b>
Sit-up test	527	262	265
Under/normal weight	366	173	193
Overweight/obese	161	89	72
Standing long jump test	524	261	263
Under/normal weight	365	173	192
Overweight/obese	159	88	71
Sit and reach test	532	263	269
Under/normal weight	368	172	196
Overweight/obese	164	91	73
Shuttle run test	517	260	257
Under/normal weight	364	173	191
Overweight/obese	153	87	66
Cooper test	515	258	257
Under/normal weight	361	171	190
Overweight/obese	154	87	67

**Table 2:** Physical fitness test results comparing under/normal weight and overweight/obese participants, rotation = 90

Physical	Under/normal	Overweight/	p	Under/	Overweight/	p	Under/normal	Overweight/	p
fitness tests	weight (M, SE)	obese (M, SE)		normal Weight - females (M, SE)	obese females (M, SE)		Weight - males (M, SE)	obese males (M, SE)	
	(M, SE)			(M, SE)			(M, SE)		
Sit-up	19.96, 0.24 sit-ups	17.64, 0.36 sit-ups	< 0.001	18.92, 0.29 sit-ups	16.78, 0.43 sit-ups	= .003	21.11, 0.36 sit-ups	18.31, 0.53 sit-ups	< .0001
Standing broad jump	149.69, 1.34 cm	130.48, 1.65 cm	< .001	141.72, 1.53 cm	130.48, 1.65 cm	< .0001	150.09, 2.20 cm	134.03, 2.18 cm	< .0001
Sit and reach	0.86, 0.53 cm	-1.38, 0.72 cm	= .008	4.78, 0.70 cm	1.50, 1.15 cm	= 0.04	3.67, 0.80 cm	-3.67, 0.63 cm	= .99
Shuttle run	22.19, 0.12 sec	23.25, 0.18 sec	< .001	22.77, 0.15 sec	23.92, 0.27 sec	= .0013	21.55, 0.17 sec	22.75, .24 sec	= .0002
Cooper	1666.83, 16.62 m	1447.17, 23.97 m	< .001	1539.76, 21.48 m	1376.30, 21.48 m	= .003	1810.50, 30.47 m	1501.75, 34.21 m	< .0001

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## **FIZIČKA SPREMNOST I TJELESNA TEŽINA KOD DJECE PREDADOLESCENTSKOG UZRASTA: EUROFIT TESTOVI MOTORIČKIH SPOSOBNOSTI POSMATRANI KOD DJECE U DOBI OD 11 DO 12 GODINA**

Rana prevencija pretilosti tokom djetinjstva u današnje vrijeme predstavlja najvažnije pitanje javnog zdravlja. Više od polovine djece i adolescenata širom svijeta ne zadovoljavaju preporuku bavljenja umjerenom do intenzivnom fizičkom aktivnošću u trajanju od 60 minuta dnevno. Ovaj trend može smanjiti nivo fizičke spremnosti i time prouzrokovati smanjenje kvalitete života tokom životnog vijeka. Definisana kao niz sposobnosti za izvođenje fizičke aktivnosti i vježbe (poput aerobnog kapaciteta, izdržljivosti, snage, fleksibilnosti), fizička spremnost se smatra jednim od najvažnijih obilježja zdravlja tokom odrasle dobi, djetinjstva i adolescencije. Metode: Proveli smo transverzalnu studiju kako bi ispitali fizičku spremnost djece predadolescentnog uzrasta iz regije Emilia-Romagna. Antropometrijski parametri (visina i težina) te nivoi fizičke spremnosti djece su mjereni putem EUROFIT baterije testova. Kod svih primijenjenih EUROFIT testova, učinak djece je imao vrijednosti ispod dovoljnog nivoa kada je u pitanju dob i spol. Nadalje, bio je negativno povezan se pretilošću. Naše istraživanje je dalo dokaz da je opći nivo spremnosti našeg uzorka bio nizak te da je učinak pretilo/gojazne djece bio niži u poređenju sa djecom koja su imala ispodprosječnu i normalnu težinu.

**Ključne riječi:** fizička aktivnost, indeks tjelesne mase, pretilost, predadolescenti, fizičko obrazovanje

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# A STUDY OF MORPHOMETRIC CHARACTERISTICS OF THE STUDENT POPULATION: A GOLDEN RATIO PERSPECTIVE

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## ABSTRACT

The structure and function of the human body are based on the mathematical law of the golden ratio which expresses the ratio of the whole and its parts which are in the proportion of "golden numbers" 1.618; 0.618; 0.382 or form a Fibonacci sequence of numbers. During life, a human adapts to external conditions, interacts with the environment and adapts to it, resulting in a change in the mutual relations of body parts. The organism responds to changes in various environmental factors with an adequate reaction. The limits of oscillation pertaining to the organism's reaction to environmental factors are called the "genetic norm of the reaction" (Schmalhausen). However, in healthy people, this oscillation does not exceed 5% (exceptionally, in extreme conditions, it goes up to 10%), which is, for medicine, quite acceptable. This study was conducted on the population of students (N = 100), aged 19-21 years, from Bosnia and Herzegovina and the neighbouring countries (Serbia, Croatia, Kosovo and Montenegro). The results indicate that the interaction of bodies (which, for the most part, had similar external environmental conditions) with the environment leads to oscillations of ratios and their deviation from the golden ratio, but within the expected, medically acceptable, limits of 5%.

**Keywords:** human body, golden ratio, number  $\Phi$ , symmetry, harmony

## INTRODUCTION

In recent decades, the golden ratio and the number of PHI have made a major breakthrough in all areas of science, technology and art (Stakhov, 2012; Livio, 2003; Livio, 2008; Huntley, 2015; Radzjukevich, 2014; Omotehinwa, 2013). The golden ratio (divine proportion) is the ratio of two parts of a longer straight line divided in the manner in which the ratio of the larger part to the smaller part is equal to the ratio of the whole length to the larger part (Fig. 1).



Figure 1 - Definition of the golden ratio in geometry

$$\frac{l}{s} = \frac{(l+s)}{l} \Rightarrow l^2 = ls + s^2 \Rightarrow l^2 - ls - s^2 = 0$$

$$l_{1/2} = \frac{s \pm \sqrt{s^2 + 4s^2}}{2} = \frac{s(1 \pm \sqrt{5})}{2} \Rightarrow \frac{l}{s} = \frac{(1 \pm \sqrt{5})}{2}$$

Taking only the positive root as a solution that has a physical meaning, the required ratio of the larger and smaller part of the straight line is:

$$\frac{(1+\sqrt{5})}{2} = \Phi = 1,618033...; \quad \frac{1}{\Phi} = \varphi = 0,618033...$$

The number  $\Phi$  is embedded in the Fibonacci sequence of numbers (Stakhov, 2012; Dunlap, 1997), a sequence of intrinsic importance for

mathematics, engineering, medicine, biology and other areas of human knowledge, which is formed so that the sequence of numbers must meet the following two conditions:

1. each member of the sequence is equal to the sum of the two previous members ("third member rule")

$$a_{n+2} = a_{n+1} + a_n$$

2. each member of the sequence divided by its predecessor has the number  $\Phi$  as the result (except for the first few, Fig. 2)

$$\lim_{n \rightarrow \infty} \frac{F_{n+1}}{F_n} = \Phi$$



Figure 2 - Initial oscillation of the Fibonacci sequence

The Fibonacci sequence is created by assigning values from a set of numbers  $F = \{1, 2, 3, 5, 8, 13, 21, 34, \dots\}$  to a set of natural numbers  $N = \{1, 2, 3, 4, 5, \dots\}$ . If we indicate the members of this sequence of numbers with  $a_1 = 1, a_2 = 1, a_3 = 2, a_4 = 3, a_5 = 5, a_6 = 8, \dots$ , we have associated the natural numbers with the values of the Fibonacci sequence of numbers (Table 1).

Table 1: Formation of a Fibonacci sequence of numbers

N	1	2	3	4	5	6	7	8	9	...
	↓	↓	↓	↓	↓	↓	↓	↓	↓	
F	1	1	2	3	5	8	13	21	34	...
	$a_1 = 1$	$a_2 = 1$	$a_3 = 2$	$a_4 = 3$	$a_5 = 5$	$a_6 = 8$	$a_7 = 13$	$a_8 = 21$	$a_9 = 34$	...

The number  $\Phi$  and the golden ratio are deeply rooted in the human body, its structure and function and, in fact, represent a fundamental natural constant. Aleksey Stakhov says that the golden section "was raised in ancient Greece to the level of aesthetic canon and main constant of the universe" (Stakhov, 2012). Its fundamentality is reflected in the structure of the living world (man, animals and plants). It represents a systematic characteristic of living systems in nature, as a general principle of optimisation and symmetry, and determines the states of systems and the formation of patterns according to which these systems behave. Stewart says, "By using mathematics to organize and systematize our ideas about patterns, we have discovered a great secret: nature's patterns are not just there to be admired, they are vital clues to the rules that govern natural processes" (Kata, 2012).

Therefore, it is extremely important in experimental research to consider the appearance of the number  $\Phi$  in the relationships between the organs of our body and in the physical quantities that characterise the functions of our body. In 1854, Zeising, based on an analysis of the human body conducted on classical paintings and sculptures, concluded that the golden ratio is present in nature

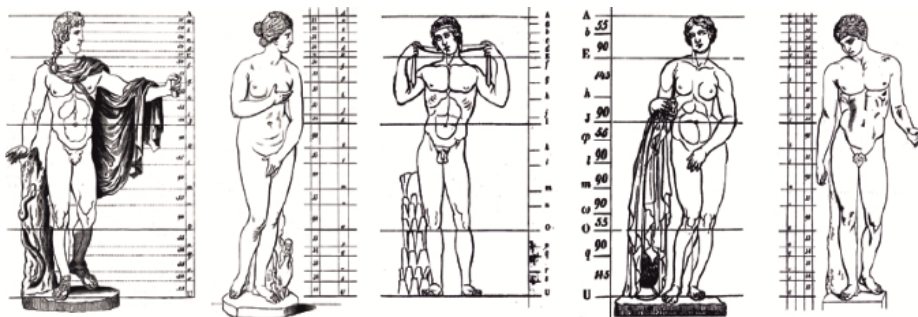
as a fundamental law of harmony. He advocated the thesis of the universal law of harmony and beauty in the Cosmos, which gained all its full meaning in the human body. He published a theory of the proportionality of the human body based on the number  $\Phi$ .

The human body is divided into 4 main areas:

1. from the scalp to the shoulders,
2. from the shoulder to the navel,
3. from the navel to the knee,
4. from the knee to the foot.

Furthermore, each of these areas is divided into 5 segments in the relationships which contains the number  $\Phi$ . In his considerations Zeising takes the navel as a point of reference and measures the body parts in relation to that point. The numbers represented in the measures of the human body are members of the Fibonacci sequence of numbers.

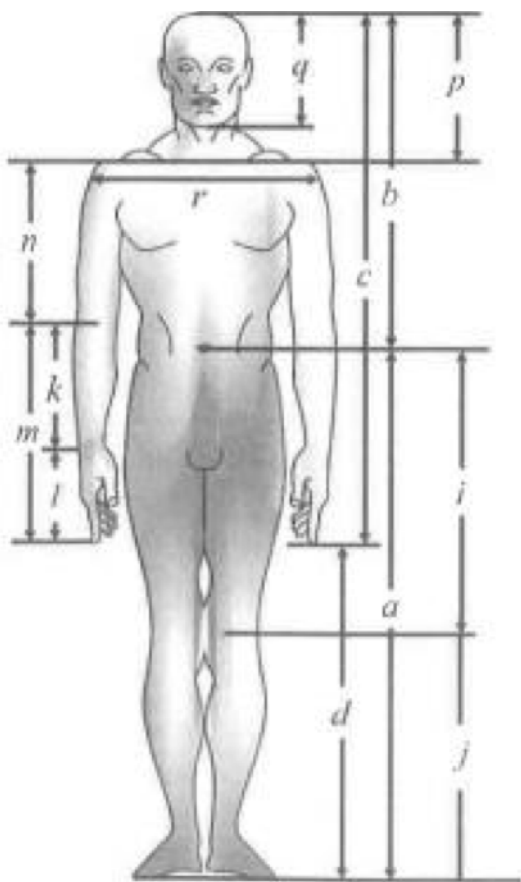
Later, other measurements of the human body proportions were performed, confirming the results obtained by Zeising (Devis, 1979; Altevorg 2020).



**Figure 3** - Zeising's considerations of morphometric characteristics of the human body (taken from Radjukevich, 2014)

## AIM

To show, by direct measurement of some body parts' lengths and the distances between individual points on the body of the subjects (100 students) as per Hajduković, that the human body is based on the mathematical law of the golden ratio and that the body's interaction with the environment can change the dimensions of body parts and their ratios from the golden ratio, but that these deviations are also within the acceptable limits of 5%.



**Figure 4** - Body distances measured in subjects (drawing: Anando Adžemi, ALAMA, Prizren)

## METHODS

In our study, we used a methodology that has its roots in Zeising theory: by measuring precisely defined parts of the human body and determining the interrelationships of the obtained values, we showed that the human body is built so that one of the main constants of its structure is the number  $\Phi$ . Using this methodology, in order to show the harmonious structure of the human body, with a clearly defined pattern, which is manifested through a fundamental constant, we measured the height of the body ( $H$ ), the distance from the navel to the sole ( $h$ ), arm length ( $m + n$ ), forearm length ( $k + l$ ), the distance from the elbow to the wrist ( $k$ ), the distance of the navel from the sole ( $a$ ), the distance of the scalp from the navel ( $b$ ), the distance of the scalp from the tip of the middle finger of the hand down the body ( $c$ ), the distance of the sole from the tip of the middle finger of the hand lowered down the body ( $d$ ), the length of the part of the hand from the elbow to the beginning of the hand ( $k$ ), the length of the hand ( $l$ ), the distance of the tip of the middle finger of the hand extended down the body from the elbow ( $m$ ), elbow ( $n$ ), the distance of the scalp from the midline of the shoulder ( $p$ ), the length of the head ( $q$ ), the width of the shoulder ( $r$ ) (Fig. 4). Each measurement was performed three times and the mean value was taken and entered into the table (Table 2). After that, the appropriate ratios of the measured dimension were determined:

$$\frac{H}{h}, \frac{m+n}{k+l}, \frac{k+l}{k}, \frac{a}{b}, \frac{c}{d}, \frac{m}{n}, \frac{k}{l}, \frac{b}{r}, \frac{r}{q}, \frac{m}{q}$$

We further determined the mean values of the obtained ratios as well as the mean values of the body proportions of each subject. In this manner, we can observe the deviation of the ratio pertaining to the measured body parts of each individual from the golden ratio, as well as the comparison of the obtained ratios in individual subjects.

## RESULTS

The study was conducted on 100 students of the Medical Faculty in Sarajevo and the measurements were mainly performed in the Laboratory for Medical Physics and Biophysics. The respondents were from Bosnia and Herzegovina and the surrounding countries (Serbia, Croatia, Kosovo and Montenegro), aged 19-21 years.

By measuring the height of the body (H) and the distance from the navel to the sole (h), we obtained the following results (Table 1):

- H/h ratio ranges from 1.59 to 1.73, with a maximum deviation of 6.8% from the golden ratio and the number  $\Phi$ .

- The mean value of the H/h ratio is 1.63, which is a deviation of only 0.6% from the golden ratio. In further measurements, we observed and measured the ratios of the arm and forearm length  $\frac{m+n}{m}$  and the ratio of the forearm length and the distance from the elbow to the wrist  $\frac{k+l}{k}$ . Let us discuss the results of the measurements, shown in Table 2.

- The ratio  $\frac{m+n}{m}$  ranges from 1.60 to 1.69, with a mean value of 1.61. The obtained value is extremely close to the number  $\Phi$ , with a deviation of only 0.6%.

- The ratio  $\frac{k+l}{k}$  values range from 1.58 to 1.75, with a mean value of 1.64, which is a deviation of 1.2% from the number  $\Phi$ . Table 3 shows the measurement results and the calculated proportions of the corresponding body parts. The values of the ratio  $\frac{a}{b}$  (Fig. 4) in individual subjects range from 1.38 to 1.60, with a mean value of 1.54. The ratio  $\frac{c}{d}$  has the range of values from 1.38 and 1.79, with a mean value of 1.63.

**Table 1:** The results of measuring the height H and the distance from the navel to the sole h, and the H/h ratio

Subjects	H (cm)	h (cm)	$\frac{H}{h}$
1.	146.2	86.5	1.69
2.	172.0	106.5	1.62
3.	170.0	105.0	1.62
4.	189.5	109.5	1.73
5.	181.0	112.0	1.62
6.	180.0	106.0	1.70
7.	181.5	107.5	1.69
8.	167.0	102.0	1.64
9.	179.0	111.0	1.61
10.	176.0	108.0	1.63

...	...	...	...
91.	169.0	106.0	1.59
92.	173.0	105.0	1.65
93.	178.0	110.0	1.62
94.	175.0	106.5	1.64
95.	161.5	100.5	1.61
96.	160.0	98.5	1.62
97.	197.0	120.0	1.64
98.	185.0	115.5	1.60
99.	188.5	116.0	1.63
100.	184.0	114.5	1.61
Mean value			1.63

The ratio  $\frac{k}{l}$  values are in the range of 1.21 and 1.68, and the mean value is 1.46.

The ratio  $\frac{b}{r}$  limits are 1.42 and 1.90, with a mean value of 1.64.

The ratio  $\frac{r}{q}$  ranges from 1.60 to 2.18, with a mean value of 1.88.

The ratio limits  $\frac{m}{q}$  are 1.83 and 2.50, and its mean value is 2.01.

**Table 2:** Results of measuring the length of the arm L, forearm l and the distance from the elbow to the wrist  $l_r$ , and presentation of the  $L/l$  and  $l/l_r$  ratios.

Subjects	$m+n$ (cm)	$k+l$ (cm)	k (cm)	$\frac{m+n}{m}$	$\frac{k+l}{k}$
1.	59.0	36.4	20.9	1.62	1.74
2.	68.0	42.5	25.5	1.60	1.67
3.	74.7	46.7	27.8	1.60	1.68
4.	70.5	43.8	26.5	1.61	1.65
5.	75.0	46.8	28.5	1.60	1.64
6.	66.5	41.4	25.0	1.61	1.66
7.	77.0	47.5	29.0	1.62	1.64
8.	71.5	44.4	27.0	1.61	1.64
9.	74.9	46.5	28.5	1.61	1.63
10.	78.0	48.5	30.0	1.61	1.62
...	...	...	...	...	...
91	63.5	38.5	22.0	1.69	1.75
92	77.5	47.0	30.0	1.65	1.57
93.	75.5	46.5	29.0	1.62	1.60
94.	69.0	42.5	26.0	1.62	1.63
95.	74.0	46.0	27.5	1.61	1.67
96.	61	37.5	21.5	1.63	1.74
97.	78.5	48.5	30.5	1.62	1.59
98.	79.5	49.0	31.0	1.62	1.58
99.	67.0	41.0	26.0	1.63	1.58
100.	77.0	47.0	29.5	1.64	1.59
Mean values				1.61	1.64

**Table 3:** Presentation of the corresponding proportions of body parts

Subjects	a/b	c/d	m/n	k/l	b/r	r/q	m/q	Mean value
1.	1.54	1.44	1.41	1.35	1.62	1.75	1.86	1.54
2.	1.54	1.66	1.40	1.53	1.77	1.61	1.83	1.55
3.	1.60	1.50	1.32	1.44	1.81	1.65	1.87	1.56
4.	1.49	1.73	1.43	1.24	1.77	2.00	2.50	1.65
5.	1.54	1.42	1.66	1.30	1.42	2.00	1.80	1.54
6.	1.49	1.72	1.40	1.21	1.77	1.90	2.30	1.61
7.	1.53	1.65	1.38	1.41	1.75	1.85	2.05	1.60
8.	1.60	1.59	1.44	1.37	1.58	2.00	2.05	1.60
9.	1.50	1.61	1.37	1.28	1.73	1.90	2.28	1.60
10.	1.52	1.79	1.35	1.52	1.51	2.13	2.26	1.67
...	...	...	...	...	...	...	...	...
91.	1.41	1.56	1.34	1.53	1.9	1.65	1.95	1.56
92.	1.38	1.51	1.47	1.68	1.71	1.90	2.01	1.65
93.	1.49	1.72	1.42	1.23	1.77	1.82	2.27	1.60
94.	1.46	1.68	1.28	1.56	1.72	1.90	1.95	1.58
95.	1.53	1.46	1.40	1.52	1.76	1.60	1.83	1.55
96.	1.59	1.50	1.32	1.44	1.76	1.65	1.87	1.54
97.	1.54	1.44	1.36	1.25	1.61	1.75	1.87	1.52
98.	1.45	1.38	1.37	1.58	1.58	2.18	2.09	1.59
99.	1.52	1.75	1.39	1.65	1.53	2.11	2.17	1.67
100.	1.55	1.73	1.38	1.52	1.61	1.95	2.12	1.63
Mean value	1.54	1.63	1.41	1.46	1.64	1.88	2.01	1.61

## DISCUSSION

The study results show that the calculated proportions of the respondents' body parts have very small deviation from the number  $\Phi$  or we can conclude that they are within the golden ratio.

The ratio of body height and distance between the navel and the sole  $\frac{H}{h}$  ranges from 1.59 and 1.73, with a mean value of 1.63. The deviation of the mean value of  $\Phi = 1.62$  is only 0.6%, which absolutely proves the assumption that H and h are within the golden ratio. The ratios of arm and forearm length are in the range of 1.60 and 1.69, and

the mean value is 1.61. Here, too, the deviation from the golden ratio is 0.6%. The ratio of the distance between the navel-sole *a* and the navel-scalp *b* is in the interval of 1.38 and 1.60, with a mean value of 1.54.

The deviation from the golden ratio is 4.9%. The ratio of the distance of the scalp from the tip of the middle finger of the hand lowered down the body (*c*) and the distance of the sole-tip of the middle finger of the hand lowered down the body (*d*) is in the range of 1.38 and 1.79, and the mean value is 1.63. So, the deviation from the ideal proportions is 0.6%.



Analysing all other calculated ratios  $\frac{m}{n}, \frac{k}{l}, \frac{b}{r}, \frac{r}{q}, \frac{m}{q}$  (Table 3), we notice that they oscillate around the ideal value of 1.62. The largest deviations (13%) occur in the ratio of arm and forearm length  $\frac{m+n}{m}$  and the ratio of forearm length and head height  $\frac{m}{q}$ . The reason lies in the fact that external forces acting on the arm, which are different in individual respondents (depending on their activity), affect this ratio.

The mean values of individual ratios for all 100 subjects are 1.59 (deviation from the golden ratio is 1.9%), and the mean values of all ratios calculated for each subject range from 1.52 to 1.67, with a mean value of 1.61 (deviation from the golden ratio is 0.6%). The obtained results agree, within the limits of acceptable deviations, with the results of other authors (Davis, 1979; Persaud-Sharma, 2015; Narasimha-Shenoi, 2012). In the literature, it can be found that the magnitudes of the distance of the navel from the knee and the distance of the sole from the knee

are in the golden ratio. Our research has led to results that do not confirm these claims: the obtained relations ( $\frac{i}{j}$ ) ranged from 1.07 to 1.38, with a mean value of 1.20. Due to the large deviation of the mean value of this ratio from the number  $\Phi$  (26%), as well as the fact that in no case did we obtain a value close to the number  $\Phi$  (for example: that the deviation is up to 5%), we conclude that the ratio of navel to knee ( $i$ ) and sole to knee ( $j$ ) are not in the golden ratio.

## CONCLUSION

The structure of the human body (student population of the Western Balkans) is based on the mathematical law of the golden ratio: the proportions of individual parts of the body tend to the number  $\Phi$ . Due to the action of external factors, the interaction of the organism with the environment, there may be deviations of these ratios from the number  $\Phi$ , but these deviations are generally in the range of 5%.

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**ISTRAŽIVANJE MORFOMETRIJSKIH KARAKTERISTIKA STUDENTSKE POPULACIJE: PRISTUP KROZ ZLATNI REZ**

Struktura i funkcija ljudskog tijela utemeljene su na matematičkom zakonu zlatnog reza koji iskazuje omjer cjeline i njenih dijelova koji su u proporciji "zlatnih brojeva" 1,618; 0,618; 0,382 ili koji tvore Fibonacciev niz brojeva. Čovjek se tokom života prilagođava vanjskim uvjetima, interaguje sa okolinom i prilagođava se okolini usljed čega dolazi i do promjene u međusobnim odnosima dijelova tijela. Na promjene različitih faktora vanjske sredine organizam odgovara adekvatnom reakcijom. Granice osciliranja reakcije organizma na faktore vanjske sredine nazivamo "genetička norma reakcije" (Schmalhausen). Međutim, kod zdravih ljudi to osciliranje ne prelazi 5% (izuzetno, pri ekstremnim uvjetima okoliša do 10%), što je, za medicinu, sasvim prihvatljivo. Istraživanja su provedena na studentskoj populaciji starosti 19-21 godine iz Bosne i Hercegovine i zemalja okruženja (Srbija, Hrvatska, Kosovo i Crna Gora). Rezultati su pokazali da interakcija tijela (koja su, uglavnom, imala slične uvjete vanjskog okruženja) sa okolinom dovodi do osciliranja omjera i njihovog odstupanja od zlatnog reza, ali u očekivanim, za medicinu prihvatljivim, granicama od 5%.

**Ključne riječi:** ljudsko tijelo, zlatni rez, broj  $\Phi$ , simetrija, harmonija

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# THE INFLUENCE OF THE MASTERY APPROACH TO COACHING ON COACHES' VERBAL FEEDBACK PATTERNS

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## ABSTRACT

The aim of the study was to evaluate the influence of the Mastery Approach to Coaching on changes in coaches' verbal feedback patterns. The research was applied on 10 coaches of team sports. Experimental data on the level of coaches' verbal feedback were gained using audio-visual recording that preceded the description and coding of verbal statements. Verbal feedback frequencies and interaction patterns were computed by DAT software. Coaches of experimental and control groups most frequently applied instruction, praise, and encouragement in verbal feedback and, less frequently, punishment and criticism. After the intervention period, coaches of the experimental group increased the frequency of instruction, praise and encouragement and decreased the frequency of punishment, compared to input values. Coaches of the experimental group to whom MAC intervention programme was applied, significantly increased the frequency of positive feedback patterns ( $p = 0.043$ ) and significantly decreased the frequency of negative feedback patterns ( $p = 0.043$ ). Moreover, considering output measures, coaches of the experimental group showed a higher frequency of positive verbal feedback and significantly ( $p = 0.009$ ) lower frequency of negative verbal feedback, compared to coaches of the control group.

**Keywords:** MAC, positive feedback patterns, negative feedback patterns, DAT

## INTRODUCTION

Verbal feedback is one of the most vital functions in coaches' communication discourse (Rink, 2002). Moreover, if it is applied appropriately, the level of new skills acquisition significantly increases (Schmidt & Lee, 2005). Coaches apply feedback as a tool for correcting mistakes, encouragement after good performance and as players' motivation for endurance and improving in overcoming obstacles and difficulties (Coker et al., 2006; Smith & Smoll, 2006). Research studies of Rink (2002), Holst and Anderson (1992), Margill (2001) and Graham (1992) agree on various feedback classifications from evaluative and corrective feedback, through general and specific, up to positive and negative feedback.

Smith and Smoll (2009) recommend applying the "sandwich" method of feedback application consisting of: a) compliment, b) future-oriented performance instruction, c) encouragement. This feedback method, two positive utterances with instruction, helps coaches to positively motivate players for better performance. On the other hand, coaches try not to use negative motivation to failure and disapproval. Torregrosa et al. (2008) point to the significance of a relationship between the manner in which players perceive coach behaviour as well as coach feedback and the motivational climate created by the coach. Coaches' communication styles have the most significant influence on the development of appropriate motivational climate. Smith et al. (1995) and Newton et al. (2000) define two basic dimensions of motivational climate: ego and mastery. Mastery climate relates to the environment where coaches communicate emphasis on maximal effort, mutual support and

cooperation as well as the importance of the players' role in a team. Treasure and Roberts (1998), White et al. (2004), as well as Carpenter and Morgan (1999) agree that coaches' orientation on performance and effort and, simultaneously, their compatible perception of mastery climate in a team relates to adaptive motivational responses, i.e., increase of players' effort, endurance and determination. On the other hand, an ego-oriented coach creates motivational climate that focuses on the results. The main problem of this approach resulted in maladaptive reactions of players like the lower level of effort, lack of endurance and a low level of players' encouragement. If coaches want to deeply understand the issue of positive and negative motivational climate creation, especially in youth sport, they should learn to recognise various kinds and aims of feedback in their communication style. Furthermore, it is also important to have conformity between the players' perception and preference of various feedback patterns (Stein et al., 2012). Educational programmes should be help assistants for coaches in the process of their personal development. Moreover, these programmes help coaches to recognise players' preferences in the issue of positive and negative feedback and connect those preferences with the individual style of feedback verbalisation as well as demonstration (Stein et al. 2012). The importance of educational programmes developed for coaches is not only visible in behavioural effects reflected on communication style changes and changes in coaches' feedback patterns. A variety of research studies, Alonso et al. (1995), Barnett et al. (1992), Smith et al. (2007), Smoll et al. (1993), Smoll et al. (2007), Theeboom et al. (1995), and the research studies of other authors revealed a positive influence of coaches' changed communication patterns on psychosocial variables like developing mastery climate, anxiety reduction, increasing self-esteem, experiencing greater sports flow as well as decreasing the frequency of dropping out, especially in the youth period. Nevertheless, the crucial step for coaches is not only to understand what kind of effective feedback patterns to use or how to use them, but also to recognise their own communication patterns and change them appropriately if they are not effective.

## METHODS

The aim of the paper is to evaluate the influence of the Mastery Approach to Coaching on coaches' verbal feedback patterns.

The research was applied on experimental and control research groups. The experimental group consisted of 5 team sports coaches (soccer, hockey, volleyball, handball) whose average age was 35.4 ( $\pm 7.17$ ) years and 82 players with the average age of 11.9 ( $\pm 1.51$ ) years. The control group consisted of 5 team sports coaches (basketball, soccer, hockey) whose average age was 38.4 ( $\pm 7.23$ ) years and 79 players with the average age of 11.4 ( $\pm 0.99$ ) years.

From the organisational aspect, the research was divided into three main periods. Before and after the implementation of the intervention programme, coaches' communication was diagnosed. During those two testing periods, we managed audio and video recordings of 10 training units and 10 matches (5 training units and 5 matches before and after the intervention). Intervention was applied on five coaches of the experimental group during a 12-week period. As an intervention, the instructional programme MAC (Smith & Smoll, 2009) was used, consisting of a DVD and a manual. The coaches who were in the experimental group were acquainted with the approach on how to learn and implement effective communication principles described in the MAC programme. Video recordings enable coaches to understand how those learnt principles appropriately apply to praxis (model situations).

Trained coaches then implement those principles to the training process through their communication discourse in interaction with players during a 12-week period. To enhance the effectivity of the intervention programme, coaches were asked to briefly check all main principles before each match and training unit and to fill in the self-monitored form after each match and training unit to see their own progress and concentrate on their communication.

Coach's verbal discourse was diagnosed by audio-visual recording of communication between the coach and players. Audio-visual recording was created using a combination of a DVD camera and a Dictaphone with a microphone to catch the continuum of communication most precisely (Slančová & Slančová, 2014). Verbal statements of the coach were transcribed and specified per coding scheme that was modified to four of the most frequently communicated statements in feedback (IN – instruction, PN – punishment, PR – praise, EN – encouragement). Coaches' feedback patterns were identified using software Discussion Analysis Tool – DAT (Jeong, 2009).

The software enables to measure the frequency of various verbal statement combinations and search for specific feedback patterns. The significance of differences in the verbal statement feedback between input and output measurements was calculated using a Wilcoxon test, a non-parametric test for dependent research groups, and Mann-Whitney U test for independent research groups. The significance of differences was evaluated on the level of significance  $p < 0.05$ . Practical significance was evaluated based on Pearson's correlation coefficient  $r$ . The range of influence of the monitored factor was evaluated according to Cohen (1988):  $r < 0.1$  (small),  $0.3 \leq r < 0.5$  (medium),  $r \geq 0.5$  (high).

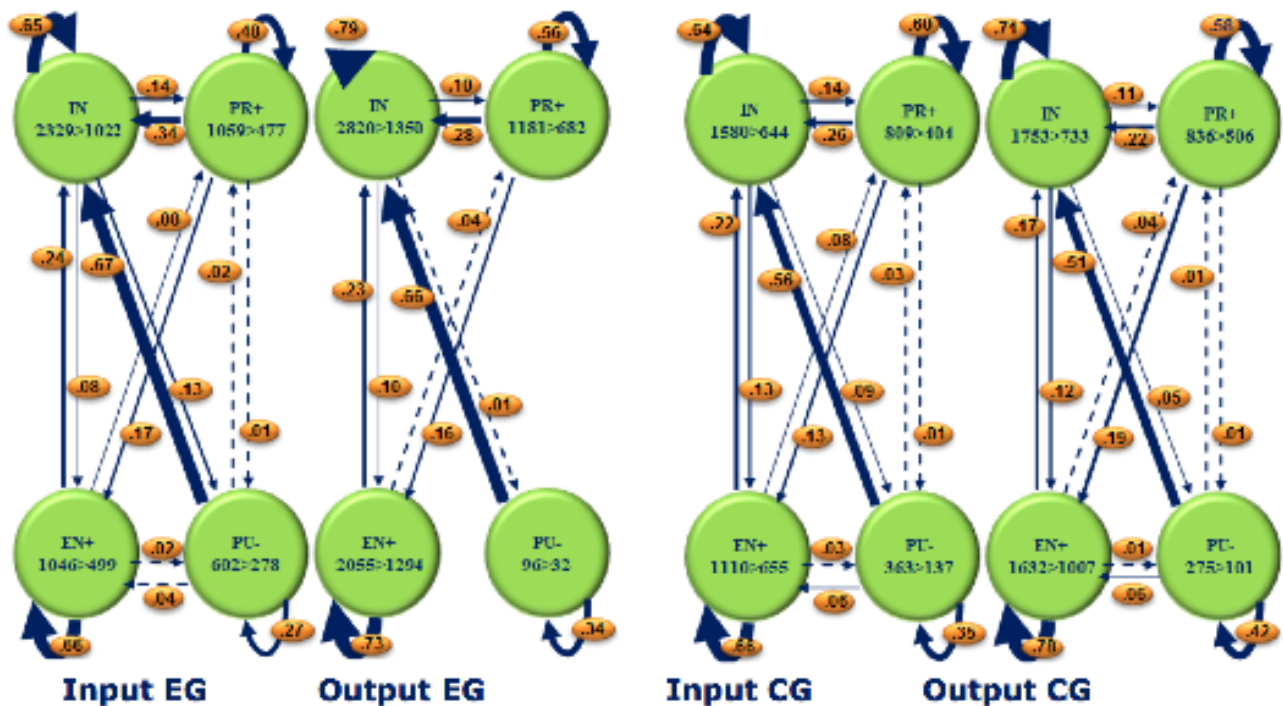
## RESULTS

The analysis of verbal statement frequencies in coaches' feedback

The first part of the analysis is focused on the comparison of input and output frequency values of the four main verbal statements communicated by coaches of the experimental group.

Verbal statements were communicated independently (i.e., one instruction IN or one praise PR+) or in chained patterns (i.e., feedback pattern PR+→IN = praise followed by instruction).

After the intervention period, changes in frequencies of verbal statements applied in feedback were observed in the experimental group (see Figure 1 – left diagram).



**Figure 1** - Coaches communication flow diagrams of verbal statements during feedback application in control and experimental groups (input - output)

Note: IN – instruction; PR+ – praise; EN+ – encouragement; PU- – punishment/criticism; example: out of 2329 instructions (IN) given by the coach, 1022 instructions occurred in chain sequence with other statements spoken by the same coach (in 65%, the first instruction was followed by the next instruction – IN or in 14%, the instruction was followed by praise PR+, etc.).

Comparing input and output values, we found out that the frequency of instruction, encouragement and praise increased in all three monitored areas (total number of statements, the number of independent statements and the number of statements occurring in chained patterns) as follows: IN total +781 (27.70%), IN independent +163 (11.09%), IN chained +328 (24.30%); PR+ total +122 (10.33%), PR+ independent +83 (14.26%), PR+ chained +205 (30.06%); EN+ total +1009 (49.10%), EN+ independent +214 (28.12%), EN+ chained +795 (61.44%). On the other hand, the frequency of punishment and criticism decreased as follows: PU- total -506 (84.05%), PU- independent -26 (80.25%), PU- chained -246 (88.49%). Similar changes were found in the control group. Increased frequencies of instruction, encouragement as well as

praise and decreased frequency of punishment and criticism in coaches' feedback were monitored (see Figure 1 – right diagram): IN total +150 (8.56%), IN independent +84 (8.24%), IN chained +240 (12.14%); PR+ total +27 (3.23%), PR+ independent +75 (18.52%), PR+ chained +102 (20.16%); EN+ total +522 (31.99%), EN+ independent +170 (27.2%), EN+ chained +352 (34.96%) and PU- total -88 (24.24%), PU- independent -52 (23.01%), PU- chained -36 (26.27%).

The analysis of positive and negative verbal statement interactions in coaches' feedback

In the second part of the analysis, we focused in more detail on the chained verbal statements that make various feedback interactions or patterns.

Considering the principle of combinatorics, the DAT software computed 16 possible combinations of verbal statement interactions that occurred in the coaches' communication discourse. Regarding the character of

verbal statements, we divided them into 9 combinations of positive patterns (i.e., IN/IN – instruction followed by instruction) and 7 combinations of negative statements (i.e., PU-/IN – instruction followed by criticism or punishment).

**Table 1:** Comparison of positive feedback pattern frequencies

Verbal Statement	Code	Feedback Pattern	EG Input	CG Input	EG Output	CG Output
Praise	PR+	PR+ → PR+	227	242	383	291
		PR+ → EN+	82	54	107	98
		PR+ → IN	162	105	193	113
Instruction	IN	IN → PR+	133	87	141	82
		IN → EN+	80	84	138	87
		IN → IN	666	411	1086	524
Encouragement	EN+	EN+ → IN+	121	146	298	167
		EN+ → PR+	42	53	50	44
		EN+ → EN+	328	435	945	785

Note: IN – instruction; PR+ – praise; EN+ – encouragement; EG – experimental group; CG – control group

Comparing input and output values (see Table 1), coaches of the experimental group increased the frequency of all positive feedback patterns, whether they were initiated by instruction (IN/PR+ = 5.67%; IN/IN = 38.67%; IN/EN+ = 42.03%), praise (PR+/IN = 16.06%; PR+/PR+ = 40.73%; PR+/EN+ = 23.36%) or encouragement (EN+/IN = 59.40%; EN+/PR+ = 15.38%; EN+/EN+ = 65.29%). Statistical analysis showed the significance of differences between input and output data in four out of nine observed positive feedback patterns IN/IN, IN/EN+, EN+/IN and EN+/EN+ ( $p = 0.043$ ). Similarly, coaches of the control group increased the frequency of positive feedback patterns that were initiated by instruction (IN/IN = 21.56%; IN/EN+ = 3.45%), praise (PR+/IN = 7.08%; PR+/PR+ = 16.84%; PR+/EN+ = 44.90%) and encouragement (EN+/IN = 12.57%; EN+/EN+ = 44.59%). However, a decrease of some patterns was also found as follows: IN/PR+

(5.75%) and EN+/PR+ (16.98%). On the other hand, the analysis showed the tendency of coaches in the experimental group to reduce the frequency of negative feedback patterns not only when the feedback was initiated by criticism or punishment (PU-/PR+ = 100%; PU-/IN = 89.25%; PU-/PU- = 85.33%; PU-/EN+ = 100%). The decrease was also obvious in situations where criticism followed instruction, praise or encouragement (IN/PU- = 93.38%; PR/PU- = 80%; EN+/PU- = 87.5%). The significance of decrease was also confirmed by statistical analysis in three out of seven monitored negative feedback patterns IN/PU-, PU-/IN and PU-/PU- ( $p = 0.043$ ). Coaches of the control group also applied less frequency of negative feedback patterns in both directions (PU-/PR = 75%; PU-/IN = 32.47%; PU-/PU- = 12.5%; TR-/PV+ = 25%; IN/PU- = 34.43%; EN+/PU- = 57.14%). The increase of frequency was observed in one pattern PR/PU- (25%).

**Table 2:** Comparison of negative feedback pattern frequencies

Verbal Statement	Code	Feedback Pattern	EG Input	CG Input	EG Output	CG Output
Praise	PR+	PR+ → PU-	10	3	1	9
Instruction	IN	IN → PU- EN+ →	136	61	9	40
Encouragement	EN+	PU-	8	21	2	4
Punishment	PU-	PU- → PR+	5	4	0	1
		PU- → IN	186	77	20	52
		PU- → EN+	11	8	0	6
		PU- → PU-	75	48	11	42

Note: IN – instruction; PU- – punishment; PR+ – praise; EN+ – encouragement



The overall analysis of coaches' positive and negative feedback

The third part of the analysis is focused on the comparison of input and output frequencies of positive and negative feedback (see Table 3).

The total frequency of positive feedback was analysed by summing up 9 possible combinations of positive patterns. The same process was applied analysing the total frequency of negative feedback by summing up 7 possible combinations of negative patterns.

**Table 3:** Statistical comparison of inter-group differences between input and output positive/negative feedback patterns of control and experimental groups

	Control group				Experimental group			
	Input PP	Output PP	Input NP	Output NP	Input PP	Output PP	Input NP	Output NP
freq.	1617	2191	222	154	1849	3333	431	43
Z	-0.674		-1.084		-2.023		-2.023	
p	0.500		0.279		0.043*		0.043*	
r	0.213		0.343†		0.640‡		0.640‡	

Note: freq. – frequencies; Z – testing criterion; p – p value of the Wilcoxon test ( $p < 0.05$ ); r – effect size (0.1 – small; 0.3† – medium; 0.5‡ – large); PP – positive feedback patterns; NP – negative feedback patterns

The coaches who were influenced by the intervention programme significantly ( $p = 0.043$ ) increased the frequency of positive feedback (+1484 feedback patterns, 44.52%) and significantly ( $p = 0.043$ ) decreased the frequency of negative feedback (-388 feedback patterns, 90.02%). A large effect size of the monitored factor (period of the intervention programme) was found in both positive ( $r = 0.640$ ) and negative ( $r = 0.640$ ) pattern changes. The same tendency was found in the control group where coaches also increased the frequency of positive feedback (+574 feedback patterns, 26.20%) and decreased the frequency of negative feedback (-68 feedback patterns, 30.63%) in social interaction with players. Statistical analysis did not confirm the significance of changes. A medium effect size of the monitored factor was found in negative pattern changes ( $r = 0.343$ ).

Inter-group comparison of input values (see Table 4) revealed that coaches of the experimental group applied positive feedback patterns more frequently, compared to coaches of the control group (232 positive patterns, 12.55%). On the other hand, inter-group analysis of differences in negative feedback patterns showed that coaches of the experimental group communicate more frequently in the form of negative feedback in social interaction with players than coaches in the control group (209 negative patterns, 48.49%). After the intervention period, coaches of the experimental group applied positive feedback patterns more frequently than coaches in the control group (1142 positive patterns, 34.26%). Moreover, coaches in the experimental group communicated negative feedback patterns less frequently than coaches in the control group (111 negative patterns, 72.07%), which is contrary to the results of input measures.

**Table 4:** Statistical comparison of inter-group input and output differences of positive/negative feedback patterns in control and experimental groups

	Positive feedback patterns				Negative feedback patterns			
	Input		Output		Input		Output	
	CG	EG	CG	EG	CG	EG	CG	EG
freq.	1617	1849	2191	3333	222	431	154	43
U	12		6		3		0	
p	0.917		0.175		0.047*		0.009*	
r	0.023		0.304†		0.444†		0.586‡	

Note: freq. – frequencies; U – testing criterion; p – p value of the Mann-Whitney U test ( $p < 0.05$ ); r – effect size (0.1 – small; 0.3† – medium; 0.5‡ – high); CG – control group; EG – experimental group

Statistical analysis showed significant difference of negative feedback pattern frequencies in input and output measures between the control and experimental group ( $p = 0.047$ ,  $p = 0.009$ ). Moreover, the analysis showed large effect size in output differences and medium effect size in input differences of negative feedback patterns.

## DISCUSSION AND CONCLUSION

The results of our study showed that coaches of the experimental group significantly increased the frequency of positive verbal feedback and significantly decreased the frequency of negative verbal feedback after the intervention period. Kravig (2003) points out that athletes prefer coaches who communicate more frequently using various variations of instruction, encouragement, and praise. Research studies of Boixadós and Cruz (1999) and Cruz et al. (2010) confirmed that coaches of experimental groups increased the frequency of encouragement and instruction from 3% up to 25% and decreased the frequency of criticism and punishment from 1% up to 17% after the implementation of intervention. Other research studies of Barnett et al. (1992) and Kravig (2003) indicate that, regardless of the type of sport or gender, players prefer coaches who establish their priority to continually support athletes and give them appropriate instruction. At the same time, coaches try to avoid using negative verbal and nonverbal answers and reactions. A positive reaction of the coach on good performance and effort as well as quality of instruction that helps players to correct mistakes maximise the potential to create positive sports experiences, especially in players with lower self-esteem (Kravig, 2003). Interesting results are found in studies which showed that the perception level of mastery climate was on the highest point when players perceived higher frequency of positive and formative verbal feedback (praise, encouragement and technical or tactical instruction after a mistake) (Stein et al., 2012). One of the most important positive results of intervention is seen in the significant decrease of negative verbal formulations in the form of criticism and punishment. The results presented by Schempp et al. (2004) showed a lower frequency of negative feedback communicated by coaches which corresponds with our results. Foreign research studies emphasise that players, who perceive aggressive behaviour of coaches, evaluate the communication with coaches as negative. Moreover, it was reflected on the decrease in the percentage of success for won matches and lower team cohesion (Kassing & Infante, 2009). Coaches of the control group also increased the frequency of positive feedback and decreased the frequency of the negative one; however, these changes were not significant. Furthermore, significant differences after the intervention period were found in both positive and negative feedback patterns in favour of the experimental group. It seems that coaches of both groups applied positive feedback patterns in various variations to the

entire team or individually. Cumming et al. (2007) point to the fact that players do not perceive the manner in which a coach communicates with other players in the team to a large extent. However, players limit their evaluation of motivational climate on individual feedback which is communicated by the coach. This is the main reason why individual perception of the coach's communication (mainly individual feedback) is an important factor related to the level of players' motivational climate perception (Duda, 2001). A higher frequency of the applied positive patterns which are combined with motivational statements and instruction reflects the coach's intention to direct the awareness and concentration of the players. It helped players cope appropriately and effectively with problem situations (Bortoli et al., 2010). Frequent communication of instruction in the coach feedback confirms the statement that a coach plays an important role of a facilitator in the process of acquiring new skills and players' continual improvement (Coker et al., 2006). One of the limits of the research is lack of nonverbal feedback analysis of coaches as well as meta language analysis. Another question should be raised considering verbal and nonverbal feedback of the coach and gender or different age aspects. Coatsworth and Conroy (2006) explain the importance of age which should significantly influence the results of intervention focused on making feedback more effective. Moreover, they point to greater effectivity of interventions in younger players (11 years old and younger) than in older ones (12 years old and older). Younger players are less cognitively mature, and their thinking is much more specific. They cling to coaches and parents' direct feedback, praise, attention, and encouragement (Harter, 1999; Horn & Weiss, 1991). Older players perceive parents and coaches' feedback as less important than the evaluation of their competencies by teammates (Horn & Weiss, 1991). On the other hand, players in the adolescent period acquire abstract and cognitive skills, individualise personal performance standards and modify them according to the self-evaluation of their own performance. In other words, they pride themselves on self-evaluation rather than on external feedback (Horn & Harris, 2002). One of the inevitable assumptions for positive influence of educational programmes is voluntary and active participation of coaches in the process of acquiring new communication principles and changing ineffective communication patterns (Cruz et al., 2010). Regarding the significance of changes under the influence of intervention, we can point out that coaches of the experimental group actively and concentratedly participated in the implementation process of communication principles described in the MAC programme (Sousa et al., 2008). The intervention programme positively influenced the monitored feedback patterns of coaches; moreover,

it also showed a protective effect. We found a radical decrease of criticism and punishment in coaches of the experimental group even though they were under the influence of emotionally strained situations, especially during matches. During the intervention period, we focused our attention on the individual approach to each coach in the experimental group. It helped us to evaluate more effectively the level of feedback patterns, mutual searching for appropriate communication patterns and areas to improve. The effectivity of such an approach is also confirmed by Cruz et al. (2010) who emphasise the need for an individual approach to coaches during application of the intervention programme. The individual approach has ultimately more effective influences on behavioural variables because coaches can set their own goals and priorities for improvement as well as analyse the areas of improvement. Considering the analysis results, the positive influence of the educational programme

is visible. Future research should be focused on congruency between the perception of coach feedback and players preferred feedback. It would help to find out whether specific feedback of a coach is perceived by players as positive or negative one. Within longitudinal monitoring of the intervention effect, it would be appropriate to focus attention on the ratio evaluation of won and lost matches during a season. Finally, educational programmes create an opportunity for continual personal development of coaches in such an important phenomenon like interpersonal communication. Furthermore, it is also important to monitor the effect of the determined feedback patterns on behavioural and cognitive variables of all participants in the training process.

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**UTICAJ PRISTUPA SAVLADAVANJA TRENAŽNOG PROCESA NA OBRASCE DAVANJA VERBALNIH POVRATNIH INFORMACIJA TRENERA**

Cilj ove studije je procijeniti uticaj pristupa savladavanja trenažnog procesa (engl. MAC - Mastery Approach to Coaching) na promjene u obrascima davanja verbalnih povratnih informacija trenera. Istraživanje je primijenjeno na 10 trenera timskih sportova. Eksperimentalni podaci o nivou verbalnih povratnih informacija trenera su dobiveni korištenjem audio-vizuelnog snimanja koje je prethodilo opisivanju i kodiranju verbalnih izjava. Učestalost verbalnih povratnih informacija i obrasci interakcije su izračunati putem DAT softvera. Treneri eksperimentalne i kontrolne grupe su najčešće koristili upute, pohvale i ohrabrivanje tokom davanja verbalnih povratnih informacija, a rjeđe su upotrebljavali kaznu i kritiku. Nakon perioda intervencije, treneri eksperimentalne grupe su povećali učestalost davanja uputa, pohvala i ohrabrivanja te smanjili učestalost kažnjavanja, a u poređenju sa ulaznim vrijednostima. Treneri eksperimentalne grupe koji su primjenjivali MAC program intervencije su značajno povećali učestalost obrazaca davanja pozitivnih povratnih informacija ( $p = 0,043$ ) te značajno smanjili učestalost obrazaca davanja negativnih povratnih informacija ( $p = 0,043$ ). Nadalje, s obzirom na izlazna mjerenja, treneri eksperimentalne grupe su pokazali veću učestalost davanja pozitivnih verbalnih povratnih informacija i značajno ( $p = 0,009$ ) smanjili učestalost davanja negativnih verbalnih povratnih informacija, a u poređenju sa trenerima kontrolne grupe.

**Ključne riječi:** MAC, obrasci davanja pozitivnih povratnih informacija, obrasci davanja negativnih povratnih informacija, DAT

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# THE ROLE OF EXTRACURRICULAR ACTIVITIES IN IMPROVING THE SOCIAL AND PSYCHOLOGICAL ASPECTS OF SYRIAN REFUGEE CHILDREN IN JORDAN FROM THE VIEWPOINT OF SUPERVISORS FOR EXTRACURRICULAR ACTIVITIES IN IRBID SCHOOLS

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## ABSTRACT

This study aimed at shining a light on the individual lived experiences of teachers participating in implementing and teaching extracurricular activities to Syrian refugee students in Irbid schools in Jordan. To achieve the objectives of the study, a qualitative approach was used. The data for this study consisted of transcripts made from audio-recorded interviews with 31 teachers. The study revealed that social and psychological challenges had the overwhelming response from interviewees, especially shyness, a refugee student's feelings with regard to belonging to his peers and issues related to self-confidence. In terms of how teachers evaluate the programmes applied to students, the interviewees revealed a wide range of positive responses. The study also revealed that the most serious challenges are faced by teachers so as to deliver effective extracurricular activities with a lack of tools or necessary equipment for both artistic and sports activities as well as financial resources from NGO's to carry out their activities. In light of the results, the researchers proposed a set of recommendations such as encouraging Syrian refugee students to enter extracurricular activities and removing obstacles that lead to students not participating in extracurricular activities, including the work on renewing and developing all types and areas of these activities that keeps pace with the continuous changes and developments, in a way that simulates the tendencies and trends of students and meets their needs.

**Keywords:** extracurricular activities, social aspects, psychological aspects, Syrian refugee children, Jordan, Irbid schools

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## INTRODUCTION

The presence of extracurricular activities has been well-researched and adapted in many societies, especially in their academic institutions. Besides the traditional academic framework for students, extracurricular activities became an essential part of a student's educational journey, whether in early childhood or higher education (Fairclough & Stratton, 2006).

A necessary benefit of extracurricular activities is the improvement and, in some cases, the appearance of social skills. As a result, students find their participation in extracurricular activities to be their comfortable safe zone for communicating, building, and forming relationships with other students (Romanov & Nevgi, 2008).

The formation and improvement of social skills affect a student's social life and potentially impact their academic progress and wellbeing. Too often, students who participate in extracurricular activities tend to be more comfortable expressing themselves and openly speak about their feelings and interests. Yet, considering the impact of extracurricular activities on students in general, extracurricular activities on students who previously experienced or continue to suffer the consequences of trauma are just as significant for their social and mental development.

More precisely, the impact of extracurricular activities for refugee students in Jordan proves to benefit the refugees' overall wellbeing. From the different forms of art to various sports, refugee students in Jordan are integrated into extracurricular activities that aim at improving their social skills and allow them to participate outside their comfort zone. As a result of refugee participation in extracurricular activities, students can form relationships, express themselves, and most importantly, use the skills learnt from their pursued extracurricular activity as a tool for self-expression (Von Aufschnaiter & Von Aufschnaiter, 2007).

Evidence on the various benefits related to refugee students' personality and classroom participation and the challenges with extracurricular activity application might provide an insight into how current extracurricular activities can be improved and made specifically for refugee students' needs. More specifically, the evidence needs to consider the added level of previously experienced trauma and current personal and familial problems associated with the refugees' transition and adaptation to a new country. Finally, an interview investigation with teachers teaching and providing students with extracurricular activities gives a

personalised perspective into the application and challenges associated with extracurricular activities besides a sole outsider perspective.

## STATEMENT OF PURPOSE

Evidence on the various benefits related to refugee students' personality and classroom participation and the challenges with extracurricular activity application might provide an insight into how current extracurricular activities can be improved and made specifically for refugee students' needs. More specifically, the evidence needs to consider the added level of previously experienced trauma and current personal and familial problems associated with the refugees' transition and adaptation to a new country. Therefore, the statement of purpose for this study revolves around identifying the role of extracurricular activities in improving the social and psychological aspects of Syrian refugee children in Jordan from the viewpoint of supervisors for extracurricular activities in Irbid schools.

## STUDY OBJECTIVES

The study aims to introduce an interview investigation with Jordanian teachers teaching and providing Syrian refugee students with extracurricular activities so as to explore their perspective on the application and challenges associated with extracurricular activities besides a sole outsider perspective.

## STUDY QUESTIONS

In light of the statement of purpose, this study is driven by the following questions:

- 1) Which social and mental issues can be noticed among Syrian refugee students?
- 2) What is the importance of extracurricular activities in the development of the students' character from the viewpoint of the respondents?
- 3) How qualified are teachers who work with traumatised refugee students?

## LITERATURE REVIEW

There is well documented evidence that sports and artistic extracurricular activities are beneficial for children's psychosocial and physical wellbeing; yet, many challenges lie in the way for the Jordanian government and international organisations to deliver effective extracurricular activities to refugee youth. Jordan is home to one of the highest numbers of refugees in the world, including an estimated 1.3 million Syrian refugees that have entered the country since the start of the Syrian Civil War in 2011 (Federman & Akour, 2019).

For the 233,000 registered school-aged Syrian children in Jordan (with likely many more unregistered), only 136,000 were enrolled in formal education (Culbertson, 2016). For the youth who do have access to formal schooling, particularly those out of the more than 80% of refugees that live outside of refugee camps, they often enter schools struggling to expand their capacity. These factors create particularly difficult challenges for humanitarian stakeholders to ensure these youth are educated.

The Jordanian Ministry of Education (MoE), intergovernmental organisations (IGOs) and non-governmental organisations (NGOs) agree that there needs not only be a plan to educate these refugees in the short term, but to create an appropriate response that will provide lasting solutions for refugee youth who are not likely to return to their home countries in the near future. The emergency education plans (EEP) to address these long-term concerns have included various measures, such as the decision for government-run schools that enrol refugees to create two time shifts for students, with the morning for Jordanian students and the afternoon for Syrians and other refugee youth (Culbertson, 2016). International organisations that are helping implement the EEP for the Jordanian educational system note that the MoE employs an insufficient number of overworked teachers to adequately educate refugee youth (Culbertson, 2016).

There is also noted evidence that teachers are ill-equipped to deal with the trauma and the physical and mental health issues many refugee students experience once they enter a classroom. According to Culbertson, many teachers feel as though they must act as counsellors for traumatised refugee students in a classroom when they have not received proper psychosocial training to serve in this capacity. All of the previously mentioned problems are exacerbated by the move to e-learning caused by the COVID-19 crisis, compounding the difficulty in the ability to reach refugee students to meet both their academic and psychosocial needs (UNHCR, 2020). It is clear that there is a need to reach refugee students in new ways to meet their long-term needs while they remain in Jordan.

The space for extracurricular activities, such as sports and physical education, is one way for students to have extra space to learn, heal, and become included in their host communities. Refugees in Jordan, as well as Jordanians themselves, deal with a particular host of non-communicable diseases as is common in other developing countries, such as obesity and diabetes, which also account for the leading causes of death in Jordan (Alshayeb et al., 2019).

Access for some space for refugees to simply move and exercise is a low-cost way to mitigate some of these preventable diseases.

Physical education and sports programmes are a way to create such spaces. Prior to the pandemic, Generations for Peace designed a sports initiative for 12,000 direct beneficiaries around the country, training over 200 teachers and youth centre workers to lead sports activities (Beyond Sports, 2019). There are other programmes that are run by international groups, such as GIZ which also reaches thousands of students, trains teachers, and does this work in a way that ensures that at least half of all participants are girls (GIZ, 2020). Such large-scale measures point to the need of youth to be involved in these activities in a way that would be beneficial to their health. But, beyond physical benefits, sports offer ways to help students feel engaged, connected to one another, and integrated in their communities. Sports have been a proven vehicle for students to engage in fun activity that also creates trust among community members and broader society, a source of therapy, a diversion from the every-day difficulties of integrating into a new place, and a way to build community understanding (Olliff, 2008). A study including refugees in Australia noted that there was a significant increase of psychological wellbeing among refugee children who played sports than those who did not, with children from more disadvantaged socioeconomic backgrounds enjoying an even greater sense of wellbeing (O'Donnell et al., 2020). Access to sports is a fun, interactive way for refugee youth to feel engaged and live healthier lives.

Another important avenue for refugee youth is access to the arts, including drawing, drama, music, and more. The authors' previous study (Nashwan et al., 2019) showed that the arts have a particular effect on refugee youths' psychosocial wellbeing. Interviewees noted that the arts lead students to feel connected to their homeland, such as through drawings that help them evoke memories and values of the past. They also noted that activities, such as practicing music, helped soothe feelings associated with past trauma, and other activities, such as writing and playwriting, helped give the youth a sense of agency in telling their story and impacting the society around them. These effects are common with refugees across the world, with one study of Rohingya refugees benefitting from the arts, where exposure helped mitigate senses of hopelessness and inspired calmness and mental fortitude in one particular study (Rebolledo, 2019). Many organisations and schools have offered artistic programmes to reach refugees from across Jordan. The NGO Artolution provides platforms for Syrian youth to be engaged in public art projects in both Za'atari camp and various host communities, helping augment the voices of refugee youth and letting them feel heard (Artolution, 2020).

The youth also benefit from other artistic mediums, such as when funding allowed youth in Za'atari camp to film a now well-known soap opera, *Ziko & Shreko*, that allowed more refugees' voices to be heard (UNHCR, 2016).

Although many of the programmes exist because of NGO's, the potential for similar effects to happen in more formal education sectors is high. Yet, still, there are challenges that confront the role of schools and other settings to include extracurricular activities such as sports and arts. One example is teacher training and capacity, as connected to other issues the school deals with, as well as the general capacity to have artistic- and sports-related programmes to begin with (Culbertson, 2016). There is also a lack of funding for these programmes within the formal education sector. According to UNICEF's "Budget Brief of 2019 of the Public Education Sector in Jordan", the Jordanian MoE spent less than 1% of its total expenditures on sports programmes in 2019 within schools, with support for artistic programmes not even mentioned. While it is true that many of these programmes are supported by IGOs and NGOs, the lack of support within formal education for extracurricular activities points to some of the difficulty in expanding these programmes.

More problems emerge when the issue of how students are treated when it comes to gender differentiation arises. In Jordan, boys are often given more opportunity to be involved in extracurricular activities, such as sports, than girls. For both genders, there is stigma around getting too involved in the arts when time is often seen as better served elsewhere (Nashwan et al., 2019). A similar issue occurs with sports involvement, which leads organisations to emphasise equal gender involvement such as the work of GIZ (2020). The potential for the extracurricular programmes in the arts and sports for refugee youth in Jordan is proven by the numerous programmes that already exist for them. Numerous studies show the multiple layers of benefits these activities offer young people. There also is a glaring discrepancy in the valuing of these programmes by the MoE and the international humanitarian community. If more programmes which include sports and artistic offerings were accessible in schools, it would be a way to address youth through institutions that already exist, and perhaps would be an incentive for more refugees to attend these schools. Access to more funds and training programmes to assist teachers and others who work with these youth in formal education settings would alleviate many of the issues that teachers are facing with the influx of refugee youth and would provide longer-term solutions to address the health and psychosocial wellbeing of these refugees.

## METHODOLOGY

The study used qualitative research methods which provide the researcher with the opportunity to gain holistic understanding of the phenomena being studied. In addition, the researcher also achieves a deeper comprehension of the challenges and benefits of extracurricular activities from a teacher and administrative perspective.

## STUDY POPULATION AND ITS SAMPLE

The study population is defined as the total sample that the researcher aims to study to achieve useful results. It represents the audience that the researcher wants to study and generalise the study on the entirety of its sample.

The study population represents all teachers participating in implementing and teaching extracurricular activities to refugees, and the study sample consisted of 31 teachers.

## STUDY TOOLS

Data for this study consisted of transcripts made from audio-recorded interviews with 31 teachers.

## SELECTION OF PARTICIPANTS

Recruitment and interviewing were conducted by the researchers of the study and the inclusion criteria comprised: (1) elementary school teachers, male or female, (2) having teaching experience with either refugee or Jordanian students, or both, (3) age under 50. The researchers approached the teachers who taught refugee students in the subjects of physical education and arts. All subsequent participants were recruited using the snowball method, where participant referral was utilised. A description of the study in Arabic was given to all participants and potential participants, including a detailed description of the purpose and goal of the study. Researchers conducted interviews in private settings, such as the participant's home or the researchers' private office, at the participant's convenience. However, some casual interviews were conducted in public settings such as school or a restaurant. Finally, the duration of each interview was from 30 to 45 minutes.

## DATA COLLECTION

The researchers conducted the study using two survey-style interview methods: phone and face-to-face.

Before commencing an interview, the researchers obtained an informed consent, which was in Arabic. After the description of the study goal and purpose, and in the process of obtaining informed consent, each participant was given the opportunity to ask questions about the study. Moreover, the researchers made participants aware of the use of pseudonyms, and reassured participants that their name would be anonymous and any identifying information would be removed. After the researchers addressed the participants' questions and concerns, they presented the participants with an informed consent form which outlined the purpose of the study and any information necessary for the participants' decision to participate in the study. Following the collection of informed consent, the researchers carried out a semi-structured interview investigation using questions such as the following:

1. What social and mental issues can you notice about your students such as introversion, social isolation, and extreme shyness?
2. Do you believe in the importance of extracurricular activities in the development of the students' character?
3. How do teachers work with traumatised refugee students and are they qualified to work with them?

## DATA ANALYSIS

Interviews were transcribed in Arabic, and researchers partially translated any words used in the form of slang. The researchers then used an inductive method to decode common language and themes used by participants and the ones that arise between all interviews. Following the transcription of the interviews, the researchers read and reread the transcripts multiple times so that they are familiar with the content and the common themes that arise between interviews, most of which address the questions asked. Subsequently, they individually coded the data and then reviewed the identifying themes, those of which were common between research participants. The purpose of an individual coding and review process is to ensure result reliability and eliminate bias. The researchers concluded the data analysis by reviewing the data specific and identifiable to each theme, and finally extracting direct quotes from the interview transcripts that address the research questions and represent participant personal narratives.

## RESULTS

The structured interviews illustrate the experiences of teachers who help run extracurricular programming for refugees and reveal the potential these activities hold for their students as well as the barriers to running the programmes.

The subjects of these interviews were teachers from a range of backgrounds. 31 teachers were interviewed in total, including at least 23 women and seven men. 21 indicated that they had experience teaching in Jordan for over three years, although less accumulated as many years teaching refugees. Each of the interviewees earned higher education degrees, with 16 earning Bachelor's degrees and 14 having post-graduate degrees. Only eight individuals noted that they held a major in either arts or sciences, despite leading extracurricular activities in these areas. These teachers lead numerous extracurricular activities inside and outside of school environments. In the sports arena, extracurricular activities included games such as soccer, football, and "mini games" played for fun. Art-focused educators centred on drawing, playing with putty, theatre, video making, radio broadcasting, storytelling and other creative activities. Some teachers revealed they also teach extracurricular activities related to technology and science. Teachers led these activities through their schools as well as with the help of outside NGOs such as Right to Play.

When asked about the social and psychological challenges their students face in their programmes, the overwhelming response the interviewees gave was shyness. Teachers described this phenomenon in a number of different ways, linking shyness with distancing from fellow students and isolation. One respondent elaborated further that shyness was often associated with "a feeling that [a refugee student] does not belong to his peers and does not resemble them". Other respondents noted issues related to shyness, such as "introversion", and issues related to self-confidence such as bullying, difficulty with public speaking, and stuttering. The separateness that many refugee students face when engaging into extracurricular activities is related to a feeling that they do not fit in with other children, leading students to stay separate from their peers.

Teachers further noted that many of their students come into the classroom carrying psychological burdens from issues that they deal with at home with their families. Many of their refugee students come from households facing severe financial difficulties, causing the stress that exacerbates shyness, hyperactivity, and rebelliousness. Parental conflicts, such as divorce, were also noted to cause similar issues. Students' issues seemed to extend to their lives at school and extracurricular activities.

When asked questions about how they felt the students had been impacted by their programming, the interviewees revealed a wide range of positive responses. A common theme in the interviewees' responses throughout both arts and sports

programming was of “enhanced personality” and improved confidence. One teacher who teaches drawing to students noted that when her activities are successful, it allows students “feel self-confidence and a sense of responsibility” as a result of the drawing. A feeling of ownership over one’s piece of art helps reveal to students a sense of personal agency. Another teacher noted that, through a student’s participation in the school’s public radio channel, they were able to work through a stuttering challenge. With the encouragement of the student’s teacher, this child was able to have a platform to not only gain further confidence in speaking, but to be heard by a wider audience as well. Extracurricular activities, as the teachers revealed, are areas where refugee students can practice a new activity and gain confidence in themselves during the process.

A common response among other interviewees was how these various extracurricular activities acted as vehicles of healthy expression and creativity. One teacher described that the potential of sports opportunities, such as basketball and soccer at his school, “worked to improve and prevent depression” through acts of play. This teacher and others pointed to the important role of these activities to promote happiness and address psychological issues refugees face coming into the classroom, with another teacher describing how, through their technology programme, a student’s hyperactivity was improved through the course of the programme. Another teacher described how extracurricular activities “help students show their talents, cover an appropriate area of their time, and develop the ideas and creativity they have.” The importance of maintaining a place to develop creative talents outside the traditional academic periods is something several other teachers noted as well. These extracurricular activities were revealed to be the places where students could develop habits that improved their psychological wellbeing and provided a creative outlet.

The teachers further recognised that participation in extracurricular activities provided an outlet to combat the most common issue they see their refugee students facing: shyness. A previously mentioned teacher who taught drawing also noted that “the act of drawing worked to eliminate the problem of shyness in students and helped them invest their time and effort in useful work”. Dedication to an outside craft helped lead to a sense of achievement and worth that students could bring into other areas of life. Several teachers noted how important it is for students to participate on a sports team, with one interviewee describing that “sports teams contributed to integrating students and increasing their interaction and social participation.” Having a vehicle to interact with friends through

targeted sports play in an active and healthy manner provided an important way for students to feel connected to one another. These and many other examples show the power of these non-academic areas to benefit refugee students, combat shyness through engagement, and provide community in a new country.

The interviewed teachers noted several ways to make sure their extracurricular programmes run effectively. Several noticed that making sure students regularly attended these activities prove to ensure that they consistently gain benefit from extracurricular activities. Students’ participation, of course, proves hard with students from households that are facing financial and other kinds of hardship. The teachers noticed enhanced benefit when the activities are led in a way that is more goal-oriented. Some art teachers created a goal for their students’ work such as through a public performance or a set broadcast. Those who were involved in sports noted the importance of ensuring competition in sports as providing a fun and valuable focus for the students. Teachers who kept students coming consistently and working towards more specific outcomes found that students gained more from the extracurricular activities.

Even with all of these benefits, most teachers noted that they face serious challenges to deliver effective extracurricular activities. Several interviewees noted “a lack of tools” or necessary equipment for both artistic and sports activities as well as financial resources from the government and NGOs to carry out their activities. Several also mentioned time as a challenge, as these activities are often not fully integrated within the divided Jordanian school day between refugees and Jordanians. Others mentioned that parents were an impediment to having students join these activities, often meeting resistance from these adults. Various challenges make the logistical hurdle of bringing children into extracurricular activities difficult.

Within the extracurricular activities themselves, many teachers noted that, although some can handle the various psychological issues students face, not all are adequately trained to deal with the trauma many students from Syria and elsewhere bring into the classroom. One teacher described how they see the common role of a teacher to create “an atmosphere of comfort among his students and also, by understanding the student’s tendencies, group actions play a great role in that atmosphere.” Not all participants were so enthusiastic. An interviewee who led role-playing exercises admitted that, “unfortunately, many of us are not educated” when it came to handling the sensitive issues many refugee students can face when entering into their activities. Another teacher observed that others who lead activities may be “sympathetic” to the refugee students but, at the same time, “do not have the experience and knowledge to deal with these circumstances” that the children face and which are related to any of the various issues stemming from trauma that students can face.



The majority of interviewees described various systems for dealing with issues when they arose with a student, including going up a chain of individuals within the school or organisation where the extracurricular activity was taking place to contacting parents. While these safeguards created some form of a safety net for addressing refugee students' needs, the teachers' responses infer more steps are needed to be taken to ensure students' needs are adequately met.

## DISCUSSION

The data collected from the interview-investigation in this report revolved around one key theme: personal development and wellbeing. The common perception by many of the interviewed teachers illuminates the benefits of extracurricular activities on refugee students' overall health and wellbeing, mental and social development. Furthermore, the results highlight shyness as a key personality issue that many refugee students experience on a daily basis. Though shyness can be perceived as a common characteristic among students in the same age group, with the added context such as the fact that many of the refugee students experienced some sort of traumatic experiences in Syria or adapting to their new life in Jordan, shyness is now a forced personality change that impedes refugee students from developing socially and even academically. For this reason, the benefits outlined in this report seem to directly impact the psychological and social challenges associated with shyness such as introversion, lack of self-confidence, and difficulty with self-expression.

Personality enhancement and improved self-confidence are placed among the benefits of extracurricular activities, in addition to an increase in creativity and self-expression. With activities that encourage engagement and expression, such as storytelling, voice making, and theatre, refugee students are able to use such extracurricular activities as tools to break out of their shyness.

Similarly, increased engagement and student interaction form a relationship and a community with shared interests, further encouraging refugee students to participate more and invest their time pursuing their passions. It is important to note that extracurricular activities with specific goals and constant student participation illustrate more benefits among refugee students, further supporting the idea that these extracurricular activities give refugee students something to hold on and look forward to, giving them an opportunity for personal growth. Furthermore, the constant investment and interest in extracurricular activities by refugee students provides them with the tools to overcome their psychological and mental barriers such as trauma.

In addition, some students even use some extracurricular activities, specifically the ones that encourage expression, such as storytelling and drawing, as a safe environment to express their thoughts and feelings.

All of the previously mentioned benefits are critical in refugee students' adaptation in a new country; however, as the data illustrates, there are many challenges that prevent teachers from maximising the benefits associated with extracurricular activities, the most prominent of all being the lack of resources. The provision of material and financial resources is important in the implementation and functioning of extracurricular activities, and the lack of such resources presents a challenge in meeting the goal of these activities.

On the other hand, teachers reported that the lack of training in dealing with refugee students is another issue when integrating and motivating refugee students in extracurricular activities, especially when they experience instances of traumatic memory recall or when they need therapeutic help.

Even though the results outline the psychological and social benefits as well as challenges associated with refugee students participating in extracurricular activities, more research is needed to address the personal perception of refugee students in their participation in extracurricular activities, and an added parallel investigation on the benefits and challenges of those same activities, but in other schools, and with a different population in the same age group.

Moreover, important questions to consider include the following: what is the refugee students' perception of the activities?

Is there a correlation between participation in extracurricular activities and academic growth?

What added impact could teacher training in refugee health issues have on refugee adaptation and involvement in extracurricular activities?

Finally, could the degree of previously experienced traumatic experiences affect the level of refugee students' participation in extracurricular activities and could it be a barrier in their retention of the benefits?

All of these questions are important in getting a deeper understanding into the research of extracurricular activities and development, especially among vulnerable populations, such as Syrian Refugees, and our report highlights a step forward in finding the answers.



## RECOMMENDATIONS

In light of the above-mentioned results, the researchers recommends the following:

1. Encouraging Syrian refugee students to enter extracurricular activities.
2. Removing obstacles that lead to students not participating in extracurricular activities, including the work on renewing and developing all types and areas of these activities that keeps pace with the continuous changes and developments, in a way that simulates the tendencies and trends of students and meets their needs.
3. Working to provide suitable places for the practice of extracurricular activities and provide a guide containing a list of activities and their objectives as well as the provision of rewards, material and moral incentives for the participating students.
4. Eliminating the difficulties of extracurricular activities, including the provision of specialised administrative personnel and the participation of teachers, taking into account their teaching quorum so that they can present their best efforts in teaching on the one hand, and participate in supervising extracurricular activities on the other hand.

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**ULOGA VANNASTAVNIH AKTIVNOSTI U POBOLJŠANJU DRUŠTVENIH I PSIHOLOŠKIH ASPEKATA SIRIJSKE DJECE IZBJEGLICA U JORDANU SA STANOVIŠTA SUPERVIZORA VANNASTAVNIH AKTIVNOSTI U ŠKOLAMA U IRBIDU**

Ova studija je imala za cilj rasvijetliti individualna proživljena iskustva učitelja koji učestvuju u provođenju i podučavanju vannastavnih aktivnosti za Sirijske učenike izbjeglice u školama u Irbidu, Jordanu. Kako bi se postigli ciljevi studije, korišten je kvalitativni pristup. Podaci za ovu studiju su se sastojali od transkriptovanih snimljenih razgovora sa 31 učiteljem. Studija je otkrila da su društveni i psihološki izazovi iznimno zastupljeni u odgovorima ispitanika, a posebno stidljivost, osjećaji učenika izbjeglica po pitanju pripadnosti svojim vršnjacima i pitanja vezana za samopouzdanje. Kada je riječ o učiteljskoj procjeni programa namijenjenih učenicima, ispitanici su ponudili širok spektar pozitivnih odgovora. Studija je također otkrila da je većina ozbiljnih izazova sa kojima se učitelji suočavaju vezana za uspješno provođenje vannastavnih aktivnosti uz nedostatak alata ili potrebne opreme kako za umjetničke, tako i za sportske aktivnosti, kao i nedostatak finansijskih sredstava od NVO-a za provođenje njihovih aktivnosti. S obzirom na rezultate, istraživači su predložili niz preporuka poput ohrabriranja Sirijskih učenika izbjeglica da se bave vannastavnim aktivnostima i otklanjanja prepreka koje vode ka tome da učenici ne učestvuju u vannastavnim aktivnostima, a uključujući i rad na obnovi i razvoju svih vrsta i područja ovih aktivnosti koje idu u korak sa neprestanim promjenama i razvojem na način da stimulišu tendencije i trendove učenika te im zadovoljavaju potrebe.

**Ključne riječi:** vannastavne aktivnosti, društveni aspekti, psihološki aspekti, Sirijska djeca izbjeglice, Jordan, škole u Irbidu

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# MACRO AND MESO INDICATORS OF SUCCESS PERTAINING TO EUROPEAN COUNTRIES IN ELITE TRIATHLON

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## ABSTRACT

Many researchers are trying to determine why a particular nation is more successful in sports by comparing different indicators sorted into the micro, meso and macro level. The subjects of this research are different European countries and the sport of elite triathlon. This study aims to identify macro and meso indicators that statistically have the greatest effect on the success of nations in elite triathlon from 2009 to 2017. The analysis is based on World Triathlon Series data, organised by the International Triathlon Union, and the country's economic data. Two models were designed and empirically tested using a multiple linear regression method. The results show that one of the most dominant success indicators of a single nation in triathlon is the number of athletes on the highest level of sports performance, and the number of people employed in sports, an indirect part of the country's GDP. The success of a particular nation depends primarily on clearly set goals in the long-term strategy of sport system development and support provided to coaches who play essential roles in detecting, motivating and attracting talents, and selecting, planning, organising and ensuring the implementation of the training system.

**Keywords:** success indicators, triathlon, Europe

## INTRODUCTION

There are many studies on the correlation between success in elite sports and social, economic, or geographic factors (e.g., Clumpner, 1994; Chalip, 1995). Many scientists try to answer questions such as: Why is some nation more successful in elite sports than other? or What should we do that we have not done already, to be on the top? The factors usually studied include economic wealth, the number of inhabitants, land area, nationality, and political systems (Baimbridge, 1998; Dolowitz & Marsh, 2000; De Bosscher, De Knop, & Heyndels 2003; De Bosscher et al., 2006). Many countries invest enormous amounts of funds to keep their top athletes competitive in sport arenas, reach top-level achievements and be better

than their competitors. These politics may be rooted and find justification in patriotic beliefs, but there is not enough evidence to support that such a sport policy can affect the improvement of results in top sport. This means that, to date, there is no statistically significant relationship between economic development and success in elite sports (Colwell, 1981; Condon, Golden and Wasil, 1999). Furthermore, the self-generated questions are: Which performance indicators to observe and how to define them? and How to define top sport and what reference values to consider?

The definition of success indicators in sports is very complex and variable. It requires complex understanding and knowledge on genetics, environmental factors, and the influence of external factors on people (Seppänen, 1981; De Bosscher et al., 2006; Kuper & Sterken, 2003). Indicators are usually categorised into three basic levels:

the micro, meso and macro level. The correlation of the above indicators is very strong, and each indicator must be observed in relation to the other. Their cohesion is manifested in all social and cultural levels of a particular country.

Macro indicators are most frequently studied in scientific research due to the accessibility of public databases (Gillis, 1980). The indicators on this level are quite rigid and usually include the geographical position of a country and its climate, the economy and population size, the political and cultural system, and the development of the urban system. Examples of macro-level indicators most used by scientists include population, land area and GDP (Hoffmann, Ging, & Ramasamy, 2002; Tcha & Perchin, 2003; De Bosscher, De Knop & Heyndels, 2003).

Meso-level indicators are influenced by the political system and its sensitivity towards sport, i.e., sports policy. Sports policy is related to national politics, which is subject to structural changes and ruling political parties, so meso indicators can be influenced and modified according to the changes in national politics and attitudes. This level is not sufficiently studied and leaves many doubts. Previous literature finds that these results have not reached a clear consensus and that there are no clearly defined indicators of this level (Douyin, 1988; De Bosscher et al., 2006).

Micro-level indicators include the athlete's individual characteristics and his/her immediate environment (family, club, coach, school, friends, etc.). Some indicators on this level can be controlled and influenced by, for example, technique and tactics. Some others, such as genetics, cannot (Chelladurai, 2005; Gibbons et al., 2003; Greenleaf, Gould, & Diefen, 2001).

The subject of this research is the sport - triathlon and macro and meso indicators of success pertaining to the selected European countries in the elite competition system. Triathlon is a modern multisport activity and Olympic-recognised sport that consists of three disciplines – swimming, cycling, and running – performed on different distances and in various time limits, in a predefined order (Friel & Vance, 2013). It is a highly technologically advanced sport that combines the athlete's preparation and control technology, high technological achievements of sports equipment, the latest knowledge in psychological preparation and the science of sports nutrition (Shepard, 1992). Taking all this into account, triathlon reflects the technological advancement and development of a society and, as such, is unique. Triathlon consists of eight variations and more than twenty different disciplines, with the most important and the most respected disciplines being Olympic triathlon (1500m swim, 40km bike ride and a 10k run) and sprint triathlon (750 m swim, 20 km cycle and 5 km run) (Dengel et al., 1989; Sleivert & Wenger, 1993; Bernard & Busse, 2000). The International Triathlon Union (ITU) presented a new elite competition

format called the World Triathlon Series (WTS) in 2009. The primary goal of this format is to bring together the best triathletes from all over the world, as well as to raise the level of quality and visibility of triathlon. The most important part of this system are the five competitions in Olympic-distance disciplines, and three sprint triathlon competitions which have been in place from 2018 onwards (Triathlon Media Guide, 2016).

In WTS series competitions, there are 65 competitors in the men's and women's races, with 75 competitors in the finals of both races. With a 2.5 USD million fund, the WTS is one of the richest and most respected forms of triathlon competitions in the world. The scoring and ranking system is based on scores from the finals and five top WTS results. 1.250 points are awarded to the winner/winners of the finals, and 1.000 points for winning each other WTS event. Each of the subsequent positions is reduced by 7.5% of points. Competitors must be within the cut-off time to win the points, which will be determined by adding 5% to the winner's time in the men's event and 8% in the women's event (ITU World Triathlon Series Ranking, 2017; Vleck et al., 2008; Le Meuret et al., 2009).

## METHODOLOGY

### Sample

This study used data on respondents ranked in ITU's WTS competitions. The ranking is used to determine the best season triathletes and the final ranking is obtained by summing up the five best WTS races and the points achieved at WTS Grand Finals.

WTS data includes 5 basic indicators for male and female competitors and is amended with 7 variables from EUROSTAT (Statistical Office of the European Union). The statistical analysis covers the period from 2009 to 2017 due to availability of data at the time of writing this paper. Further, this analysis focuses only on respondents from Europe, primarily because of the availability of all the relevant data on triathlon and economic indicators accessible through EUROSTAT.

### Variables

12 variables (indicators) used in this study were collected from the WTS ranking data and the country's economic data according to EUROSTAT. These variables belong to macro and meso groups of indicators. A detailed description of the variables is given in Table 1 (unless stated otherwise, all tables are made by the authors). The observation unit in this analysis is the whole country and the

purpose of this research is to determine which factors affect success of a particular country in top triathlon. "Success" is defined here through the average number of points achieved by competitors from each country at WTS. The factors affecting success are divided into three groups: 1) characteristics of the competitor; 2) economic wealth of a particular country; and 3) geographical features of a particular country.

The dependent variable, the average score of a country (PTS) on WTS competitions, is calculated as the ratio of the total score of all the contestants pertaining to a country and the total number of WTS participation of the same country, for each year. This indicator approximates the quality and orientation of each system to top results in the triathlon. The characteristics of the contestants constitute the first group of factors and include the following variables: total number of individual country contestants (ATHs), average age of all competitors (AGE) and the proportion of men in all contestants (GENDER). The logic behind choosing these variables is the following. A greater total number of WTS contestants of a particular country implies that triathlon is already at a significant level of development in that country, and therefore, positive effects of this variable on the success in triathlon can be expected. This indicator also approximates the quantity or breadth of the system that shows the investment in a greater number of triathletes. Younger triathletes should be at an advantage in events of this type because WTS competition is one of the most difficult and challenging in the triathlon world over Olympic- and sprint-distance (Kreider et al., 1988; Thoden, 1991; De Vito et al., 1995). This is also supported by the fact that, as an athlete grows older, endurance increases but the explosion and speed drop (O'Toole, Douglas, & Hiller, 1989; O'Toole & Douglas, 1995). Consequently, it is expected that a state with younger triathletes on average will have more success. The average age of triathletes in a state is an indicator that also shows strategic planning and investment in young athletes, i.e., whether it is a short-term or long-term strategy for sport development (Lepers & Maffiuletti, 2011). Finally, the percentage of men shows gender distribution in WTS events of a certain country, and thus shows consciousness for gender equality. However, there are more men than women in triathlon, so in theory, it should be easier for women to win more points. For this reason, we expect that countries with a higher percentage of women in the WTS triathlon will have a higher number of average points. The indicators that fall within the second group of factors are the economic wealth of a state and economic factors associated with triathlon. Ideally, the analysis would include the national triathlon federation budget of each country, which would be a direct measure of investment in triathlon. However, due to unavailability of this data, the investment and importance of triathlon were measured by other

available indicators. As a country's general wealth, GDP per capita (GDPpc) was taken, expressed in USD for 2010. The assumption here is that a more financially secured and wealthier society will spend more time and money on the quality of life through sport, including triathlon. Although GDP per capita is a rather rough estimate of wealth (e.g., it does not take into account the distribution of this wealth), it is expected the wealthier countries will be able to provide more resources for triathlon, and thus achieve better results. But even if some country is wealthier, it does not necessarily mean that much money will be invested in sports. For this reason, the added value of the industry "Sports, Entertainment and Recreational Activities" (National Classification of Economic Activities, 2007, sector 93) in the total added value of the entire economy (VASport) was considered. In this way, the sports industry is measured in the overall economy of a country. This indicator serves as an approximation of the sports industry development in an individual country, which shows how much people are engaged in sports.

In addition, to separate public and private expenditure on sports goods and services, the share of household expenditure on sports goods and services in the total household expenditure (HHcons) was measured. It approximates how much an individual invests in sports equipment compared to some other activities. A variable of employment in sports activities – the share of employees in sports activities over the total number of employees – (EMP) was also introduced. This indicator shows how many professional experts (professional staff) work in the sports system of a particular country and how many countries are aware of the importance of education in sport. Finally, we define the trade share (import and export) of sports goods typically associated with triathlon – swimming, cycling, and running equipment. Namely, for each country, the trade share for the following groups of goods (TRADE)<sup>1</sup> is:

1) general physical activity equipment, gymnastics or athletics, sports and outdoor games, swimming pools and paddling; 2) bicycles, not motorised; 3) swimsuits, ski suits, sports gloves; and 4) sports footwear. This indicator approximates the expenditure on specific triathlon equipment. For all these factors, it is expected that they have a positive impact on the success of a state in the triathlon. The final group of factors are geographical and annual economic factors. The first of them is access to the sea (SEA). Most of the major international triathlon competitions take place in open water or in the sea, so it is also assumed that the development of the triathlon system will be greater in countries that have the geographic advantage of sea access. Also, the ability to organise a training and competition system throughout the year should be an advantage for this country. The economic effects of a single year (YEAR) were also examined (e.g., the financial crisis at the end of 2008 had a much greater impact

<sup>1</sup>(According to EUROSTAT "Harmonized Commodity Description and Coding System")



on sports in 2009 or 2010 than in 2014) through a set of binary variables as covariates in the analysis for every year. Also, this is an indicator of feasibility pertaining to the strategy and support in the development and long-term periodisation.

**Table 1:** Description of variables in the study

Dependent variable	
PTS	Average number of points scored by a state on WTS competitions each year, calculated as the ratio of the total number of points achieved by its national representatives and the total number of participations in WTS races.
Triathletes' characteristics	
ATH (macro)	Total number of the countries' triathletes who participated in at least one WTS competition each year.
AGE (meso)	The average age of all contestants of a country who participate in WTS competitions each year.
GENDER (meso)	The gender ratio of contestants pertaining to a country who participate in WTS competitions each year.
Country economic indicators	
GDPpc (macro)	Real (2010 USD) GDP per capita of each state (whose representatives participate at WTS competitions) for each year (counted at constant rates from 2010 in US dollars).
VAsport (meso)	The added value of the industry "Sporting activities, entertainment and recreational activities" (NACE Rev. 2 sector 93) in the total added value of all the industries of a country whose representatives participate in WTS competitions.
TRADE (meso)	Trade share (import and export) related to sports goods associated with triathlon - swimming, cycling and running equipment: 1) general physical activity equipment, gymnastics or athletics, sports and outdoor games, swimming pools and paddling; 2) bicycles, not motorised; 3) bathing suits, ski suits, sport gloves; 4) sport footwear.
EMP (meso)	Share of employees in sports activities of a country.
HHcons (meso)	Share of the total average household expenditure of each country on sports goods and services.
Geographic and time indicators	
SEA (macro)	Binary variable – sea access of a country (whose representatives participate in WTS competitions) (1 = Yes, 0 = No).
YEAR	Binary variable for a given year.
COUNTRY	Binary variable for a given country.

Note: The source of all data for economic factors is EUROSTAT (<https://ec.europa.eu/eurostat>), except for GDPpc, whose source is the online World Bank database (<https://datacatalog.worldbank.org/>). The source of the score on WTS competitions is the ITU online database (<https://www.triathlon.org/rankings>).

The theoretical model for the success of a state in triathlon

For the analysis of factors affecting the success of a state in elite triathlon, a theoretical model of the following form (shown in the form of linear equations) is presented: 
$$PTS_{st} = \alpha + \beta'IND_{st} + \gamma'ECON_{st} + \delta'GEO_s + \varepsilon_{st} \quad (1)$$

In Equation/Model 1,  $PTS_{st}$  stands for the average number of points of a state  $s$  in time  $t$ ,  $IND_{st}$  is the matrix of all characteristic variables of competitors pertaining to a state  $s$  in time  $t$ ,  $ECON_{st}$  the matrix of economic indicators of a state  $s$  in time  $t$ ,  $GEO_s$  the matrix of all geographical indicators of a states which are fixed in time (and therefore without index  $t$ ),  $\alpha, \beta, \gamma$  and  $\delta$  are vector parameters to be estimated and  $\varepsilon_{st}$  an error estimation (Acquisti, Brandimarte, & Loewenstein, 2015). Descriptive statistics of variables used in Model 1 are given in Table 2. The analysis covered 27 European countries that had at least one representative at WTS competitions from 2009 to 2017: Austria, Belgium, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Ireland, Israel, Italy, Luxembourg, Monaco, Netherlands, Norway, Poland, Portugal, the Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland and Ukraine. The total number of country-year observations is 194. The "average country" in this dataset obtained 212 WTS points, with a total of 5 WTS contestants and an average age of 26 as well as a slightly higher share of men (52%) versus women. The average real GDP per capita is about 40.000 USD with an extremely large variation range of over 140.000 USD. In an average state, only 0.43% of the added value is achieved in sports activities, although the approximate trade of "triathlon goods" accounts for almost two thirds of the total commodity exchange (60.6%). Furthermore, only 0.77% of all employees are employed in sports activities, while the average household spends 3.34% of their household budget on sport activities.

**Table 2:** Descriptive statistics of the variables from Model 1

Variable	N	Mean	St. dev.
Average number of points	194	212.88	102.48
Triathletes' characteristics of a certain country			
Total number of triathletes	194	5.03	4.48
Average age of the triathletes	194	26.34	2.88
Men	194	0.52	0.33
Country economic indicators			
(ln) real GDP per capita	194	39,723.34	24,816.20
% of sports VA* in total VA	162	0.43	0.14



Trade in triathlon goods	171	60.6	15.53
Employed in sport	171	0.77	0.33
Household expenditure for sport	158	3.34	1.62
Sea access	144	0.74	0.44
Geographic and time indicators			
Observations per year			
2009	19	0.10	0.30
2010	19	0.10	0.30
2011	23	0.12	0.32
2012	22	0.11	0.32
2013	21	0.11	0.31
2014	21	0.11	0.31
2015	23	0.12	0.32
2016	23	0.12	0.32
2017	23	0.12	0.32

% employment in sports	96.57*** (29.97)	
Average HH <sup>b</sup> sports consumption	-5.253 (5.982)	
Sea	5.376 (14.44)	6.886 (18.99)
Observations	194	158
R <sup>2</sup>	0.874	0.875
Adjusted R <sup>2</sup>	0.865	0.860
Year effects	YES	YES

Notes: \* p-value < 0.1, \*\* p-value < 0.05, \*\*\* p-value < 0.01.

Standard errors are presented in parentheses. The year effects are omitted as they are not the focus of our research and for presentation purposes, but they are available upon request. a VA denotes "value added". b HH denotes "households".

## RESULTS

The theoretical Model 1, in its empirical form, is given by the following equation:

$$\begin{aligned}
 PTS_{st} = & \alpha + \beta_1 ATH_{st} + \beta_2 AGE_{st} \\
 & + \beta_3 GENDER_{st} \\
 & + \gamma_1 GDPpc_{st} \\
 & + \gamma_2 VAsport_{st} \\
 & + \gamma_3 TRADE_{st} \\
 & + \gamma_4 EMP_{st} \\
 & + \gamma_5 HHcons_{st} \\
 & + \sum_{t=1}^{T-1} \delta_t YEAR_t + \epsilon_{st}
 \end{aligned} \quad (2)$$

Model/Equation 2 was evaluated by a multiple linear regression method (Eng. ordinary least squares, further: OLS), which is the standard method for this type of research (Škrinjarić, 2016; Škrinjarić, Budak, & Žokalj, 2018; Srhoj, Škrinjarić, & Radas, 2018). The estimation results are presented in Table 3. The model is estimated in two versions - in the first version, only GDP per capita as a measure of the wealth of a country is used, as it is most frequently used in scientific literature, while the second version includes other covariates related to the importance of sport in a particular country (which is also one of the scientific contributions of this research).

**Table 3:** Estimation Results of the Model/Equation 2 by OLS Method

Variable	Version 1	Version 2
Number of triathletes	8.367*** (1.457)	8.044*** (1.691)
Average age	-3.198* (1.819)	-1.847 (2.486)
Men	5.617 (20.07)	0.868 (24.39)
(ln) real GDP per capita	26.04*** (5.059)	10.23 (8.238)
% of sports VA <sup>a</sup> in total VA		34.64 (60.36)
% trade in triathlon goods		0.896 (0.547)

Focusing on Version 1 of the Model 2, the results indicate that significant variables are "total number of triathletes" and "real GDP per capita", i.e., these variables are statistically significantly different from zero in explaining the variation in the dependent variables (the average number of points in a country at WTS competitions). Two significant results are interpreted in the following way: if the total number of WTS triathletes pertaining to a state is increased by one triathlete, leaving all other variables constant (*ceteris paribus* assumption), the average number of points achieved by a country increases by 8.4 points, on average. The interpretation of GDP per capita estimate is similar - if GDP per capita is increased by 1 percentage point, leaving all other variables constant, the average number of points achieved by a country will increase by 26.0 points, on average. All other variables are not statistically different from zero, and thus are not interpreted. In Version 2 of the Model 2, we added the variables that approximate the importance of sport as an activity in a particular country. The total number of triathletes pertaining to a country has remained very significant for the country's success - the magnitude of the effect has only slightly decreased. On the other hand, within this specification, the effect of GDP per capita disappears, and is replaced by the positive effect of the share of people engaged in sporting activities with even greater magnitude of effect on the average number of points in a country. Finally, the results show that age and gender of countries' triathletes are not related to the country's success in the WTS triathlon.

## CONCLUSION AND DISCUSSION

By observing the most used indicators of success, this research has shown that one of the most dominant indicators of a nation's success in triathlon is the number of athletes who have the highest level of sport performance. In both the abbreviated version (Version 1, 8.367, p-value < 0.01) and the extended version of our model (Version 2, 8.044, p-value < 0.01), the estimated coefficients are statistically relevant.

The background of this indicator is far more complex than the number itself. Such a result cannot be reached overnight and by chance. It is a product of clearly set goals in a long-term strategy for the development of a nation's sports system, which implies investing in athletes from the youngest age groups and sexes. The results also suggest that investing not just in triathletes but also in teams of professionals will have synergistic effects in creating a positive competition atmosphere within individual national teams, which will ultimately result in a greater number of average WTS points.

The wealth of a country has a statistically significant role (26.04,  $p$ -value < 0.01) in the success when GDP is observed independently, as in the Version 1 of the model. In the expanded model, its importance decreases, and the most important indicator, as this research suggests, is the number of people employed in sports (96.57,  $p$ -value < 0.01), which is an indirect

part of GDP. This indicator should be implemented in the long-term strategy and systematic development of sport in a particular nation. Coaches are the most important sports employees and the link in the training process who trigger, detect, motivate and attract talents, carry out selection, planning and programming, organise and ensure the implementation of the training system, all in order to achieve top results. The coaches should have resources in order to gain and apply new scientific and professional knowledge, because success in sport is dependent on it. Thus, investment in their education should be permanent.

This research has shown great technological requirements of triathlon through the scoring system at the highest level but also its sensitivity as any other sport. Individual indicators in elite triathlon, not covered in this study, will be observed in future research.

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**MAKRO I MEZO INDIKATORI USPJEHA EUROPSKIH ZEMALJA U ELITNOM TRIATLONU**

Mnogi istraživači pokušavaju utvrditi zašto je određena nacija uspješnija u sportu uspoređujući različite pokazatelje razvrstane na mikro, mezo i makro razinu. Predmeti ovog istraživanja su različite europske zemlje i sport elitnog triatlona. Cilj ove studije je identificirati makro i mezo pokazatelje koji statistički najviše utječu na uspjeh nacija u elitnom triatlonu od 2009. do 2017. godine. Analiza se temelji na podacima Svjetske triatlonske serije, koju je organizirala Međunarodna triatlonska unija, i ekonomskim podacima analiziranih zemalja. Dizajnirana su dva modela i empirijski ispitana metodom višestruke linearne regresije. Rezultati pokazuju da je jedan od najdominantnijih pokazatelja uspjeha pojedine nacije u triatlonu broj sportista na najvišoj razini sportskih performansi i broj zaposlenih u sportu, neizravni dio BDP-a zemalja. Uspjeh određene nacije prvenstveno ovisi o jasno postavljenim ciljevima u dugoročnoj strategiji razvoja sportskog sustava i podršci koja se pruža trenerima koji igraju bitne uloge u otkrivanju, motiviranju i privlačenju talenata te odabiru, planiranju, organiziranju i osiguravanju provedbe sustava treninga.

**Ključne riječi:** indikatori uspjeha, triatlon, Europa

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# THE EFFECTS OF APPLYING THE TRADITIONAL MODEL AND VOLLEYBALL TRAINING DRILLS WITH THE USE OF BASIC GAMES IN 10-11-YEAR-OLD FEMALE VOLLEYBALL PLAYERS

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## ABSTRACT

In this paper, we have tried to present a highly important and current topic with clear goals and tasks. The aim was to determine the effects of various programmes in volleyball, that is, the effects of applying certain methods to motor skills and motor achievements in 10-11-year-old female volleyball players. We analysed the differences occurring due to the application of the programme comprising the traditional work method which has been applied in the control group and the work method solely involving the ball with the use of basic games in the experimental group. The obtained results point to the fact that the applied training model comprising the traditional approach gave rise to positive changes in favour of the control group for the variables: 10m V/S run, FABER test, backwards obstacle course and side steps. In ten out of sixteen variables which we used in this research, there were positive changes in favour of the experimental group which applied the volleyball drills model and basic games in each part of the training. The variables which had positive changes were: standing long jump, 30-second torso lift, 30-second torso extensions, flexed arm hang, hand tapping, foot tapping, wall foot tapping, deep bench forward bend, seated forward bend, backward long jump. In eleven variables, the differences were significant at the level of  $p < 0.01$ , while in two variables, the differences were significant at the level of  $p < 0.05$ , which determine the space of motor achievements. Based upon the obtained research results, the presented changes are conditioned by different work content and can become an obstacle for possible corrections when creating a plan and programme for training younger categories.

**Keywords:** volleyball, motor skills, motor achievements, transformational effects, girls, basic games

## INTRODUCTION

**M**otor achievements represent a combination of motor knowledge and motor skills and are expressed through the athlete's ability to combine and fully use them in a specific motor activity so as to achieve the best possible result (1-3). Since motor achievements come down to achieving maximum results in certain motor activities, the goal of their verification is to determine the potential abilities of the athlete, that is, the level of their achievement in certain stages of training (4-6). Complex sports activities comprise a system of simple and intricate movements pertaining to one or several athletes in sports competitions between individuals or teams (7, 8). Volleyball has the components of aerobic and anaerobic activities and is defined as a polystructural complex sport (9, 10). Often, the methods for developing and maintaining certain anthropological, most frequently motor and functional, dimensions in sports practice are called "training methods", and the methods for increasing the pool of technical and tactical knowledge are called "learning" or "teaching methods" (11-14). With the goal of planning optimal training, the selection of training methods is carried out by choosing those which can more efficiently affect the development of training in a young child who is subjected to systematic training (15, 16). Motor skills enable us to successfully, strongly, quickly, lengthily, precisely and harmoniously execute different motor tasks (17, 18).

## WORK METHOD

In this research, we have monitored the changes in the dynamic system of 10-11-year-old female volleyball players from the aspect of motor skills and achievements in the function of time (longitudinal research with the duration of 6 months) under the influence of the applied operators within the volleyball training process and application of various work methods and forms in the training process. A total of 100 young female volleyball players have volunteered for this research conducted by applying the experimental research model including the initial and final testing of the experimental ( $n = 50$ ) and control ( $n = 50$ ) groups. During the study, female volleyball players were randomly divided into two different groups: experimental and control. The control group applied the traditional training approach while the experimental group conducted a programme using volleyballs and basic games. The training process for the control and experimental groups was conducted three times a week for the duration of 1h and 30 min. The training process has been continually conducted for 24 weeks. The differences were in the content of the training process, that is, the method and work form. The traditional method was applied in the control group (running, shaping exercises, exercises containing movement with and without the ball and learning volleyball techniques

by working in pairs). In the experimental group, the work was solely based on exercising with the ball and using basic games in all parts of the training. In both groups, emphasis was placed on the special didactic approach to methodical exercises which were appropriate and necessary for their age (19). The content of the 90-minute training programme which was applied in the control group comprised: shaping exercises - stretching for the first 15 minutes, 15-minute stretching exercises, 10-minute balance exercises, 15-minute training for the development of motor skills and technical training and development (volleyball elements).

The content of the 90-minute training programme which was applied in the experimental group comprised: basic games adapted to all parts of training (introductory, main and final) and volleyball drills. The intensity of each training in both groups was designed to be 60-80%.

After the athletes' families read and signed the form which described the testing procedure (consent form), the following tests were applied within the 24-week training programme: Explosive strength: standing long jump - MSDM; 10m V/S run - M10VS; seated basketball throw - MBKL; Repetitive and static strength: 30-second torso lift - MD30; 30-second torso extensions - MI30; flexed arm hang - MVIS; Speed: hand tapping - MTAR; foot tapping - MTAN; wall foot tapping - MTANZ; Flexibility: deep bench forward bend - MDPK; seated forward bend - MPSR; FABER test - MFABER; Coordination: backwards obstacle course - MPONA; side steps - MKOST; backward long jump - MSDN. All subjects who participated in this research underwent measurements and testing under the same conditions.

Motor skills were measured in the afternoon, during team training. The measurements were taken using standard instruments. SPSS 21.0 software package was used for statistical analysis and calculation. Since the data on intergroup tests showed a normal distribution, a t-test was used for comparing both the independent samples and paired samples. The accepted level of significance in this study was  $p < 0.05$ .

## RESULTS

In Table 1, we determined the difference between the experimental and control groups with the use of a t-test for independent samples. Analysing the results from Table 1, it is visible that there are no statistical differences ( $p < .01$  and  $p < .05$ ) between the arithmetic means of the control and experimental groups comprising female volleyball players in all the variables treated in this research.



**Table 1:** Differences between motor skills in the experimental and control groups - initial measurement

	Independent Samples Test				
	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
MSDM	.023	.881	1.208	99	.230
M10VS	.222	.639	-.376	99	.707
MBKL	.233	.630	.411	99	.682
MD30	.553	.459	-.749	99	.456
MI30	2.717	.102	-.458	99	.648
MVIS	1.945	.166	-.539	99	.591
MTAR	1.976	.163	.551	99	.583
MTAN	.086	.770	-.597	99	.552
MTANZ	2.576	.112	-.110	99	.913
MDPK	.016	.899	-1.463	99	.147
MPSR	.191	.663	-1.514	99	.133
MFABER	.172	.679	.950	99	.345
MPONA	.312	.578	-.247	99	.805
MKOST	.139	.710	.358	99	.721
MSDN	1.959	.165	.383	99	.703

Investigating the results in Table 2, in the final measurement, it is visible that one variable did not have any statistically significant difference between the initial and final measurements, namely, the variable MBLK (seated basketball throw) with the significance of .207. All other variables achieved statistically significant differences at the level of  $p < 0.01$  in twelve variables: standing long jump – MSDM – sig. 0.003; 10m V/S run - M10VS – sig. 0.004; 30-second torso lift - MD30 – sig. 0.000; 30-second

torso extensions - MI30 – sig. 0.001; flexed arm hang - MVIS – sig. 0.001; hand tapping – MTAR – sig. 0.004; foot tapping – MTAN – sig. 0.000; wall foot tapping – MTANZ – sig. 0.000; deep bench forward bend – MDPK – sig. 0.001; seated forward bend – MPSR – sig. 0.001; FABER test MFABER – sig. 0.005; side steps – MKOST – sig. 0.000. In variables (backwards obstacle course – MPONA – sig. 0.014 and backward long jump – MSDN – sig. 0.031), there was a statistically significant difference at the level of  $p < 0.05$ .

**Table 2:** Differences between motor skills in the experimental and control groups - final measurement

	Independent Samples Test				
	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	T	df	Sig. (2-tailed)
MSDM	.114	.736	-3.093	99	.003
M10VS	2.535	.115	2.916	99	.004
MBKL	.312	.578	-1.271	99	.207
MD30	.744	.390	-6.336	99	.000
MI30	5.262	.024	-3.415	99	.001

MVIS	4.250	.042	-3.517	99	.001
MTAR	.130	.720	-2.985	99	.004
MTAN	.496	.483	-6.448	99	.000
MTANZ	.029	.866	-5.462	99	.000
MDPK	1.745	.190	-3.346	99	.001
MPSR	.354	.553	-3.581	99	.001
MFABER	.206	.651	2.840	99	.005
MPONA	2.884	.093	2.511	99	.014
MKOST	1.718	.193	4.762	99	.000
MSDN	.924	.339	-2.188	99	.031

## DISCUSSION

The success of each athlete should always be observed as a dependent changeable variable which is subject to a larger number of constant and changeable factors and, in this context, we can definitely claim that the training process, in whichever form, contributes to the general progress of all life functions and activities (20-22). In Table 2, the results of analysing the differences between arithmetic means of variables for assessing motor skills in the experimental and control groups are presented and, based upon the significance of the changes (p) tested by using a t-test, we can see that the applied programmes have produced positive partial changes in four variables (10m V/S run - M10VS, FABER test - MFABER, backwards obstacle course - MPONA; side steps - MKOST) in favour of the control group and ten in favour of the experimental group (standing long jump - MSDM, 30-second torso lift - MD30, 30-second torso extensions - MI30, flexed arm hang - MVIS, hand tapping - MTAR, foot tapping - MTAN, wall foot tapping - MTANZ, deep bench forward bend - MDPK, seated forward bend - MPSR, backward long jump - MSDN). In eleven variables, the differences were significant at the level of  $p < 0.01$ , while in two variables, the differences were significant at the level of  $p < 0.05$ , which determine the space of motor achievements. Qualitative motor skills are, according to (8) "comprised of four fundamental skills: coordination, agility, balance and precision as well as their derivatives such as speed coordination, lateral agility, etc. Their characteristics are quality management and control of whole-body or body-part movements; control of spatial and temporal parameters when executing certain motor tasks." Motor communication in sports games is performed on a motoric plan by engaging the movement system (23, 24). All movements in team sports games are performed in the attack and defence system. The main communication channel is the ball and it determines the team's interpersonal communication in the attack and defence (25). The primary communication channel also requires certain movement characteristics from the players in the sense of certain movement

structure characteristics, their differentiation, as well as considering the motor dispositions which are accomplished through movement (26, 27). When training young age categories, emphasising the number of repetitions during movement learning is not appropriate if the formation of new habits is connected with a quick decrease in the functional abilities of the nervous system (4, 28, 29). Training methods represent specifically determined methods for trainers working with the youth so as to achieve the best possible development of their psychosomatic qualities and more complete acquisition and development of a certain sum of knowledge on movement and situation structures in a specific sports discipline (30, 31). In the age categories comprising 10-11-year-olds, there are sensitive periods during which a certain motor skill can be affected, and the game is an ideal means for developing these skills (32, 33). Controlling physical movements is the essence of volleyball training since, in this case, a physical movement is aimed towards the goal, means and development. In sport, training has its own characteristics whose essence lies in the fact that the majority of the new matter is learnt by mastering different physical movements in the form of physical exercise (19, 34)

## CONCLUSION

The conducted research obtains its purpose through explaining the effects of the programme which contribute to the difference in motor functioning of the two groups of subjects, that is, the results providing evidence are the information based upon which we determine the changes that have been generated by the training treatment reflected in a different level of skills or, in other words, which skills contribute the most to the difference alongside a simultaneous insight into the skills necessary for a successful outplay, i.e., which of the training methods are best for application in this age category so as to get the best possible motor achievements.

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### **EFEKTI PRIMJENE TRADICIONALNOG MODELA I TRENIGA SA LOPTAMA UZ PRIMJENU ELEMENTARNIH IGARA KOD ODOJKAŠICA UZRASTA 10 -11 GODINA**

U ovom radu pokušali smo predstaviti veoma važnu i aktuelnu temu sa jasnim ciljevima i zadacima. Cilj nam je bio da utvrdimo efekte različitih programa u odbojci, odnosno efekte primjene određenih metoda na motoričke sposobnosti i motorička dostignuća kod odbojkašica uzrasta 10-11 godina. Analizirali smo razlike koje su se desile usljed primjene programa po tradicionalnom modelu rada koji je primjenjen kod kontrolne grupe i modelu rada isključivo sa loptom sa primjenom elementarnih igara kod eksperimentalne grupe. Dobiveni rezultati ukazuju da je primjenjeni trenažni model po tradicionalnom pristupu izazvao pozitivne promjene u korist kontrolne grupe i to varijable: trčanje 10mV/S, FABER test, poligon natraške i koraci u stranu. Kod deset od šesnaest varijabli koliko smo koristili u ovom istraživanju pokazale su se pozitivne promjene u korist eksperimentalne grupe gdje se primjenjivao model rada sa loptom i elementarne igre u svakom dijelu treninga. Varijable koje su ostvarile pozitivne promjene su: skok u dalj iz mjesta, dizanje trupa trbuh 30 sec, ispravljenje trupa 30 sec, izdržaj u zgibu, taping rukom, taping nogom, taping nogom o zid, duboki pretklon na klupici, pretklon iz sjeda raznožno, skok u dalj natraške. Kod jedanaest varijabli razlike su značajne na nivou  $p < 0,01$ , dok su kod dvije razlike značajne na nivou  $p < 0,05$ , a koje određuju prostor motoričkih dostignuća. Na osnovu dobijenih rezultata ovog istraživanja, predstavljene su promjene uvjetovane različitim sadržajima rada te se mogu predstaviti kao preporuka za eventualne korekcije pri izradi plana i programa treninga mlađih kategorija.

**Ključne riječi:** odbojka, motoričke sposobnosti, motorička dostignuća, transformacioni efekti, djevojčice, elementarne igre

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# DISRUPTED HABITUS: PHYSICAL ACTIVITY EXPERIENCE AMONG IMMIGRANT YOUNG PEOPLE

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## ABSTRACT

The purpose of this phenomenological study was to investigate physical activity as disruptively experienced by Indonesian immigrant youth. Seventeen young Indonesian immigrants living in New Zealand agreed to participate in the research. Open-ended interviews were conducted to specifically obtain the data about embodiment and the lived experience of doing physical activity within migration contexts. All recorded interviews were transcribed verbatim for further analysis. The results showed three themes, including (1) pre-migration habitual physical activity, (2) migrating the physical capital, and (3) the creative migrant-related practices. Current elaboration of Bourdieu's conceptual works is advantageous in illuminating migrant-specific experience with regard to physical activity. While follow-up studies may consider either other sociological frameworks or approaches in qualitative research, the accumulated knowledge on this specific topic can improve policies, programmes, and practices concerning immigrant youth physical activity.

**Keywords:** immigrant youth, physical activity, Bourdieu, lived experience

## INTRODUCTION

Youth physical activity has been well documented in literature. Scholarly works have, almost conclusively, depicted the prevalence, patterns, and determinants of youth physical activity (e.g., Garn, et al. 2016; Kim, et al. 2017; Kowaleski-Jones, et al.; 2016; Rainham, et al., 2012). Undoubtedly, such knowledge has become one of the vital elements in the process of policy making, programme development, and practice concerning health, youth, and physical activity.

Despite its contribution, the existing literature can risk missing important information as the underpinning studies are disproportionately much driven by an epidemiological perspective (Wright & MacDonald, 2010). Indeed, little is known about youth's lived experiences regarding physical activity, the constructed meaning of those experiences, the process of their participation, and other aspects derived from youth perspectives. Deriving from these needs, scholars have attempted to pay attention to this generally neglected area in

youth physical activity literature (e.g., Hoffman, Hayes, & Napolitano, 2014; Shea & Beausoleil, 2012; Verschuren, et al., 2012). Other scholarly works have also illuminated this area by using socially critical frameworks.

One of the important frameworks includes Bourdieu's concepts. His works underline a sociological perspective on corporeality and embodiment which is epistemologically powerful in looking at aspects of physical activity being skewed towards one biomedical viewpoint. The tenets of a Bourdieusian approach, namely capital, habitus, and field, have advanced the understanding about youth physical activity from a fresh new outlook. For example, some studies focused on cultural capital (e.g., physical capital) as it mediated young people's participation (Wiltshire, Lee, & Evans, 2017), played out in constructing ability (Wright & Burrows, 2006), and "produced and reproduced advantage and privilege" (Horne, et al., 2011, p. 861). Stuij (2015) worked with youth from different social classes on how they acquired the habitus (e.g., skills and competences) necessary to participate in physical activities. Similarly, other scholars also borrowed Bourdieu's framework to interpret school physical

education and sport as a social field which regulated the gendered body (Metcalfe, 2018) and the social space of physical education class (Hunter, 2004).

Studies about specific population such as immigrant youth have also employed Bourdieu's theory. Meador's (2012) ethnographic project focused on one of Bourdieusian central thoughts: taste. Taste socially categorises individuals based on their preference for things such as arts, sports, clothes, and music. Meador informed that the interplay of preferences for the academic, school physical activity, peer culture could academically hinder immigrant students. Furthermore, Pang and MacDonald (2015) drew on Bourdieu's central tenets and Chinese Confucianism philosophy to investigate various dynamic immigrant youth experiences in school physical activity. In a quadrangular representation, they reported a heuristic of differences on Chinese immigrants' embodied capital (in)consistency with Anglo-Celtic practices and (mis)recognised experiences.

In this current study, we were motivated to contribute to the existing literature. We used the Bourdieusian framework, focusing specifically on the experiences of major life change. The framework also allowed us to explore immigrant youth's physical activity experience as they entered into new social fields within the country of migration involving disruption of the habitus and devaluing the social and cultural capital.

## METHODS

### Study design

The current research included a qualitative method through which we approached the research problem with a phenomenological research framework. This framework focuses on participants' experience and the meaning they attribute to it. In this study, we paid close attention to activity as experienced by those who have crossed cultural borders. Illuminated by Bourdieu's framework, three research questions were developed to guide our study.

1. What were the participants' physical activity experiences prior to immigration?
2. How has the immigration event disrupted their physical activity experience?
3. How was physical activity currently practiced within the immigration context?

### Participants

The participants for this study were Indonesian immigrants ( $n = 5$  females, 12 males) aged between 13 and 20 years old. They are recent immigrants to New Zealand marked by their immigration status (first and second generations). We considered recruiting participants who have stayed in New Zealand for at least

one consecutive year. With this length of stay, it was expected that the youth had more meaningful lived experience with regard to physical activity in their new home country. We also considered physical activity from the perspective of physical culture (Giardina & Newman, 2011; Silk & Andrews, 2011). This way enabled us to take into account various forms of physical activity through which the youth culturally exercised their physical body within multiple, transnational contexts. An example included recreational physical activities, exercises, and sports (Kirk, 1999).

### Data collection and analysis

Data were collected through in-depth, open-ended phenomenological interviews focusing on collecting information about participants' experiences. The interviews were conducted in the language (e.g., Bahasa Indonesia or English) chosen by the participants. All the interviews were recorded and transcribed for analysis.

Data analysis was conducted by using thematic analysis. The procedures included reading the interview transcripts, assigning the significant statements with codes, grouping related codes into categories, and recovering themes from those categories. As a phenomenologically informed analysis, we looked for segments of the data that authentically described the participants' lived experience. We also paid attention to not being too mechanical during the analysis process (van Manen, 1990).

## RESULTS

Three themes emerged from our analysis. They include: (1) pre-migration habitual physical activity, (2) migrating physical capital, and (3) the creative migrant-related practices. The following sections describe these three themes.

### Pre-migration habitual physical activity

Some of the participants ( $N = 12$ ) were the first generation of immigrants who left the country at their early age. Most of them indicated to have school-based physical activity (PA) experience, but only five participants could actually recall their Indonesian experience. Despite having experienced various types of games, most of the participants played soccer/futsal and badminton. The following paragraphs describe pre-immigration PA derived from these five first-generation participants' experience. Physical education throughout the archipelago tended to provide the students with soccer experience. If there was different activity content of the day, it would normally be followed



by playing soccer. Tykno said, "The teacher taught us different sports, but it was always soccer for ten minutes before it's over." This might reflect the centrality of soccer in the heart of Indonesian society. Unlike soccer, badminton is rarely delivered as a PE content. However, the badminton national team has consistently secured the podiums since 1958, including the Summer Olympic Games. These international achievements served to reinforce "a sense of Indonesia national identity" (Brown, 2006, p. 93) which has eventually allowed badminton to become the common sport.

The youth's participation was mostly informal, non-organised in nature. Access to organised physical activities is usually not immediately available in Indonesia (Soegiyanto, 2013). The exception includes school-based activity programmes (e.g., physical education classes and sport-based extracurricular programmes). Narjo mentioned, "I played futsal in Indonesia, but it was only a school activity." These programmes were generally poorly designed and limited by the lack of proper equipment and facilities. Other than the school programmes, considerable efforts were usually needed to participate in organised physical activities. In this context, participation involved not only provision of reliable transportation and significant expenses for membership fees (economic capital) but also specific know-how, knowledge, demeanours, and manners (cultural capital) required for meaningful engagement. Following Bourdieu's line of thought, the preference in organised physical activities in Indonesia would generally mark the upper-class habitus (Shilling, 2004) since it could only be afforded by the dominant classes.

Furthermore, we found that the contexts of physical activity (i.e., organised/non-organised physical activities) were also prevalent in creating social distinction, in addition to the types of physical activities. Certain types of physical activity have distinctly been positioned within the field, resulting in the differentiated values of the activities and the participants' social hierarchy. For example, swimming, tennis, and golf were often appreciated as having higher taste and were played by the dominant classes. Meanwhile, the working classes' physical activity experiences included pick-up soccer, badminton and volleyball. Mukri observed the popular sports in Indonesia. He said, "Most of them play football. Maybe not everyone plays football but a lot of them do the most common sport there is football and then after that it's badminton cause a lot of people play badminton." [sic] However, soccer and badminton were actually also played by participants from different social statuses. What made those activities create social distinction were the contexts of the activities. Some dominant classes played popular sports, yet in organised settings. Putting it all together, the organised and upper-class sports would magnify the symbolic value of the activities and

the social status of the participants.

An equally important thought from Bourdieu (1978: 826) is how "the legitimate function of sporting activity" could also create social distinction within pre-immigration contexts. Coming from a relatively dominant class family, Karmini played badminton. She said, "In Indonesia I used to do sport to keep healthy and lose weight." Her statement indicates motivation formed through her acquired dispositions and competences. We have reflected that Indonesians tended to believe in sport as a vehicle to develop personal characters (Coakley, 2011) and, therefore, their participation was beyond corporeal purposes. The upper-class people, however, considered that sport participation served as their corporeal techniques and disciplines since the obesity discourse was mainly circulated among the dominant classes. This analysis aligns with Mehraein's (2016) study that corporeal health was central in engaging in sport among Iranian upper classes.

Borrowing Shilling's (2004) concept of physical activity as a situated action, additionally, data can be interpreted that, prior to the resettlement in New Zealand, the participants had endured habitual physical activity facilitated by the material contexts. It was shown by, for example, the pre-reflective nature of their experience. Some of the youth took their physical activity participation for granted even though the conditions of the available facilities and equipment limited their physical activity. They tended not to think much about how their bodily activities should work out under certain situations and just went off doing the activities. Karmini described her swimming experience back in Indonesia. She said, "We have to swim by width because there is too many people and they don't divide the line. So yeah, it's very hard to swim the full length one because people are going from any direction." [sic] Karmini never thought that such a pool situation was actually poorly organised and would not be able to help her accomplish adequate amount of physical activity until she swam in New Zealand pools. However, the limited material situations did not inhibit the youth to actually grasp one of the core elements of physical activity, which was the enjoyment.

Literature has informed that enjoyment is an important structure of physical activity experience among young people (e.g., Yungblut, Schinke, & McGannon, 2012). Despite being constrained to perform the real games, they still enjoyed their physical activity. Mamat came from a well-resourced family, but real equipment to play soccer was not immediately available in his neighbourhood. He said, "What I remember is we still played soccer but without a ball. We used water bottle, plastic water bottle. It's pretty fun yeah." This habitual way of doing physical activity involved a complete familiarity. Following Mearleau-Ponty's line of thought (Moran, 2011), these youth did not seem to cognitively

calculate whether or not a water bottle (improper equipment) would be kickable for playing soccer. The youth basically embodied the plastic bottle, dirt field and bamboo stick goalies, and experienced them as objects unseparated from their corporeality. These objects served as instruments being used to articulate the very essence of the game play: enjoyment.

#### Migrating physical activity: an embodied interruption

Immigration literature informs that the longer immigrants stay in the host country, the more they are acculturated (Portes & Rivas, 2011). The youth participating in this study were relatively recent migrants marked by the immigration generations. First generation (N = 12) had different lengths of stay, ranging from 1 to 10 years. Five participants were second generation immigrants and have spent their entire lives in New Zealand.

Taking into account a phenomenological framework, Kirova and Emme (2012) argued that immigration is "an experience that interrupts the familiarity of the lifeworld" (p. 142). In physical activity, familiarity can be a result of what, in Foucault's conception, is called disciplinary techniques (Markula & Pringle, 2006). These techniques are commonly operationalised in physical activity as practices intended to regulate bodies (Kirk, 2002). Eventually, this regulated corporeality leads to normalised bodies. First generation participants tended to get accustomed with physical activity skills, techniques, and knowledge required for meaningful participation in Indonesian contexts. Karmini said, "I used to do badminton. I take badminton after school activity. That's more because a lot of my friend [sic] taking it." Then, the event of immigration appeared to be the interruption of Karmini's normalised body and the barrier to proceed with badminton. She explained, "I would love to do badminton but I don't see a lot opportunity to do it here. I don't really saw [sic] or talk to people who do badminton here." During the time of intense interrupted familiarity, some of the youth tried to step into a new field even though their physical capital (i.e., skills) might not effectively work out for productive use (i.e., playing the games). As a result, awkwardness of corporeal performance could happen as experienced by Tykno. His corporeal capital was associated with kicking, not passing the ball using hands. He also had no know-how about playing rugby. He stated, "It was quite hard for the first time. Cause the ball is like different ball. But I try to play for the first time I kinda just kick the ball. Cause this is the only sport that I play in Indonesia is like soccer. I just kinda kick the ball, nowhere." [sic]

Furthermore, the interruption of pre-immigrated habitual physical activities could also result in what Shilling (2004) called "embodied crisis" (p. 483). Seven participants articulated concerns with their bodies

as vital assets to participate meaningfully in physical activity. Although not even a half of the participants, their typical physical appearance was equal to the average Indonesians who are inferior in height and muscular development. Embedded in their flesh were the body size and shape which they did not consider to be, what Bourdieu (1978) called, "the legitimate body and legitimate use of the body" (p. 826) for playing the mainstream sports in New Zealand society. Narjo, for example, thought that he would not physically fit into rugby. He put his reason, "I see my size, like other Indonesians, I'm not really big." In other words, some of the participants experienced misrecognition through which "the performance-competence discourse was played out against those with particular body types" (Hunter, 2004, p. 187).

Another part of the embodied crisis included the manner in which most of the boys found out that New Zealand students were really focused on real physical contact. This was certainly not a style of playing that they used to do. With soccer being the main sport in Indonesia, their sport was team sport but it was a different level of physicality. More specifically, the participants considered that their physical capital inhibited skill development required to play contact sports, which in turn led to the formation of habitually rooted disapproval of those sports. For example, Luthfi looked back to his early years of settling in New Zealand.

"I just don't like contact sport. I remember back in year two and you were playing basketball and in a lot of contact sport you had to steal the ball and I told the teacher, "ugh it's not my thing, I need to sit down." I just can't do it."

All of these seven participants also considered not to play team sports requiring strong physicality. For example, Mukri's habitually ingrained frame of mind included a disposition that his body could not be effective to play certain types of sport. Back in Indonesia, Mukri's body was effective as physical capital to play socially visible sports. In his post-immigration time, however, his physical capital was not exchangeable to afford the major sports in New Zealand, even to obtain demasculinised, limited-contact sports such as touch rugby. For once, Mukri had tried to participate, but an accident had traumatised him. He said, "He was my age but not the same body type. He was huge. He was a lot bigger. He ran to me into a wall. They said I blacked out, they said I passed out." [sic]

In addition, analysis showed that embodied crisis also happened as a result of the devaluation of preference. A few numbers of the participants experienced their physical activity preference being devaluated, especially among those who engaged in non-body contact sports. They seemed to learn that New Zealanders valued the centrality of body contact sports and positioned other sports peripherally. In some cases, devaluation took place through racially

stereotyping those who participated in non-mainstream sports. For example, having resided in New Zealand as a first-generation immigrant for 15 years, Lutfi shared his experience,

"Kiwi people, they're very rough, especially boys. They're very rough. They love contact sport tackled rugby. I just can't, because some people can be very traumatic. Especially for people who're not from New Zealand because it's not - they don't identify as Kiwi some people they come here, "Oh you're in New Zealand - you have to be like - you have to try to be like us."" [sic]

While devaluated cultural capital can happen to any individual, it appears to be unavoidable among immigrants.

#### The creative migrant-related practices

One important construction of phenomenological habitus includes congruity with Bourdieu's original thought on habitus. It states that the actions of a social agent are ingrained in habits. However, Crossley argued that, among these reproductive actions, there are actions that "manifest a degree of creativity and innovation" (p. 116).

One of the creative and innovative actions may be manifested through creative revelation by which the participants discovered that, beyond physicality, physical activity could be aimed at integrating into their new home culture. This was especially apparent among those who came to New Zealand when they had already been adolescents such as Narjo, Andre, Kartika, Mamat, Putra and Tyo. For example, Narjo acknowledged that he could not legitimately use his body to play body-contact sports. Instead, he took advantage of school sports to learn English. He described his early days of staying in New Zealand, "The first time I came here, I had no friends. My English was poor. I felt lonely in school. Then, I joined a sport event at school so I could talk to people." Apparently, language limitations have been deemed to be the barriers for immigrants to integrate in their receiving countries (e.g., Santiago, et al. 2014; Turney & Kao, 2009). The participants, especially those recently arrived in New Zealand, creatively took advantage of physical activity as one important gate to acculturation.

The actions of the participants also showed ingenious discovery as they found themselves, borrowing Shilling's idea (2004), physically more "capable [than] they had previously assumed" (p. 484). This was particularly true among female participants (N = 5) who grew up with a family habitus that, to a certain degree, predisposed traditional gender roles. For example, second generation Amanda grew up with relatively traditional values of Islam and played relay race in her all-girl, religious-based school. She considered that physical activity participation could help her redefine femininity as not always about

"lazy and being make-up and nail polish." Similarly, Fara had long considered to join community boxing because of its masculine stereotype. However, she finally thought that boxing "shouldn't be men only, girls can do it too" and continued to sign up for the class. She stated, "You know what? Who cares, I'll do it anyway." Certainly, physical activity was not the only pathway to experience liberation. Some of the female participants acknowledged that they became attentive of gender equality through cultural learning from various resources in New Zealand society. However, they reinvented physical activity as an important arena in which they could express their newly acquired awareness regarding gender equality.

Additionally, aligned with Erel's (2010) findings, data showed that the youth in this study creatively negotiated and validated the practices of their physical activity throughout the dominant physical cultural practices in New Zealand. However, being aware of the devaluation of their physical capital or misrecognition of their bodily cultural practices, they negotiated their participation by lingering around their predisposed habits of cooperation and participating in pick-up games or organised sports which deemphasised competitiveness and exclusiveness. First-generation Fara told her experience of getting through the basketball trial:

"We don't care how good or bad you are as long as you wanna play, just get in. Cause they thought there will be more than 10 people cause they need 10 people to be in the team. But there was only 9 people who trial so everyone got in." [sic]

She enjoyed her social basketball and validated it as her joyful, relaxing moment. Some other participants made their physical activity culturally valid for acquiring social networking in a safe way. For example, Luthfi stated,

"It's just social soccer, just get in there to meet new people that's probably the most important thing if you can get that experience, but that's, there's no, "Oh we're counting on you, you do this," None of that."

Another creative revelation included the negotiation of school physical education as a likeable subject. First generation youth who had Indonesian PE experience (N = 5) did not regard the subject as academically central. Considering to have a low status, Narjo said, "I have no impression about PE in Indonesia." In their post-immigration period, however, most of the participants validated PE as not only an enjoyable subject matter but also, more importantly, as a safe place for their physical activity engagement. For example, Luthfi described that in PE, "Teachers, they're really understanding." This act of validation could indicate a strong self-empowerment among the participants of this study. Therefore, the youth's action to validate PE as a likeable subject was actually empowering.

## CONCLUSION

Immigration from one society to another culturally contrasting society could result in a major life change. This change included physical activity habitus as experienced by immigrant youth in this study. Bourdieu's framework has been useful to understand how habitually ingrained physical activity played out in reproducing current participation within the new context. This action was clearly articulated in the theme "pre-migration habitual physical activity." As immigration then appeared to interrupt a considerable part of the habitus, however, frameworks beyond the Bourdieusian had become powerful in looking at how disrupted habitus manifested in the youth's physical activity. The second theme, "migrating physical capital," represents their experiences of crisis when their sedimented habits had no longer been much effective for engaging in physical

activity in their new social field. This crisis led to the creation of innovative actions depicted in the last theme about their new sporting practices. This theme aligns with the notion of situated action through which the immigrants' action was not only mediated by their habitus, but also the crisis they were dealing with and its creative revelation (Shilling, 2004). In fact, the youth had been able to navigate themselves throughout New Zealand's physical culture and had managed their current physical activity participation. Moreover, the study represents a solid portrayal of phenomenological habitus. Following Crossley's line of thought (2001), the phenomenological analysis of habits allowed the current study to consider how young people's habits not only disposed actions regarding physical activity, but how these actions also create new habits.

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**NARUŠENI HABITUS: ISKUSTVO FIZIČKE AKTIVNOSTI MLADIH IMIGRANATA**

Svrha ove fenomenološke studije je bila ispitati fizičku aktivnost koju su mladi imigranti iz Indonezije iskusili kao narušenu. Sedamnaest mladih imigranata iz Indonezije koji žive u Novom Zelandu su pristali na učešće u istraživanju. Intervjui otvorenog tipa su provedeni kako bi se dobili specifični podaci o utjelovljenju i proživljenom iskustvu bavljenja fizičkom aktivnošću unutar konteksta migracije. Svi snimljeni intervjui su doslovno transkriptovani za dalju analizu. Rezultati su ukazali na tri teme, uključujući (1) uobičajenu fizičku aktivnost prije migracije, (2) migraciju fizičkog kapitala i (3) kreativne prakse vezane za migrante. Trenutna objašnjenja konceptualnih djela Bourdieua su korisna za pojašnjavanje iskustava svojstvenih migrantima, a u odnosu na fizičku aktivnost. Dok daljnje studije mogu razmatrati ili druge sociološke okvire ili pristupe u kvalitativnom istraživanju, prikupljeno znanje o ovoj specifičnoj temi može poboljšati politike, programe i prakse koje se odnose na fizičku aktivnost mladih imigranata.

**Ključne riječi:** mladi imigranti, fizička aktivnost, Bourdieu, proživljeno iskustvo

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# NORMATIVE DATA ON HEIGHT, WEIGHT AND BODY MASS INDEX AMONG BELGRADE PRE-SCHOOL CHILDREN

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## ABSTRACT

Child care, health and normal physical growth are recognised as one of the most important tasks in the upbringing of pre-school children. The prevalence of childhood obesity has been increasing dramatically worldwide, yet the normative data among pre-school children is not available for a number of countries. The purpose of the present study was to provide normative data quantifying height, weight and body mass index of 4-7-year-old Belgrade pre-school children. This research included a sample of 814 4-7-year-old pre-school children of both genders (551 boys and 263 girls) who were evaluated during the regular programmed activities within the children sport school (three times per week). Body weight and body mass index were measured using standard procedures of bio-electric impedance InBody 230. Weight, height and BMI percentile values are presented in gender-specific tables. The results showed that, compared to the age of the observed sample, the highest prevalence of BMI values above the average is in 5-year-old girls (30.3%) and 4-years-old boys (28.3%). The prevalence rates of overweight (including obesity), vary across different age groups, with the highest rates reported in 5-year-old boys (15.2%) and 4-year-old girls (15.1%). The results of the present study confirm this troubling prevalence in our country, indicating a secular trend of increasing among pre-school children. Monitoring growth to identify health- or nutrition-related problems is an important task for healthcare professionals.

**Keywords:** 4-7-year-old children, body composition, percentiles, sport school

## INTRODUCTION

Child care, health and normal physical growth are recognised as one of the most important tasks in the upbringing of pre-school children. In contrast to other ages, pre-school children are still in the process of forming healthy habits that will further reflect their future life (Ivanović & Gajević, 2016; Bićanin, Milenković, Radovanović, Gajević, & Ivanović, 2018). Professional and scientific attention is increasingly occupied with childhood obesity, poor body posture and insufficient physical activity, including an intensive need to monitor body composition and physical fitness (de Onis, Onyango, Borghi, Siyam, & Pinol, 2006; Tambalis, Panagiotakos, Arnaoutis, Psarra, Maraki, et al., 2015; Ivanović & Gajević,

2016; Bićanin et al., 2018). Recording body weight and height on a standard percentile table is an essential tool for monitoring growth, and therefore, long-term health in children and adolescents (Cattaneo, Monasta, Stamatakis, Lioret, Castetbon, et al., 2010; Wijnhoven, van Raaij, Spinelli, Rito, Hovengen, et al., 2013; Tambalis et al., 2015; Freedman & Berenson, 2017). The existing information about childhood obesity in Serbia suggests that the prevalence is similar to that observed in developed countries (Djordjic, Radisavljevic, Milanovic, Bozic, Grbic, et al., 2016) and some anthropometric indices have increased during the past 10 years (Ivanović & Gajević, 2016). These parameters have significant social importance due to direct relation of inactivity with many cardiovascular diseases, hypertension and diabetes as the leading mortality cause in adults from developed countries, which was also confirmed in the previous research results (Freedman & Berenson, 2017).

Body composition structure changes, leading to obesity, are considered one of the most important public health problems of the modern age and, according to their estimation and frequency, this problem is the second cause that can be successfully prevented. Systematic monitoring and evaluation of the body composition, motor abilities and postural status in children would provide timely evidence of many health problems – before any serious outcome. Additionally, based on the results of previous research, efforts to alter BMI trajectories for adult obesity should ideally commence before the age of 6. The natural resolution of high BMI starts in adolescence for males and early adulthood for females, suggesting a critical window for secondary prevention (Buscot, Thomson, Juonala, Sabin, Burgner, et al., 2018).

The lack of references to these problems certainly hindered the elaboration of the mentioned phenomena that are the subject of this research. One of the most important reasons for the insufficient number of research dealing with this theme includes a lack of attention towards children of this age, which consequently causes the impossibility of taking adequate and precise anthropometric measurements. Children of this age are naturally active and impatient, so these achievements are quite boring to them, causing great difficulty for researchers to conduct their work. The main goal of this research is to provide normative data quantifying height, weight and body mass index of 4-7-year-old Belgrade pre-school children.

## MATERIALS AND METHODS

### Participants

This research included a sample of 814 4-7-year-old pre-school children of both genders (551 boys and 263 girls) who were evaluated during the regular programmed activities within the Belgrade children sport school (three times per week). The criteria for the distribution of subsamples were years of age, rounding them to  $\pm 6$  months. The parent of each subject was informed about the potential risks and discomfort associated with the study, and measurements were carried out upon obtaining the willing consent of their parents in accordance with the requirements of the Helsinki declaration.

### Procedures

The participants' body weight and body mass index were obtained by applying the method of multichannel bio-electric impedance – BIA (InBody 230, Seoul, Korea), and the participants were measured without shoes, wearing lightweight clothes (Bićanin et al., 2018). Standing height (0.1 cm) was measured in the standing position with a portable stadiometer (Seca®, Hamburg, Germany).

### Statistical analysis

Mean values, standard deviation and percentiles were calculated for body weight, height and BMI, separately for boys and girls in 1-year intervals. The calculated percentiles were the 3rd, 10th, 25th, 50th, 75th, 90th and 97th. Gender differences were compared using an independent samples t-tests. When exploring changes in the observed variables by age, a repeated-measures ANOVA was conducted. All statistical methods were processed in the SPSS software package for Windows, Release 20.0 (Copyright © SPSS Inc., 1989-2011).

## RESULTS

The mean values, SDs and percentiles according to age and gender are shown as follows: for body height, Table 1; for body weight, Table 2; and for body mass index (BMI), Table 3.

**Table 1:** Descriptive statistics for body height

Age	Mean	SD	Percentiles (in cm)						
			3 <sup>rd</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	97 <sup>th</sup>
Boys (n = 551)									
4	108	4.6	99.1	102.1	105.0	108.0	110.9	113.9	116.8
5	114	4.6	102.7	106.5	110.3	114.0	117.8	121.6	125.3
6	121	5.5	103.8	109.3	114.7	120.2	125.7	131.2	136.6
7	125.9	5.2	109.3	114.9	120.4	126.0	131.6	137.1	142.7
Girls (n = 263)									
4	106.5	4.5	98.0	100.8	103.6	106.5	109.5	112.5	115.7
5	114.1	4.4	104.8	107.7	110.7	113.8	116.9	120.2	123.4
6	120.6	5	110.3	113.7	117.0	120.4	123.7	126.9	130.2
7	125.1	5.8	112.6	117.8	122.2	125.9	129.3	132.3	135.1

**Table 2:** Descriptive statistics for body weight

Age	Mean	SD	Percentiles (in kg)						
			3 <sup>rd</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	97 <sup>th</sup>
Boys (n = 551)									
4	18.5	2.2	14.6	15.5	16.6	17.9	19.4	21.1	23.1
5	20.4	2.9	16.3	17.3	18.6	20.1	21.9	24.4	27.7
6	23.5	3.8	18.0	19.2	20.7	22.6	24.9	28.1	32.5
7	26	4.3	19.6	21.2	23.1	25.4	28.2	31.7	36.3
Girls (n = 263)									
4	17.8	2.5	13.8	14.8	16.1	17.5	19.2	21.3	23.9
5	20.7	3.5	15.7	16.9	18.4	20.1	22.3	25.1	28.7
6	23.5	3.7	17.7	19.1	20.8	22.8	25.4	28.6	33.1
7	25.8	4.4	18.9	20.7	22.8	25.3	28.3	32.0	36.5

**Table 3:** Descriptive statistics for body mass index

Age	Mean	SD	Percentiles (in kg/m <sup>2</sup> )						
			3 <sup>rd</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	97 <sup>th</sup>
Boys (n = 551)									
4	15.8	1.2	13.7	14.3	15.0	15.7	16.5	17.5	18.6
5	15.7	1.4	13.5	14.1	14.8	15.6	16.5	17.7	19.3
6	16	1.8	13.5	14.1	14.8	15.7	16.8	18.3	20.7
7	16.3	1.9	13.4	14.1	14.9	15.9	17.2	18.9	21.3
Girls (n = 263)									
4	15.7	1.3	13.4	14.0	14.7	15.5	16.5	17.6	18.9
5	15.9	2	13.5	14.0	14.7	15.6	16.7	18.2	20.4
6	16.2	1.9	13.8	14.3	14.9	15.8	16.9	18.6	21.9
7	16.4	2	13.8	14.4	15.1	16.0	17.2	19.0	22.3

An independent samples t-test showed significant differences in body mass index according to the gender on the general level  $F = 3.842$ ,  $p = 0.005$ . Statistically significant differences were also found with regard to age in both genders in body height and body weight ( $p = 0.000$ ). In BMI, statistically significant differences were found between 5- and 7-year-old males ( $p = 0.043$ ).

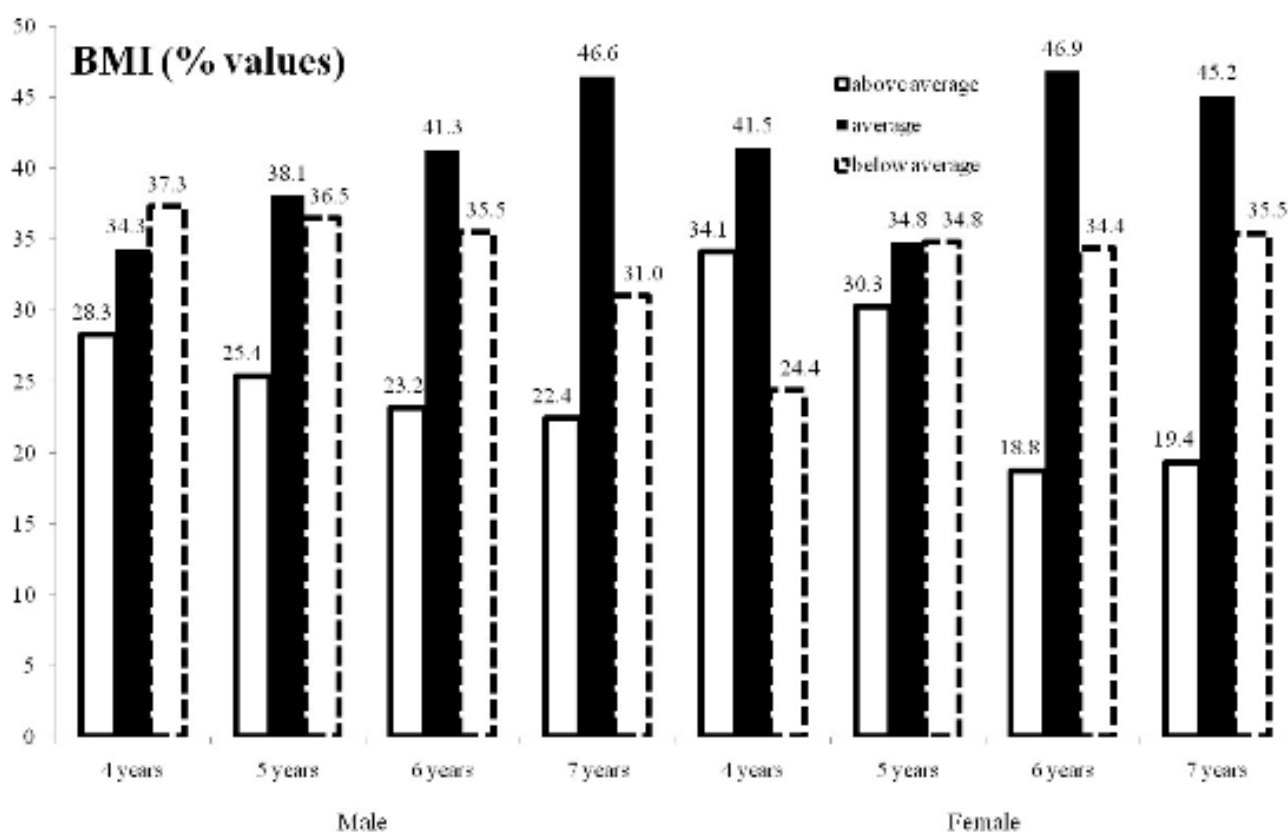
## DISCUSSION

The present study aimed to present normative values of height, weight and body mass index among Serbian 4-7-year-old pre-school children, and to compare them with age-matched peers from other countries.

The mean percentiles of body height, weight and body mass index in the present study (Table 1-3) are generally consistent with other studies from same age groups (de Onis et al., 2006; Cattaneo et al., 2010; Tambalis et al., 2015; Djordjic et al., 2016).

It is important to mention the results of the research concerning the prevalence of obese children. Regarding the obtained results, body mass index data in Figure 1 shows the percentage representation of the observed sample at the levels of average values, above average values and below-average values.

The results showed that (Figure 1), compared to the age of the observed sample, the highest prevalence of BMI values above the average is in 5-year-old girls (30.3%) and 4-years-old boys (28.3%).



**Figure 1** – Percentage representation of BMI values

It is more important that the results showed (compared to the above-average BMI) that 13.8% of boys and 15.1% of girls at the age of 4 were located in the category overweight plus obesity; 15.2% of boys and 11.4% of girls at the age of 5 were located in the category overweight plus obesity; 15.1% of boys and 11.3% of girls at the age of 6 were located in the category overweight plus obesity, and 12.1% of boys and 14.5% of girls at the age of 7 were located in the category overweight plus obesity.

Similar scarce data are reported in previous research (de Onis et al., 2006; Cattaneo et al., 2010; Ogden, Carroll, Kit, Flegal, 2014; Tambalis et al., 2015; Djordjic et al., 2016). For example, the reported prevalence of overweight plus obesity at the age of 4 ranges from 11.8% in Romania (2004) to 32.3% in Spain (1998-2000) (Cattaneo et al., 2010).

Countries in the Mediterranean region and the British Islands report higher rates than those in the Central, Northern and Eastern Europe (Cattaneo et al., 2010).

In the United States, 17% of youth aged 2 to 19 years are obese, although the prevalence remained stable between 2003-2004 and 2009-2010 (Ogden, Flegal, Carroll, Johnson, 2002; Ogden et al., 2014).

The rates are generally higher in girls than in boys (Cattaneo et al., 2010). Đorđić et al. (2016) reported that prevalence rates of obesity among 6-9-year-old Serbian school children vary across different age groups, with the lowest obesity rates being reported in 7-year-old boys (6.2%) and the highest obesity prevalence rates being observed in 6-year-old boys (9.7%).

The overall prevalence of overweight (23.1%, including obesity) and obesity (6.9%) in Serbian primary-school children seem to be comparable to rather high rates previously reported in other countries (Đorđić et al., 2016).

It is more than obvious that childhood obesity represents a growing public health problem worldwide (Wijnhoven et al., 2013; Tambalis et al., 2015). More than 20% of children are classified as overweight/obese according to the International Task Force Organisation, and percentages seem to be rising (Cattaneo et al., 2010; Ahrens, Pigeot, Pohlabeln, De Henauw, Lissner et al., 2014; Tambalis et al., 2015).

## CONCLUSION

This study provides current information on normative values of somatic growth in 4-7-year-old pre-school children. Data on previous results of overweight and obesity in pre-school children are scarce. Overweight among 4-7-year-old children is a serious public health concern and its variation across the European countries depends on the country. The results of the present study confirm this troubling prevalence in our country (Serbia), indicating a secular trend of increasing among pre-school children. The alarming magnitude of the paediatric overweight/obesity problem highlights the need for country-specific policies and interventions to confront this epidemic in pre-school children.

The results of this study should serve in the function of most informative indicators that will enrich the technological process of managing, monitoring, control improving, and optimising anthropometric measurements in the given population. Also, these values could be used as approximate indicative values to compare anthropometric indices scores of children from other countries.

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## **NORMATIVNI PODACI O VISINI, TEŽINI I INDEKSU TJELESNE MASE KOD PREDŠKOLSKJE DJECE IZ BEOGRADA**

Briga o djeci, zdravlje i normalan fizički razvoj su prepoznati kao jedan od najvažnijih zadataka u odgoju predškolske djece. Učestalost pretilosti tokom djetinjstva se dramatično povećava širom svijeta, ali normativni podaci o predškolskoj djeci nisu dostupni za određeni broj zemalja. Svrha ove studije je predstaviti normativne podatke koji mjere visinu, težinu i indeks tjelesne mase kod predškolske djece u dobi od 4 do 7 godina iz Beograda. Ovo istraživanje je uključivalo uzorak koji se sastojao od 814 predškolske djece oba spola (551 dječak i 263 djevojčice) u dobi od 4 do 7 godina, a koji su vrednovani tokom redovnih programskih aktivnosti unutar dječije sportske škole (tri puta sedmično). Tjelesna težina i indeks tjelesne mase su mjereni koristeći standardne procedure bioelektrične impedancijske analize sa InBody 230. Vrijednosti težine, visine i BMI-ja su u postocima predstavljene u tabelama, a prema spolu. Rezultati su pokazali da je, u poređenju sa dobi posmatranog uzorka, najveća učestalost iznadprosječne vrijednosti BMI-ja bila prisutna kod djevojčica u dobi od 5 godina (30,3%) i dječaka u dobi od 4 godine (28,3%). Stepenn učestalosti prekomjerne težine (uključujući i pretilost) se razlikovao u zavisnosti od dobne grupe, uz najveći stepen koji je bio zabilježen kod dječaka u dobi od 5 godina (15,2%) i djevojčica u dobi od 4 godine (15,1%). Rezultati ove studije potvrđuju zabrinjavajuću učestalost u našoj zemlji ukazujući na sekularni trend povećanja kod predškolske djece. Praćenje rasta kako bi se utvrdili problemi vezani za zdravlje ili ishranu predstavlja iznimno važan zadatak zdravstvenih stručnjaka.

**Ključne riječi:** djeca u dobi od 4 do 7 godina, tjelesna građa, postoci, sportska škola

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# THE 4-KM FIELD-BASED TEST IS CORRELATED TO SOME PHYSIOLOGICAL PARAMETERS OF ELITE CYCLISTS

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## ABSTRACT

Background: Although studies have shown that field-based tests used to assess the level of sports performance are correlated to maximal oxygen uptake ( $VO_{2max}$ ), little evidence has been provided regarding the correlations with other physiological parameters such as maximal power output (MP), maximal heart rate ( $HR_{max}$ ), minute ventilation (MV) and respiratory frequency (RF) in aerobic athletes. Therefore, the purpose of the study was to determine the correlations between the 4-km field-based test and some physiological parameters in elite cyclists. Methods: Thirty-two elite male cyclists (mean  $\pm$  SD; height =  $179.6 \pm 6.4$  cm, weight =  $72.2 \pm 13.5$  kg, body mass index =  $22.3 \pm 3.6$  kg/m<sup>2</sup>, fat mass =  $10.4 \pm 5.5$  %) completed the 4-km test.  $VO_{2max}$ ,  $HR_{max}$ ,  $MP_{absolute}$  and  $MP_{relative}$  power output, MV and RF were determined from indirect calorimetry using an incremental protocol. The 4-km test was assessed based on the finishing time in seconds. The correlations between the 4-km test and physiological profile variables were determined by the Pearson's correlation coefficient ( $r$ ). Results: A strong correlation ( $r = -0.70$ ,  $p < 0.001$ ) between the 4-km test and  $VO_{2max}$  was observed. The 4-km test was also correlated with  $MP_{absolute}$  ( $r = -0.50$ ,  $p = 0.004$ ),  $MP_{relative}$  ( $r = -0.51$ ,  $p = 0.003$ ) and MV ( $r = -0.32$ ,  $p = 0.05$ ), while no significant correlations with  $HR_{max}$  ( $r = -0.09$ ,  $p = 0.641$ ) and RF ( $r = -0.22$ ,  $p = 0.231$ ) were observed. Conclusions: This study shows that the 4-km field-based test is correlated with  $VO_{2max}$ , power output and MV in elite cyclists.

**Keywords:** cardiorespiratory fitness, athletes, field testing, ergometry, correlation

## INTRODUCTION

Measuring physiological parameters of athletes can be useful in assessing training status, recovery timing and sports performance (O'Gorman et al., 2000). Being able to generate such information may be an important component in making adjustments towards training planning and programming. One of the most important physiological parameters widely used for athletes to detect the level of aerobic fitness is maximal oxygen uptake ( $VO_{2max}$ ). In endurance disciplines, several studies have shown that this measure can discriminate between the top level and amateur performers (Hopker et al., 2007; Impellizzeri & Marcora, 2007; Lucia et al., 1999).

The determination of  $VO_{2max}$  can be objectively assessed by direct and indirect calorimetry. Besides the  $VO_{2max}$ , another important indicator of sports performance in cycling is maximal absolute ( $MP_{absolute}$ ) and relative ( $MP_{relative}$ ) power output (Allen & Coggan, 2010). Unfortunately, generating both parameters through an objective method often comes short in terms of availability, cost and time (O'Gorman et al., 2000). Therefore, having a valid field-based test to predict the aforementioned parameters may be useful in eliminating laboratory shortcomings and testing more subjects at one time (Leger & Lambert, 1982). Only a handful of studies have examined the validity properties of several field-based tests for evaluating endurance capacity (Santilla et al., 2013; O'Gorman et al., 2000; Grant et al., 1999).



Specifically, a study conducted by O'Gorman et al. (2000) supported the validity of the 12-min ( $r = 0.67$ ), the 3000-m ( $r = -0.67$ ) and the 20-m ( $r = 0.61$ ) run tests as predictors of  $VO_{2max}$ . Another study, comparing 7 predictive tests and the direct  $VO_{2max}$  test, showed that the maximal Bruce treadmill test ( $r = 0.49$ ) and the 85% Bruce treadmill test ( $r = 0.59$ ) were correlated to  $VO_{2max}$  in both men and women (Grant et al., 1999).

In cycling, studies examining correlation properties of the field-based tests to predict the level of  $VO_{2max}$  are lacking. Most field-based tests designed for cyclists consist of all-out time trials of different durations, like the 20-min time trial test (Allen & Coggan, 2010), which are predominantly time-consuming. In line with that, one study has shown that a simulated 16.1-km cycling time trial is significantly and strongly correlated with  $VO_{2max}$  ( $r = -0.76$ ) in 12 cyclists (Loftin & Barren, 1994). In highly trained cyclists, the 20-km cycling trial was strongly correlated with peak power output and  $VO_{2max}$  (Hawley & Noakes, 1992). Finally, a study by Sanders et al. (2017) showed that the 8-min time trial test was strongly correlated to power output and blood lactate concentration.

At the Olympic Games in 2004 and 2008, Bradley Wiggins was the winner in the 4-km cycling discipline, concluding that this sport-specific field-based test is a valid instrument for measuring sports performance in cyclists. Since only a handful of studies have used field-based tests to predict physiological endurance variables, we hypothesised that the 4-km test can be a valid screening tool for determining physiological parameters in cycling. Therefore, the main purpose of the study was to determine the validity properties of the 4-km field-based test for predicting some physiological parameters in elite cyclists.

## MATERIALS AND METHODS

### Study subjects

Thirty-two male elite cyclists were enrolled in this cross-sectional study. All subjects were free from any kind of acute or chronic diseases and injury and had participated at the national level for at least 5 years. Each subject needed to complete at least 90% of testing protocol.

Prior the study, the main purpose, hypotheses and potential risks were explained to all subjects, after which a written informed consent for participation was signed. The study was approved by the Faculty of Kinesiology, University of Zagreb (Ethical code number: 2014) and was followed in accordance with the Declaration of Helsinki.

### The 4-km field-based test

To assess the level of sports performance, each subject performed the 4-km test. Before testing, the subjects had performed a 10-min light warm-up. The cycling lane was 430.9 m in length. To finish the test, each subject needed to travel 9 laps and additional 122.1 m. The final score was expressed in seconds. Each subject was instructed not to train 3 days before the testing procedure, so as to avoid the fatigue effect. The bicycle type used in the study was MTB for field-based testing (Carbon 29; front and rear Shimano Deore XT shift with 20 speeds; Magura custom hydraulic brakes; Schwalbe Racing Ralph Performance tires 29 x 2.25; weight 10.9 kg). The reliability of the 4-km field-based test was high (Cronbach's  $\alpha = 0.94$ ). The temperature and the percentage of humidity were between 24 and 26 C° and 55-60%.

### Incremental cycle-ergometer test

Maximal oxygen uptake ( $VO_{2max}$ ) test started by using the initial resistance of 50 W during the first minute, after which the resistance increased by 20 W every other minute. The test ended when the subject stopped cycling due to exhaustion or other reason. During the test, the subject kept continuous frequency of pedalling 90/min. After the test, the subject continued to pedal for 3 minutes without the external resistance. **Quark b<sup>2</sup>** (COSMED, Italy) is an automatic, computerised system being able to collect the data regarding ventilation parameters. The measuring protocol consists of a respiratory mask for the nose and mouth (Hans Rudolph, USA) attached through a bidirectional turbine with an optoelectronic reader for air ventilation. From the air turbine, the air is transmitted to fast O<sub>2</sub> and CO<sub>2</sub> analysers, removing the moisture without changing the gas concentration. Based on **Quark b<sup>2</sup>** breath-by-breath and Polar Electro OY CE 0537 (Polar Electro, Finland) systems, we calculated maximal oxygen uptake ( $VO_{2max}$ , mlO<sub>2</sub>/kg/min), maximal heart rate ( $HR_{max}$ , beats/min), maximal absolute ( $MP_{absolute}$ , W) and relative to weight ( $MP_{relative}$ , W/kg) power output, minute ventilation (MV, L/min) and respiratory frequency (RF, #/min). The reliability properties of the measured parameters were high (Cronbach's  $\alpha = 0.87 - 0.92$ ). The indoor temperature and humidity during the procedure were between 23 and 25 C° and 60-65%.

### Anthropometric characteristics

Height, weight and body mass index [weight (kg)/height (m<sup>2</sup>)] were measured according to the instructions of the International Biological Programme (IBP). Body height was measured to the nearest 0.1 cm. To assess fat percentage, we

used Tanita Body Composition Analyser (BC-418; Tanita, Tokyo, Japan). Impedance and body mass are automatically measured, and the subject's height and age are entered into the system. Fat percentage using the Tanita BC-418 has been shown to correlate highly with the dual-energy X-ray absorptiometry (Pietrobelli et al., 2004).

#### Data analysis

Descriptive statistics and Kolmogorov–Smirnov (normality of the distribution) tests were calculated for all experimental data before inferential testing. The Kolmogorov–Smirnov tests showed that data were normally distributed. The degree of coherence between the 4-km test and objectively assessed physiological parameters was assessed using Pearson's product–moment correlation ( $r$ ), where correlation values denoted the association between variables and tests as small ( $r = 0.1–0.3$ ), moderate ( $r = 0.3–0.5$ ), large ( $r = 0.5–0.7$ ), very large ( $r = 0.7–0.9$ ), and almost perfect ( $r = 0.9–1.0$ ) (Hopkins, 2004). Data analysis was performed using the Statistical Package for the Social Sciences (ver. 23.0, SPSS Inc., Chicago, IL, USA).

## RESULTS

Basic descriptive statistics of the study subjects is presented in Table 1. A strong correlation ( $r = -0.70$ ,  $p < 0.001$ ) between the 4-km test and  $VO_{2max}$  was observed. The 4-km test was also correlated with  $MP_{absolute}$  ( $r = -0.50$ ,  $p = 0.004$ ),  $MP_{relative}$  ( $r = -0.51$ ,  $p = 0.003$ ) and MV ( $r = -0.32$ ,  $p = 0.05$ ), while no significant correlations with  $HR_{max}$  ( $r = -0.09$ ,  $p = 0.641$ ) and RF ( $r = -0.22$ ,  $p = 0.231$ ) were observed.

## DISCUSSION

The purpose of the study was to determine the correlation properties of the 4-km field-based test to predict some physiological parameters in elite cyclists. The findings show: (1) the 4-km test is strongly correlated with the objectively measured  $VO_{2max}$ , (2) the 4-km test was moderately correlated with  $MP_{absolute}$  and  $MP_{relative}$ , (3) the 4-km test was poorly correlated with MV and (4) no significant correlations between the 4-km test, HR and RF were observed. The results of this study are in line with previous studies estimating  $VO_{2max}$  from field-based tests (Sanders et al., 2017; Santilla et al., 2013; Allen & Coggan, 2010; O'Gorman et al., 2000; Grant et al., 1999; Loftin & Barren, 1994; Hawley & Noakes, 1992). Specifically, a study by O'Gorman et al. (2000) supported the validity of the 12-min ( $r = 0.67$ ), the 3000-m ( $r = -0.67$ ) and the 20-m ( $r = 0.61$ ) run tests as predictors of  $VO_{2max}$ . Another study, comparing 7 predictive tests and the direct  $VO_{2max}$  test, showed that the maximal Bruce treadmill test ( $r = 0.49$ ) and the 85% Bruce treadmill test ( $r = 0.59$ ) were correlated to

$VO_{2max}$  in men and all correlations for the women were found to be significant (Grant et al., 1999). In cycling, a simulated 16.1-km cycling time trial was significantly and strongly correlated with  $VO_{2max}$  ( $r = -0.76$ ) in 12 cyclists (Loftin & Barren, 1994). In highly trained cyclists, the 20-km cycling trial was strongly correlated with peak power output and  $VO_{2max}$  (Hawley & Noakes, 1992). Sanders et al. (2017) showed that the 8-min time trial test was strongly correlated to power output and blood lactate concentration. Previous evidence suggests that "conducting exercise tests is an essential part of the training monitoring process of athletes as it allows coaches to track the effectiveness of different training programs or strategies and to determine whether progress has been made" (Sanders et al., 2017). Such measurements often take place in laboratory settings, which are sometimes not available, cost much and are time-consuming (O'Gorman et al., 2000). In this study, the mean time of completing the 4-km test with preparation was  $\approx 10$  min for 10 cyclists at one time, therefore, such a test may have a beneficial practical application and is not time-consuming in predicting several physiological/endurance parameters in elite cyclists. This study also confirmed the fact that the most important indicators for sports performance in cycling were  $VO_{2max}$  and  $MP_{absolute}/MP_{relative}$ , since they were strongly correlated to the 4-km test. In cycling literature, these two parameters often coexist, i.e., higher levels of  $VO_{2max}$  are strongly correlated to MP (Allen & Coggan, 2010). Notably, the correlation coefficient between the direct  $VO_{2max}$  and MP measurement in this study was 0.86, pointing out that the 4-km field-based test may be used as a screening tool to predict both  $VO_{2max}$  and MP. In that way, the coaches and strength and conditioning trainers may keep tracking the initial testing values and adjusting training protocols for maximal efficiency and physiological benefits of an individual.

## CONCLUSION

This study shows that the 4-km field-based test is strongly correlated to  $VO_{2max}$  and moderately correlated to  $MP_{absolute}$  and  $MP_{relative}$  in a sample of elite cyclists. Although the cross-sectional design cannot inform about the causality of the correlation, the 4-km test may serve as a tool which easy to perform and correlates well with the most important factors of cycling performance.

## ACKNOWLEDGEMENTS

We would like to thank all the study participants for their enthusiastic participation during the measurement.

**Table 1:** Basic descriptive statistics of the study participants (N = 32).

Study variables	Mean	SD	Minimum	Maximum
Height (cm)	179.5	6.4	164.5	192.0
Weight (kg)	72.6	13.8	49.7	104.0
Body Mass Index (kg/m <sup>2</sup> )	22.4	3.6	17.3	30.5
Fat mass (%)	10.7	5.5	2.4	22.5
4-km test (sec)	397.8	23.6	367.0	456.0
VO <sub>2max</sub> (mlO <sub>2</sub> /kg/min)	57.5	8.2	42.2	71.6
MPO <sub>absolute</sub> (W)	312.5	37.8	230.0	370.0
MPO <sub>relative</sub> (W/kg)	4.4	0.8	2.7	5.7
MV (L/min)	121.1	19.9	89.0	156.7
HR <sub>max</sub> (beats/min)	182.5	11.2	163.0	205.0
RF (#/min)	44.3	6.4	33.4	54.6

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**TERENSKI TEST - 4 KM JE U KORELACIJI SA NEKIM FIZIOLOŠKIM PARAMETRIMA ELITNIH BIKIKLISTA**

Kontekst: Iako su studije pokazale da su terenski testovi korišteni za procjenu nivoa sportske izvedbe u korelaciji sa maksimalnim unosom kisika ( $VO_{2max}$ ), malo je dokaza korelacije sa drugim fiziološkim parametrima poput maksimalne snage (MP), maksimalnog broja otkucaja srca ( $HR_{max}$ ), minutne ventilacije (MV) i respiratorne frekvencije (RF) kod aerobnih sportaša. Prema tome, svrha studije je bila utvrditi korelacije između terenskog testa - 4 km za predviđanje nekih fizioloških parametara elitnih biciklista. Metode: Trideset i dvoje elitnih biciklista (aritmetička sredina  $\pm$  standardna devijacija; visina =  $179,6 \pm 6,4$  cm, težina =  $72,2 \pm 13,5$  kg, indeks tjelesne mase =  $22,3 \pm 3,6$  kg/m<sup>2</sup>, nivo masti u organizmu =  $10,4 \pm 5,5$  %) je podvrgnuto testu - 4 km.  $VO_{2max}$ ,  $HR_{max}$ , MP - apsolutna snaga, MP - relativna snaga, MV i RF su utvrđeni direktnom kalorimetrijom koristeći inkrementalni protokol. Test - 4 km je procijenjen na osnovu prolaznog vremena u sekundama. Korelacije između testa - 4 km i varijabli fiziološkog profila su određene koristeći Pearsonov koeficijent korelacije (r). Rezultati: Utvrđena je snažna korelacija ( $r = -0,70$ ,  $p < 0,001$ ) između testa - 4 km i  $VO_{2max}$ . Test - 4 km je također bio u korelaciji sa MP apsolutna snaga ( $r = -0,50$ ,  $p = 0,004$ ), MP relativna snaga ( $r = -0,51$ ,  $p = 0,003$ ) i MV ( $r = -0,32$ ,  $p = 0,05$ ), a značajne korelacije sa  $HR_{max}$  ( $r = -0,09$ ,  $p = 0,641$ ) i RF ( $r = -0,22$ ,  $p = 0,231$ ) nisu utvrđene. Zaključci: Ova studija pokazuje da je terenski test - 4 km u korelaciji sa  $VO_{2max}$  snagom i MV kod elitnih biciklista.

**Ključne riječi:** kardiorespiratorna kondicija, sportisti, terensko testiranje, ergometrija, korelacija

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# INCREASING THE EXTERNAL FOCUS OF ATTENTION ENHANCES THE CENTRE OF MASS DISPLACEMENT IN BASKETBALL FREE SHOT

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## ABSTRACT

The purpose of this study was to determine the effect of increasing the attentional focus (near and far) on the body centre of mass displacement among university male basketball beginners participating in learning the basketball set shot. So, 45 right-handed male students with an average of 18-30 years and no knowledge of basketball were randomly chosen, and through the pretest consisting of 10 set shots, they were randomly matched into 2 experimental groups: Near External (i.e., focus on the shot angle) and Far External (i.e., focus on the basket). An acquisition test was conducted with instructional feedback, but Retention and Transfer tests were conducted with no instructional feedback at all, for each group. The subjects' performance was recorded by a Motion Analyser, and the Kinovea Software was used to analyse the displacement. Data was analysed by an independent ANOVA test at  $P \leq 0.05$  level. The results demonstrated a significant difference between the near external and far external focus on the body centre of mass displacement.

**Keywords:** near and far external attention, centre of mass, basketball

## INTRODUCTION

Some studies have indicated that consciously directing attention externally rather than internally enhances motor skill performance (Wulf, 2007). An external focus of attention is achieved when conscious attentional resources are directed towards the result of a movement or the effect the movement has on the environment (Wulf, Ho"ß, & Prinz, 1998).

On the contrary, when an internal focus of attention is used, cognitive resources are consciously directed inwards towards the performer's

movement. Recent studies have demonstrated that the standing long jump (Porter, Ostrowski, Nolan, & Wu, 2010; Wu, Porter, & Brown, 2012) and vertical jump (Wulf & Dufek, 2009; Wulf, Dufek, Lozano, Pettigrew, 2010) performance are enhanced by directing the performer's attention externally rather than internally during the jumping action.

Similar findings have been demonstrated using a variety of tasks (Wulf, 2007), populations (Porter & Anton, 2010; Wulf, Landers, Lewthwaite, To"llner, 2009; Wulf & Su, 2007), golf (Perkins et al., 2003), tennis (Hadler et al., 2014), basketball (Aghdasi et al., 2014), football and volleyball (Wulf et al., 2002; Pasca et al., 2014), baseball (Gastenda & Garry, 2007), dart-throwing (Merchant

2007; Aghdasi et al., 2014), gymnastics (Abdollahipour, 2015), keeping balance on the balance platform (Naimi Kia et al., 2011), exceptional children (Chiviawasky et al., 2013), and vertical jumping (Ashrafi et al., 2012). The benefits of an external focus of attention are typically explained using the constrained action hypothesis (Wulf, McNevin, Shea, 2001). This hypothesis suggests that directing attention externally facilitates nonconscious automatic cognitive processing, which allows the motor control system to produce fast and accurate movements.

The automaticity that is facilitated by an external focus of attention promotes efficient neuromuscular activation (Marchant, Greig, Scott, 2009), optimal movement patterns and elevated force generation (Wulf & Dufek, 2009), determining the target (Wulf et al., 2007), keeping balance (Wulf & Mercer, 2005) and producing maximum power (Wulf et al., 2007), changes of the gravity centre (Wulf et al., 2007; Salehian & Yasrebi, 2011) and enhanced agility performance (Porter, Nolan, Ostrowski, Wulf, 2010).

In contrast, when attention is directed internally, automatic processing is interrupted. This interruption "constrains" the motor control system, negatively influencing motor skill execution. Numerous studies have been conducted to validate the predictions made by the constrained action hypothesis (Wulf, 2007). McNevin et al. (2003) demonstrated that the manipulation of the external focus distance relative to the body resulted in an amplification of motor skill learning and performance.

In their study, the participants performed a balance task on a stabilometer while following instructions that directed their attention either internally to their feet, externally towards markers near their feet, or externally towards markers placed at a greater distance from their feet. The results indicated that both external conditions were superior to the internal condition, but the authors also found that the external far focus furthest away from the body resulted in performance that was superior to external focus nearer the body.

McNevin et al. (2003) indicated that coaches can improve athletic performance by simply prompting athletes to focus on a cue that is located away from their body. It is also worth noting that these skill improvements were not the result of physiological or mechanical changes but highlight the importance of the performer's cognitive state on movement organisation and execution.

As mentioned above, previous studies have demonstrated that directing attention externally rather than internally can improve jumping ability (Porter, Ostrowski, Nolan, & Wu, 2010; Wu, Porter, & Brown, 2012; Wulf & Dufek, 2009; Wulf, Dufek, Lozano, Pettigrew, 2010). Akbari et al. (2010), studying the effect of the external focus distance in a balance task, showed that the performance of the external focus is significantly better than the near external and control

group. Kheirkhiz and Bahram (2015), investigating the effect of the external focus distance increase on the muscles' electrical activity, concluded that the increase of the external focus distance has a positive effect on motor performance.

Porter et al. (2012), investigating the effect of the external focus distance, concluded that this process can recover the performance and increase the jump length. In contrast, Westphal and Porter (2013), studying the increase of external focus distance on the standing jump length, reached paradoxical results. The results showed that the increase of focus distance does not have any effect on jump length.

Although the results of the study conducted by McNevin et al. (2003) provided initial evidence that increasing the distance of an external focus away from the body can magnify balance performance, it has not been established if these findings generalise complex skills such as jumping. In the study of McNevin et al. (2003), the authors used a continuous task that required object manipulation (the subject continuously controlled and regulated the stability of the balance platform).

However, balance tasks such as this are rarely used in sport-related contexts. Instead, many sport contexts comprise discrete movements that are ballistic in nature, much like the standing long jump or vertical jump. Thus, it is important to test, both for theoretical and practical reasons, the performance enhancing effects that may exist when performing sport-related actions. The purpose of this study was to determine if increasing the distance of an external focus of attention relative to the body is generalisable to much displacement of COM or not.

We hypothesised that providing verbal instructions which focused the attention on a target in the form of a basket would result in superior performance, compared with the performance following the instructions that directed the attention externally to a cue near the throwing angle.

We also hypothesised that both external conditions would result in superior COM displacement, compared with a control condition in which instructions containing no specific focus of attention were given. If this were the case, it would complement and extend the findings of the previous studies which have almost exclusively shown the benefits of external focus for tasks requiring movement accuracy. Conflicting findings demonstrate that age (Emanuel et al., 2008), gender (Wulf et al., 2003), skill level (Perkins et al., 2003; Ford et al., 2005; Castaned & Gray, 2007; Wulf, 2008), complexity of the skill (Poolton et al., 2006;



Denny, 2010), and individual preferences (Wulf & Prinz, 2001) as well as sport settings (Porter et al., 2010) might all play a role regarding the efficacy of internal and external attentional focus in skill performance. Recently, Weiss et al. (2008) discovered that one's preferred focus of attention could play a role in the effectiveness of attentional focus, suggesting that an internal focus did not necessarily lead to a decrease in performance if it was the participant's preferred strategy. According to the contrary results, the present study followed up on this issue. We argued that, if the participants are asked to focus on an effect that is in close proximity to their body, they might be more compelled to intervene in the control processes associated with maintaining performance than they would if they focused on a more distant effect.

Assuming that an attentional focus directed towards a proximal effect (near condition) compels participants to exert relatively more conscious control over the regulatory processes involved in ball throwing, we would expect to observe compromised performance characterised as high amplitude and slow frequency of responding relative to participants focusing on more remote effects (far condition). For participants instructed to focus attention on effects that are more easily distinguishable from their actions (near condition), there should be no compelling reason to intervene in the automatic control processes intrinsic to the action, and therefore they should show lower amplitude and higher frequency responding.

## METHOD AND MATERIALS

This study used a within-subject design to investigate the potential performance benefits when increasing the distance of an external focus of attention.

### Participants

Forty-five male students (aged 18-30) with no knowledge of basketball shooting, who were not aware of the specific purpose of the study, were randomly assigned to one of two experimental groups ( $n = 15$ ) based on their pre-test scores of 10 shots and a control group ( $n = 15$ ). All participants signed an informed consent form before the experiment.

### Data gathering tool

In this test, the acquisition, retention and transfer tests from a shooting test with 6 values were applied in order to evaluate the subjects (Zachry et al., 2005).

### Movement task

The two matched groups were assigned one of two practice conditions. During ten consecutive practice sessions, all participants received the same initial instructions regarding the basket (far external) and angle of throwing (near external), but no feedback during the retention and transfer tests. All tests consisted of 10 trials with a 20-second rest period between each trial. All participants followed the same warm-up prior to each day's practice, and the shooting practice was done immediately following the five-minute warm-up period. After a day of rest, the participants performed a retention test. The transfer test was also carried out two hours after the retention test with a change in the throwing location towards the basket. The task involved throwing the ball towards the basket from the penalty line in basketball, putting markers on the subjects' centre of body mass and recording the motions by means of 4 cameras from the sagittal and frontal surfaces using a Motion Analyser. Kinovea software was used to analyse information. Testing took place in a controlled environmental condition similar across all subjects.

### Data analysis method

Data were analysed using the Statistical Package for the Social Sciences (SPSS), version 16. The criterion for significance was set using an alpha level of  $P \leq 0.05$ . Statistics (ANOVA) were calculated to determine the magnitude of the observed significant performance differences.

### Ethical Statement

This work was conducted with the formal approval of the local human subject, and clinical trials have been registered as legislation requires.

## RESULTS

As shown in the table, the test effect on COM displacement is significant in 99% of the confidence level ( $F = 398.98$ ,  $P = 0.001$ ). In other words, the degree of the centre of mass displacement in pre-test, acquisition, and retention and transfer test has got a significant difference. The group effect on leg motion is significant in 99% of the confidence level ( $F = 239.93$ ,  $P = 0.001$ ). In other words, the degree of the centre of mass displacement in the experimental group, far external attention, near external attention, and the control group has significant difference. Also, the mutual effect of the group\* test is significant in 99% of the confidence level ( $F = 86.35$ ,  $P = 0.001$ ). In other words, the degree of the centre of mass displacement regarding different group combinations and the test has significant difference.

**Table 1:** The results of the correlated two-way analysis of variance for the velocity of forearm motion

Source changes	SS	df	MS	F	Sig.	Chi Eta
Test effect	251.825	3	83.942	1339.460	.000	.970
Group effect	4.879	2	2.439	4.940	.012	.190
Group interaction * test	1.260	6	.210	3.350	.004	.138
Test error	7.896	126	.063			
Group Error	20.740	42	.494			

**Table 2:** The results of LSD follow-up test for comparing the within-group results of the forearm motion acceleration

Source changes	SS	df	MS	F	Sig.	Chi Eta
Test effect	1328.743	3	442.914	197.423	.000	.825
Group effect	4032.651	2	2016.326	98.814	.000	.825
Group interaction * test	1377.079	6	229.513	102.303	.000	.830
Test error	282.678	126	2.243			
Group Error	857.024	42	20.405			

## DISCUSSION

The purpose of this experiment was to investigate the effect of increasing the distance for the external attentional focus on COM displacement. Specifically, we sought to examine if the McNevin et al. (2003) findings would generalise to a discrete power-based skill with no object manipulation. We predicted that focusing attentional resources on a target that was located at a greater distance from the body would result in greater changes in body mass changes, compared to focusing attention externally on a cue nearer the body. We also predicted that the subjects using either method of external attentional focus would have body displacement changes significantly farther than those in a control condition in which the subjects received instructions that promoted neither internal nor external focus of attention. Based on the results of the study, the hypotheses were

supported. The present findings are consistent with the predictions of the constrained action hypothesis. Providing verbal instructions that directed the participants' attention externally (near or far) elicited automatic motor behaviours which resulted in greater displacement changes, compared with neutral instructions that did not promote automaticity within the motor control system. Consistent with the McNevin et al. (2003) findings, the far external condition was significantly farther than the near external condition, whereas both external attentional focus conditions did significantly farther than the control condition. Also, the results of this study provide evidence that the performance benefit of the far external condition generalises to whole-body actions that have a high power demand. According to McNevin et al. (2003), performance was depressed in the far external condition because focusing on cues that are near

or on the body cause the performer to exert more active control over the action. According to the authors, this causes a degradation of the natural movement dynamics within the action. The findings of this and previous studies suggest that increasing the distance of an external focus of attention relative to the body immediately enhances standing long jump performance because the far external verbal instructions reduce active control over the action. Marchant et al. (2009) recently demonstrated that verbal instructions which encourage an external focus of attention elicited greater force production and lower muscular activity, compared with instructions that encouraged an internal focus of attention. For this study, this suggests that the participants in the far external condition generated more force or displayed a more efficient muscle fibre recruitment pattern, compared with trials conducted in the control and near external conditions. This prediction is consistent with the findings reported by Vance et al. (2004). Lohse et al. (2010), studying the effect of the focus on the kinetic motion and electromyography of dart-throwing, found a significant difference in the reduction of preparation time for dart-throwing, and the reduction of the electromyography activity in some muscles, in addition to the increase of the shoulder joint kinetic changes regarding the external focus conditions. Ducharme et al. (2012) investigated the kinetic factors of the long jump regarding the external, internal and control groups, and found out that people have the longest jump in external focus than the internal conditions. Makaruk et al. (2012), studying different conditions of the focus on the performance of ball throwing, concluded that the external focus can optimise the angle of the thrown ball leading to an increase in the distance of the ball; they also stated that this process has got the highest motion domain, kinetically because of bending the ankle joint more than the gravity centre which allows the production of the highest power during the motion. Wulf (2013), analysing the kinetics and kinematics of the motion, showed that the coordination pattern of the whole body seems to be optimised due to the external focus. Gokler et al. (2015), evaluating the effect of the focus on the jumping performance and the kinematic angles of people with ACL, concluded that the external focus has a more significant effect than the internal focus on the ankle

flexion angle during landing time and the maximum flexion of the ankle as well as little time for reaching the maximum flexion of the ankle. It seems reasonable to assume that individuals would self-organise an optimal focus of attention (i.e., external) through the course of performing the throwing task; however, the results of this study suggest otherwise. This quandary warrants further investigation; specifically, an investigation that addresses how athletes focus their attention when provided no explicit instructions. We hypothesise that athletes will use strategies in which they have the most experience. For example, if their skill development was primarily derived from movement-based instructions, then they will use movement-based attentional strategies (i.e., internal focus). It is clear that researchers in this area must be more effective at disseminating their experimental findings to practitioners, promoting the use of evidence-based practices. Moreover, clarifying the discrepancy between research findings and the methodology that practitioners use is critical when considering the design of practice and rehabilitation environments for athletes or patients. The results of this study also demonstrate the need for practitioners to use standardised instructions when training and assessing motor skill performance. As demonstrated in this study, very small variations in verbal instructions can result in immediate and significant behavioural changes.

It is suggested that coaches avoid providing instructions to athletes that reference the body, and consequently encourage an internal focus of attention. Coaches should also avoid using general or vague instructions that do not consciously direct attentional resources externally. As demonstrated by the control condition in this study, providing general or vague instructions does not enhance performance, compared with using an external focus of attention. The predetermined cues should be short, concise phrases that direct attention to the effects of the movement rather than to the movements themselves. Having predetermined cues will help ensure that coaches avoid instructional cues causing the performer to focus on body segments, which consequently reduces motor skill performance.

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### **POVEĆAVANJE EKSTERNOG FOKUSA PAŽNJE POBOLJŠAVA POMICANJE TEŽIŠTA KOD SLOBODNOG BACANJA U KOŠARCI**

Svrha ove studije je odrediti efekat povećavanja fokusa pažnje (bližeg i daljeg) na pomicanje težišta kod studenata košarkaša - početnika koji uče skok-šut u košarci. Dakle, 45 desnorukih studenata sa prosječnom dobi od 18 do 30 godina, a koji nemaju znanje košarke je nasumično odabrano i podijeljeno u 2 eksperimentalne grupe predtestiranjem koje se sastojalo od 10 skok-šuteva: bliža eksterna (tj. fokus na ugao šuta) i dalja eksterna (tj. fokus na koš). Test usvajanja znanja je proveden uz davanje povratnih uputa, ali su testovi pamćenja i transfera provedeni bez davanja povratnih uputa za svaku grupu. Izvedba ispitanika je zabilježena putem programa Motion Analyser, a softver Kinovea je korišten za analizu pomicanja. Podaci su analizirani korištenjem ANOVA testa za nezavisne uzorke na nivou  $P \leq 0,05$ . Rezultati su pokazali značajnu razliku između bližeg eksternog i daljeg eksternog fokusa na pomicanje težišta tijela.

**Ključne riječi:** bliži i dalji eksterni fokus pažnje, težište, košarka

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# THE DISTAL METHOD COACH DEVELOPMENT FOR TENNIS: A NEW PARADIGM IN COACH EDUCATION

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## ABSTRACT

Coach Development Programmes have multiple aims, for example, to provide trainers and educators with knowledge and tools, to keep them up to date or to refresh the already known concepts. The Distal Method is a generic method for motor expertise attainment. It has been created based on findings from the scientific disciplines relevant to motor expertise in order to develop world-class performers in motor expertise-related domains. The Distal Method Coach Development (DMCD) for tennis is presented here. DMCD is in line with modern educational paradigms such as Physical Literacy (pedagogy), Deliberate Practice (Science of Exceptional Achievement) and the Secondary Synthetic Coach Model (SSCM). The aim of this article is twofold: i. to provide a broad overview of all the work done regarding the tennis DMCD over the years, and ii. to both fill the gap in tennis Coach Development systems and to provide a high standard in that area.

**Keywords:** motor expertise, physical literacy, contributory general expertise, coach education

## INTRODUCTION

The Distal Method Coach Development programme (DMCD) is based on the Distal Method, a system created in Greece regarding expertise and in specific, motor expertise. "Distal" (adaptations) refers to long-term and learning-related changes, as opposed to "proximal", i.e., short-term and performance-related adaptations. The Distal Method has been conceived by the author as a holistic method for attaining motor expertise. It combines findings from all related scientific and philosophic disciplines: kinesiology (motor learning, motor control, motor performance and biomechanics), psychology, neurophysiology, pedagogy, epistemology and ethics. It is based on the so-called "epistemological method" which has as its basic constituents, the two pairwise methods of analysis-synthesis and abstraction-structure (Papageorgiou & Lekkas, 2014, 2018, 2019). The Distal Method is similar in conception with

the Teaching Games for Understanding and Situated Learning approach, except that it is broader in its scope (Almond, 2015; Holt, Streat, & Bengoechea, 2002).

The Distal Method is based on three axes: i Science of Exceptional Achievement (K. A. Ericsson, Nandagopal, & Roring, 2009), ii the fundamental distinction between performance and learning, and iii Schools. The third axis might sound too vague; but, in reality, one may find common themes in many Schools, not adequately studied by Western science – for example, slow practice.

The analytic method provides us with the tools for developing models a priori: such models can then help us navigate within different School traditions and accommodate the various teachings. The main Schools that affected the development of the Distal Method are various Martial Arts Schools (Iwama Aikido, Goshin Ryu Ju-Jutsu), Ashtanga Yoga, Long Yi (chi kung), Russian School (music), Lekkasian School (epistemology) and others.

No matter how strong a method (what to do) and methodology (how to find what to do) are, if there are no coaches to apply them, nothing has been achieved. Hence, DMCD has been developed. The constituents of DMCD have been analysed, discussed and supported in various articles (Konstantinos G. Papageorgiou, 2014, 2016, 2017; Papageorgiou, 2015, 2016, 2019, 2020c; Papageorgiou, Lekkas, & Koulaniou, 2015). The requirements for effective online Coach Development courses in regard to the DMCD have also been discussed (Papageorgiou, 2020d, 2020e). All in all, the criteria for the selection of the DMCD constituents were:

- i. empowerment, for its participants,
- ii. effectiveness, via the tools it provides,
- iii. breadth and width, i.e., to holistically address all the developmental parameters (physical, mental),
- iv. balance, as far as theory and practice are concerned,
- v. enrichment, i.e., to provide many approaches to address each issue.

Here, the final synthesis (synthetic model) will be presented for the first time, additionally providing us with a higher level, bird-eye view of the whole programme, i.e., its parts, and its tools. It should not be left unsaid that the broader epistemological paradigm, also supporting the Distal Method, is novel. Indeed, a peer-reviewed journal has already been created and is dedicated to it (*Epistēmēs Metron Logos*). So, ideas, such as that of the contributory expert generalist, or the double pairwise method of *epistēmē* (analysis-synthesis, abstraction-structure) belong to this paradigm. This article is written by an epistemologist who is also a sports scientist with the understanding that many readers are not familiar with such epistemological principles and concepts, therefore, simplicity was a priority. Through this work, the concept of contributory expert generalist (Konstantinos G. Papageorgiou & Lekkas, 2020) for sports is also promoted since this type of expert coaches are needed to implement this holistic method.

## THE IMPORTANCE OF COACH DEVELOPMENT SYSTEMS

The components and the effectiveness of coach development systems have been repeatedly evaluated from various perspectives, namely: the participant's views, expert panels and results in the performance (perceived and objective) of the athletes after their coaches have successfully attended courses (usually acquiring certification, following the completion of their course).

Kai-Sim Lee et al. (2002) report that the game strategy and the technical efficacy of certified coaches (vs uncertified ones) have improved (Kai-Sim Lee, Malete, & Feltz, 2002).

Campbell and Sullivan (2005) conclude that confidence levels of such certified coaches were higher after such programmes (Campbell & Sullivan, 2005). Haslam (1990) found that Canada's national coach development programme was effective in incorporating necessary skills and theoretical background (Haslam, 1990).

The value of such programmes is also underlined by Misener and Danylchuk (2009), citing participants who felt that the primary benefit of taking a course was ensuring better prepared athletes through a higher quality of coaching (Misener & Danylchuk, 2009). This applies even more so to more qualified coaches (and not just novice ones) who felt that learning a greater variety of techniques (or even re-learning techniques) was "very helpful" – a feeling shared by their athletes as well (Hall & Rodgers, 1989). Athanailidis et al. (2016) found that more educated tennis coaches in Greece tended to score higher in self-assessing Chen's (2003) 13 competencies (Athanailidis, Laios, Arvanitidoy, Mourtziotis, & Zaggelidis, 2016).

Mccullick et al. (2005) answer the question: what do participants want as far as the coach development programme design is concerned? They found four desired characteristics: (a) the structure of the programme must have a logical, sequential and comfortable format; (b) pedagogical knowledge should be taught to the participants and modelled by the programme facilitators; (c) knowledgeable programme facilitators providing relevant content knowledge are essential; and (d) an introduction to and integration of pertinent research in sport pedagogy and subject matter content must be apparent (Mccullick, Belcher, & Schempp, 2005).

There is no doubt that specialised knowledge content, such as sport psychology, must be explicitly taught to every party: athletes, teachers and coaches if coaching efficacy is to substantially improve (Villalon & Martin, 2019; Ward, Tsuda, Dervent, & Devrilmez, 2018).

Teachers and trainers alike should develop effective communication methods to interact better and more often with their athletes; better communication means improved athletic performance (Claxton, 1988).

Neuro-Linguistic Programming includes many communication tools of varying effectiveness. Because of the simplicity and the applicability of many such tools, a knowledgeable selection would provide many benefits (Stipancic, Renner, Schütz, & Dond, 2010; Zaharia, Reiner, & Schütz, 2015).

## DMCD COMPONENTS

The DMCD components have been extensively analysed and discussed in a series of papers and books (presented in a more concise form in Papageorgiou, 2019). The coach should grasp the rationale of the tennis Distal Method, i.e., of a holistic training system, by understanding the different components of DMCD when put together; this will be our main focus here. These components that make up the DMCD are the real contribution to tennis Coaching Development programmes since i it is the first time the total sum of the components has been presented and ii no other similar programme is so holistic and all-encompassing. Before we see the components and their inter-relationships in greater detail, let us first see, in summary, what a coach will be taught in DMCD:

1. The a priori constructed biomechanical model (based on principles and not on copying top-players' movements). The personal expression of the technical form is called "style" (in DMCD terms) and is developed gradually based on the tools and methods described below.

2. The primary and secondary synthetic pairs SBLM and S+B+L+M (Stance, Ballistics, Locomotion, Manipulation) for developing tennis technique through motor skills on court (SBLM) and off-court (S+B+L+M) – fig. 1 and 2.

3. The primary and secondary synthetic pairs SFSB and S+F+S+B (Strength, Flexibility, Speed, Balance) for developing tennis-specific fitness on-court (SFSB) and off-court (S+F+S+B)<sup>1</sup>. Note: SBLM, S+B+L+M, SFSB and S+F+S+B are drill-producing generators filling the gap in having a methodology to create a complete pool of

activities for any conceivable need of the athletes in the areas of both motor learning and physical conditioning.

4 The two kinds of Performance Spirals: i for technique-tactics, and ii for physical conditioning. They are the two periodisation protocols for distal adaptations to improve performance (fig. 3)<sup>2</sup>.

5. Motowords, pairing syllables with movements to facilitate communication and engage cognition actively. Motowords also adjust the complexity level of the drills, bridging serial and random practice.

6. The tSMS (tennis Sensory-Motor Synchronisation) programme (rhythmic training): the development of timing is the single most important component of high performance in tennis. To that end, tSMS and TennisPulse applications were also developed (available in Google Playstore).

7. Drill synthesis and drill structure, to adjust the ecological validity of the drills (where a coach feeds balls). There is also rally synthesis and rally structure (where two players exchange balls for practice).

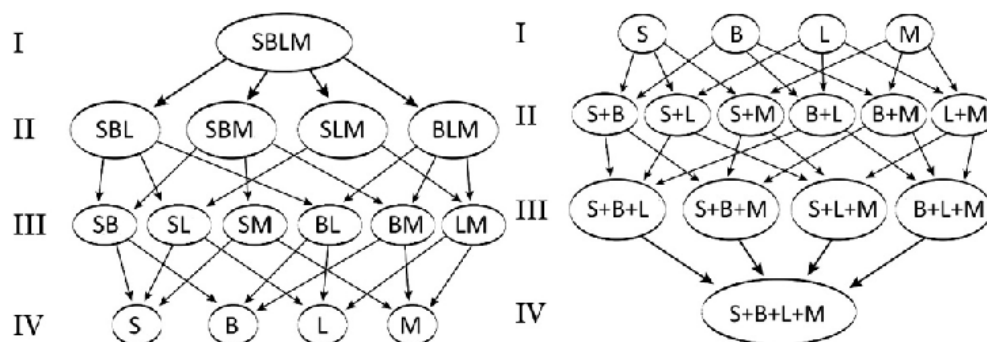
8. Differential (self)training, to facilitate the decision-making process.

9. Mental training, where the basics of sports psychology are explained.

10. NLP (Neuro-Linguistic Programming) and tapping tools for arousal adjustment and more effective sports imagery training<sup>3</sup>.

11. Theatre pedagogy: exploring the role of the coach as an empowering action coordinator ("animator", but not quite); coaches are also shown some methods from theatre pedagogy.

12. Deliberate practice and theory of expertise, ethics.



<sup>1</sup>The general layout of figures 1 and 2 is also applicable here.

<sup>2</sup>The physical conditioning performance spiral is shown; the technical-tactical performance spiral is similar, but instead of the dimensions "force" and "velocity", it has the dimensions "Contextual Interference" and "Freedom Degrees".

<sup>3</sup>Here we shall not bother with the unfounded controversy among psychologists who try to prove NLP to be "pseudoscience". All psychotherapy is a celebrated placebo effect to begin with (Ioannidis, 2016); more research is needed regarding the importance of the placebo effect per se (Howick et al., 2013).

Figure 1 (left) and 2 (right). The SBLM primary model for motor learning: developing motor skills using tennis-based drills. SBLM: Stance, Ballistics, Locomotion, Manipulation (left). The S+B+L+M secondary model for motor learning: developing motor skills using non-tennis-based drills. S+B+L+M: Stance, Ballistics, Locomotion, Manipulation (right).

Let us see now, in some greater detail, what the coach will learn in DMCD and some of the potential benefits for their athletes. First comes the biomechanical model, which in DMCD is an a priori constructed model about optimal technical form (Konstantinos G. Papageorgiou, 2016; Papageorgiou, 2020c). This means that it is constructed based on how players should optimally move, without copying any professional player.

Next, the pair SBLM and S+B+L+M for motor learning and performance (Papageorgiou, 2017a), which is a dual model providing: i a way to produce all kinds of drills for both tennis-related motor skill acquisition (S+B+L+M) and ii a way to learn tennis shots by training the fundamental movements involved as discrete motor skills (SBLM). Taking into consideration all four components of motor performance (Gallahue, Ozmun, & Goodway, 2012), the primary SBML model consists of exercises inside the court (with racket and balls along with other equipment) to improve motor skills (fig. 1); the secondary S+B+L+M model consists of a set of tennis-specific exercises that are trained outside the court for tennis (fig. 2).

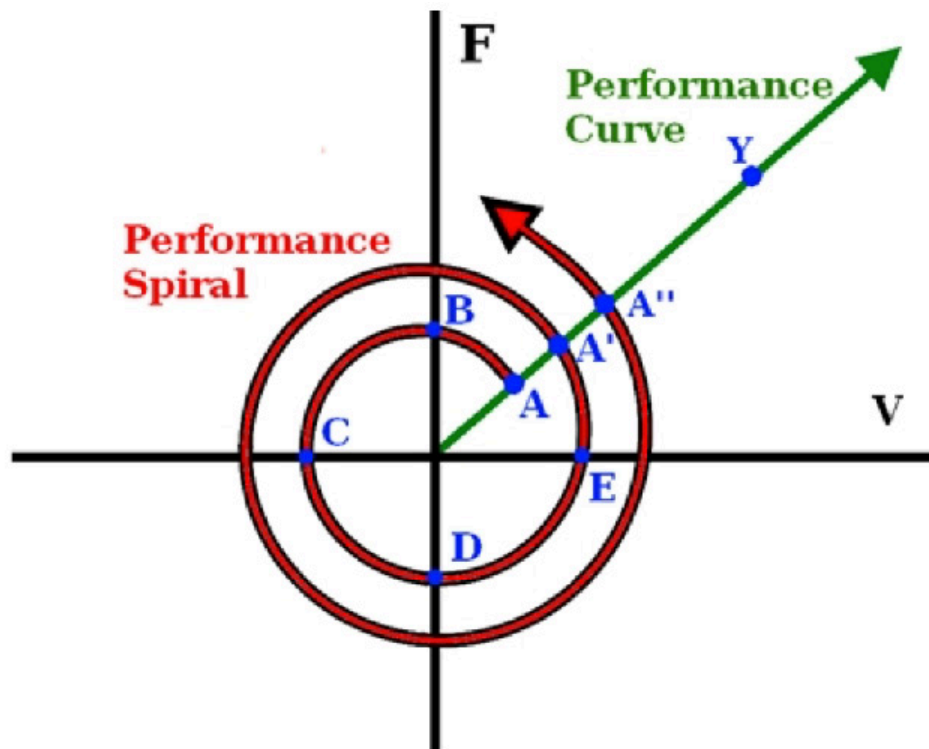
Similarly, the pair consisting of the primary SFSB and the secondary S+F+S+B models is used for physical conditioning (Papageorgiou, 2017a). Taking into consideration the four components of physical conditioning (Bloomfield & Ackland, 1994), the primary SFSB model consists of tennis-like exercises inside the court that both improve physical conditioning and strengthen the technical form; the secondary S+F+S+B model consists of exercises that are trained outside the court for tennis. In figures 1 and 2, it is shown how the primary and the secondary synthetic models are produced (SFSB and S+F+S+B are created the same way). In a top-down fashion, [SBLM] represents the game of tennis made up from the four motor skill-related components.

The next step is to create simpler and simpler drills by combining all these four components in all possible i triads, ii pairs and iii units. Therefore, by creating the corresponding series of drills, a set of tennis drills is developed for every possible aspect of tennis-related motor skills. The reverse order is taken in S+B+L+M model. In a bottom-up fashion, one should start from simple ("fundamental") motor skills, again combining them in i pairs, ii triads and iii one quadruple. This way, the result will be a set of drills that address every aspect of tennis playing but are practised outside the court without tennis equipment. TennisPulse and tSMS

are the tennis-specific rhythmic training protocols. In that respect, they belong to motor skills training; but they may be combined with any of the pairwise models we have seen (not only SBLM and S+B+L+M but also SFSB and S+F+S+B). In modern tennis, too much emphasis has been put to the physical conditioning of athletes at the expense of practice programmes designed for motor skills and coordination/timing development. TennisPulse introduces basic tennis-derived rhythmical patterns which then applies to various movements. These movements include lying down while trying to coordinate various body parts (minimum movement) as well as "shadow tennis", trying to incorporate the various rhythmical patterns in tennis shots. The first part is very similar to the Feldenkreis system (with the obvious addition of a metronome-like sound). The tSMS introduces the metronome into tennis practice as a tool for improving synchronicity.

The two Performance Spirals are periodisation protocols aimed at world-class performance (Papageorgiou, 2016, 2019); we have created a pool consisting of drills for every possible need, and the periodisation protocol helps us in selecting how to train these drills. Fig. 3 demonstrates the basic rationale regarding the physical conditioning performance spiral along with its four distinct phases of practice. Direct performance improvements are not possible. I have called this fallacy "the tennis effect" inspired by the way tennis trainers instruct players to "move quicker", or "hit the ball harder", as if a simple instruction could magically create all the adaptations needed in order for this to happen. The non-plastic performance improvement, i.e., improvement outside the present capacity of the player "even on their best day", requires distal adaptations (in the long run) and is achieved indirectly after improving all related performance parameters.

When each cycle is completed, players find themselves performing better than they did at an earlier stage. The same principles apply to the technical-tactical Performance Spiral. It provides a complete periodisation protocol for technical-tactical expertise development in tennis (and in similar sports). It unifies technique and tactics leading from training tennis technique as a closed motor skill, to extremely demanding competitive performance.



**Figure 3** - The Performance Spiral. Along the Performance Curve, A' is a point of higher performance than A. However, a performer, in order to get to A', has to follow the whole (Performance) Spiral (A,B,C,D,E and finally, A') and the respective drills and exercises instead of going directly from point A to point A' – which is not possible if learning (~plastic changes) is the goal (and not merely performance, related to elastic changes). The same applies for all other points in the curve, A', A'', until point Y, designating motor expertise. F: Force and V: Velocity. The Performance Spiral recognises four distinct phases of practice: i sport loading (B), ii slow practice (C), flow practice (D), overspeed training (E).

Motowords is a tool related to the training programme that offers the missing link between serial and random practice (Papageorgiou, 2020b). While all practice schedules are deemed as important, random practice has already been shown to be superior for skill learning (Shams & Fazeli, 2018). Motowords is a unique mix of practice schedules, communication methods and cognitive training methods.

Each motoword has up to 7 syllables (K. A. Ericsson & Moxley, 2013) and motowords describe a set of movements (a drill). Instead of pausing the training session each time to explain the next drill, the trainer simply uses motowords to communicate the next sequence of shots, any number of them, while varying the tone of her voice if needed to imply a certain change in rhythm, etc. This also adds a cognitive load which creates beneficial perturbations – as long as the complexity of the exercise remains within some desired limits, as is predicted by the deliberate practice model.

Drill synthesis and drill structure is another pairwise epistemologically rich approach for the categorisation of drills.

These two concepts help coaches design or select drills based on the criterion of function, i.e., what is the function of each drill? Is it about practicing movements or about practicing playing tennis? When should we practice movements and when should we practice the game of tennis? Drill synthesis/structure is not about how to periodise the drills or about how to adjust the complexity of the drill (the concern of training schedules, e.g., blocked and random practice). It is about implementing elements from the game of tennis: the game of tennis is not just hitting balls, exactly the way playing Bach's English Suites in front of an audience is not just pressing the right piano keys.

Maybe pressing the right keys correctly is already too difficult; however, overcoming the technical part does not make you a musician. This is something musicians acknowledge, but not just in theory, as is the case in tennis: musicians, apart from exercises (such as scales), also have a very special kind of exercises called études, designed not only to improve motor skills but also interpretation.

Listening to, for example, Chopin études, one non-musician can hardly believe they are exercises and not just beautiful musical pieces! This gap in tennis training is filled by the drill structuring methodology.



Drill synthesis concerns drills aimed at practising different skills and drill structure concerns drills aimed at practising strategy and tactics (Papageorgiou, 2019). Most training systems fail in distinguishing skill practice from real performance practice; hence, they fail to bridge the gap between practice and competitive performance. The missing link between practice and competition is drill structure; drills which train not only movements but also scenarios or movements within ecologically valid situations. It is the same as the difference between practising chromatic scales (synthesis) and practising études (structure) in music. Mental training tools, supplemented by NLP, are vital to this end: "Students who are mentally engaged to analyse the cues and relations among game parameters can improve reflective thinking, decision making and problem-solving competencies to select appropriate techniques, strategies and tactics" (Fatih Dervent, Erhan Devrilmez, Xiuye Xie, & Weidong Li, 2019) – hence, coaches should acquire such tools. In NLP, selected techniques are taught to the coaches so that they may be able to help their athletes train and adjust their arousal level, emotional states, understanding, and release some of their mental and sentimental blocks. Theoretical background from Sports Psychology is also provided to the coaches. NLP and Theatre Pedagogy are two components aimed at developing the mental and the emotional aspects of the player (Papageorgiou & Papadopoulos, 2018). They both develop a healthy mindset and help to deal with problems such as stressful competitive periods. Orlenko and Malyk (2017) demonstrate the effectiveness of art therapy for the formation of adequate self-esteem in tennis players (Gant Olena Orlenko & Iaroslava, 2017). Coaches will also be able to use the dual method of differential training and differential self-training to increase: i. the adaptability, ii. the initiative and iii. the decision-making speed of the athlete (Papageorgiou, 2019). When athletes engage more actively in thinking about their practice, the instruction which they receive becomes even more effective (Lee, Landin, & Carter, 1992). In fact, the interest for metacognitive skills in tennis competition is growing steadily (Theodosiou, Mavvidis, & Tsigilis, 2018). (Meta)cognitive skills training is an essential part of DMCD. All forms of technical and tactical training, along with the various tools used in each phase are represented in the tactics-technique training spiral for tennis, also known as "the complete model for technical-tactical expertise in sports" (Papageorgiou, 2019). Finally, coaches will be educated about the concepts of deliberate practice (as a foundation for any type of practice), theory of expertise and ethics. These are three more components addressing the psycho-social, socio-psychological and philosophical aspects of development; not only motor experts in tennis but also individuals who have consciously developed their own identity as players (and trainers), ambassadors of an explicit value system and professionals who have a deontological code (Konstantinos G. Papageorgiou, 2014, 2017;

Papageorgiou, 2015, 2017b, 2020a). Ramifications of expertise attainment in relation to both children and older, master athletes is also being considered (Fraser-Thomas & Cote, 2006; Fraser, Li, & Penhune, 2009; Hoffmann, Young, Rathwell, & Callary, 2020).

Why so many parts? It would be great if playing tennis could be reduced to some traits or characteristics and athletes, who would have them by nature ("talents") or by nurture, would excel. However, this is not the case and no simple reduction of this kind may explain, or predict, success (Dobos & Nagykalai, 2016). Still, this much sought-after success means little if one does not understand its ethical implications about balance, harmony, justice and power stemming out of the modern industrialised sports arena; the implications for one's soul, one may even add (Gongaki, 2017).

## RELATIONS AMONG DMCD COMPONENTS

The goal (ideally and in the DMCD) is for players to play according to the biomechanical model, i.e., according to the most economic and effective way ("efficiency"). The tennis effect described earlier shows that, no matter how much we wished it to happen, we cannot simply dictate the biomechanical model to any player; we cannot "upload" it to someone's brain! We need a certain procedure for that to happen, i.e., for a player to implement the biomechanical model to their games. The DMCD provides all necessary tools to the trainer for this to happen. In this section, it is explained in more detail, how each part relates to each other so that coaches may achieve the desired outcome: the development of motor experts.

Before even teaching the biomechanical model in any way, we have to be sure that players have the basic physical and motor competence to actually complete the movements. So first, we learn how to improve the athletes' basic motor and physical skills through exercises derived from the S+F+S+B and S+B+L+M models. Such exercises do not require any sort of tennis playing skills. It is also advised to use these exercises as a sort of fundamental motor skills tests which could also be combined with some other kind of formal or informal assessment. Then (or almost simultaneously), it is the time for SFSB and SBLM models to be used for improving the motor skills, on court. Coaches may use this process to help learners execute the biomechanical model: players



hold a racket and hit tennis balls, but they are not really playing tennis (to avoid misunderstandings, it can/should be done playfully). It is the most specialised form of motor skills training for tennis. The real thing, i.e., practising the game of tennis, starts at drill synthesis. Therefore, coaches learn about drill synthesis and drill structure next (in practice, as soon as minimum technical automatisations are achieved, drill structure is also introduced). Coaches may support drill structure by differential (self)training, while motowords have already been used from the stage of drill synthesis. Differential training and differential self-training are used to increase contextual interference and the ecological validity of the drills already created in the previous steps.

The two Performance Spirals answer the question "how are we going to train the drills produced by these two pairwise models?" Each spiral is never ending and ever evolving, up until and even beyond motor expertise attainment some years later and after thousands of hours of practising and playing. Every time each spiral is repeated, coaches should perform a more or less formal evaluation of performance parameters: tennis-related on-court tests: more often, every couple of cycles; ergometric tests requiring special computerised equipment: less often, every few cycles.

Coaches should incorporate play from early on, but should always be in balance with deliberate practice (all practice is deliberate practice) since playing worsens performance, whereas deliberate practice improves it (attention:

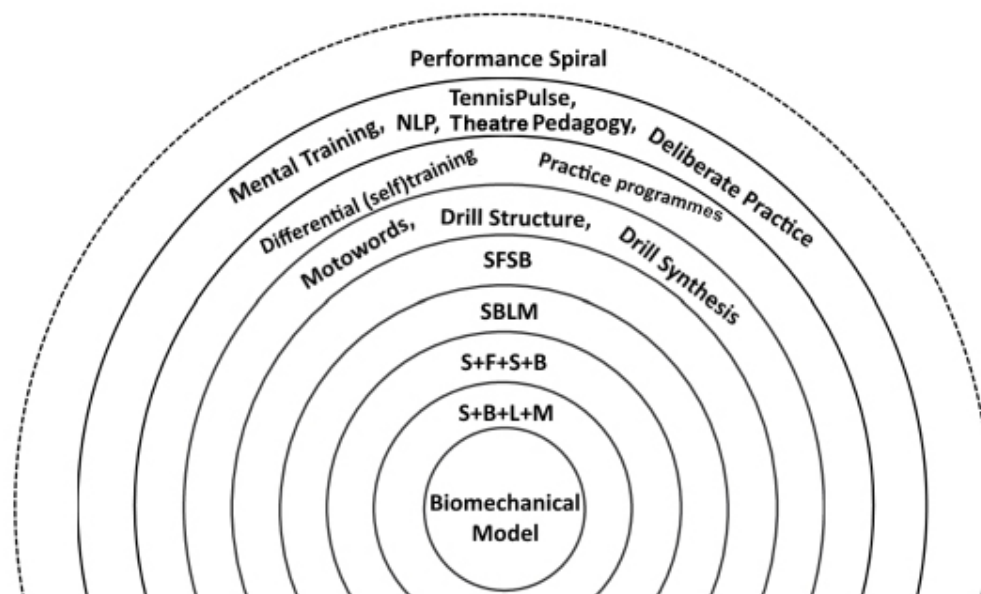
this worsening is much needed in antifragile systems such as our own psychomotor systems!).

From day one and at all times, coaches are taught to supplement the whole process by suitable mental skills practice, coordination/timing practice (TennisPulse, tSMS), Theatre Pedagogy interventions and the development of the proper expert identity of the athlete including all its components (ethical, social, professional).

All these are shown in fig. 4. Tables 1a and 1b present a three-dimensional model of tennis Expertise in Distal

Method (Table 1a) along with the tools DMCD provides for each constituent (Table 1b). If high-level expertise is the desideratum, DMCD has all the relevant components, i.e., tools that the trainer may use to develop their athletes from early stages and on, until world-class performance is achieved (K. A. Ericsson, 2007; K. A. Ericsson, Krampe, & Tesch-Römer, 1993; Janelle & Hillman, 2003; Konstantinos G. Papageorgiou, 2014).

Tennis DMCD has been taught to several coaches in Greece who claim that it has changed their perception of the sport. Unfortunately, professionalism in tennis in Greece is very low, so its components have not been empirically tested on Greek developing professional players (who are almost non-existent). Interestingly, Apostolos Tsitsipas, father and official coach of the best Greek player so far (Stefanos Tsitsipas, currently ranked at No. 6 in the world), has officially endorsed the tennis Distal Method (in writing, on the back cover of the Greek, 330 page tennis Distal Method Handbook). By all means, the paradigm shift the Distal Method introduces is still in its early stages.



**Figure 4** - Strata of DMCD learning tools extending from basic and synthetic to advanced and structured. SFSB and S+F+S+B, SBLM and S+B+L+M stand for: Strength, Flexibility, Speed and Balance, Stance, Ballistics, Locomotion and Manipulation, respectively.

**Table 1a:** A mechanistic three-dimensional model of tennis expertise. In this table, the constituents of the model are presented. SEA: Science of Exceptional Achievement. "develop." stands for development.

Grades of Resolution						
Levels of Organisation	Practice programmes	Drill Synthesis	Technique & Style develop.	Periodisation	Strategy & Tactics develop.	Drill structuring
	Procedural memory	General motor skills		Motor Performance	Specific motor skills	
	Biomechanics		Abstract biomechanics	Kinesiology	Physical Conditioning	
	Sports		Racket Sports	Tennis Tournaments	Singles/Doubles	Playing variations
	Consciousness	Psychotherapy	Psychology	SEA	Sports Expertise	Deliberate practice
	Physical literacy		Physiology	Biology of Expertise	Tennis Physiology	
	Education	Special needs education	Talent education	Pedagogy	Teaching styles	
	Humanities			Philosophy	Sports Ethics	

**Table 1b:** A mechanistic three-dimensional model of tennis expertise. In this table, the third dimension is presented: the tools that correspond to the constituents of table 1a. SFSB and S+F+S+B, SBLM and S+B+L+M stand for: Strength, Flexibility, Speed and Balance, Stance, Ballistics, Locomotion and Manipulation, respectively. NLP: Neuro-Linguistic Programming. SEA: Science of Exceptional Achievement. "develop." stands for development.

Grades of Resolution						
Levels of Organisation	Random, serial, blocked practice	motowords		Periodisation	Differential (self)training	Competition simulation
	Technical-Tactical Performance Spiral	S+B+M+L		Motor Performance	SBLM	TennisPulse/ tSMS
		Style	Ideal form	Kinesiology	S+F+S+B	SFSB
			Rally synthesis	Tennis Tournaments	Structured rallies	
	NLP	Theatre Pedagogy	Mental training	SEA	Sports Expertise	Deliberate practice
	Coaching		Assessment	Biology of Expertise	Physical Conditioning Performance Spiral	
	Simplification	Acceleration		Pedagogy	Empowering Action Coordinator	
		General vision		Philosophy	Structured discussions	

## CONCLUSIONS AND FUTURE DIRECTIONS

DMCD has been developing with the aim of becoming the golden standard in tennis coaching development programmes. Such a programme should develop coaches in all the aspects an athlete would need to become not only a world-class performer but also a "bright personality". Because, in Classic Epistemology, one is obliged to evaluate a system solely based on its preconditions and not its results, DMCD successfully accommodates the relevant theoretical models about world-class performance, providing tools for every aspect of the athlete's development.

The DMCD is not one tool, but a system of tools designed to help trainers develop motor experts in tennis. To the extent it introduces new approaches that replace old ones (such as: the expert generalists, the importance of rhythm vs. the importance of physical conditioning or reaction time, drill structure), the DMCD is also a Paradigm (in the Kuhnian sense). As such, it cannot be directly tested in the exactly same way as the Waldorf Educational System, the Montessori Educational System, or even Judo or Yoga cannot be assessed "experimentally" as a whole. Of course, parameters related to the DMCD can be tested and have actually

been tested. Testing any parameter of the DMCD is encouraged for future studies, however, the aim of this article was to present, for the first time, a new type of coaching development system, the DMCD, which, by its own accord, introduces a new Paradigm. Any such Paradigm cannot be experimentally tested as a whole; Paradigms set the scene for experiments to follow – and this is what was attempted in this article, especially for tennis. Finally, the basic tenets of the tennis DMCD are generalisable, in principio, to other motor expertise relevant domains.

After the catalytic effects of the COVID-19 pandemic, it has become increasingly important to also provide such coach development curricula via online courses and smartphone apps. The tennis DMCD system has been recently launched as a full-blown online course. Such implementations are inevitable and should be studied in depth.

### Highlights

1. DMCD offers a blend of physical, psychological and epistemological tools for tennis training to tennis coaches.
2. DMCD is both a method and a methodology for teaching tennis.
3. DMCD is a system based on the interaction of multiple tools at many levels
4. DMCD offers tools for the holistic development of motor experts in tennis from scratch.
5. DMCD is the first such system developed based on epistemological insights.

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## APPENDIX: GLOSSARY AND DEFINITIONS

Abstraction: the process of inclusion in supersets. See also: structure.

Acceleration: progress through an educational programme at rates faster or at ages younger than conventional (Pressey's definition, 1949).

Analysis: the process of segmenting an object. See also: synthesis.

Coach development: an ongoing process of revision, refinement and enrichment in regard to coaching and teaching tools and methods. Coach development is different from Coach Certification where the said teaching tools and methods must also be demonstrated and evaluated.

Contributory expertise: the type of expertise that contributes significantly in the said area of expertise. See also: expert generalists.

Deliberate practice: the type of practice where individuals consciously practice drills that are around their proximal zones of development.

Distal adaptations: chronic adaptations that require long-term planning (e.g., the increase in oxidative capacity of cells after chronic aerobic training). See also: proximal adaptations.

Epistēmē: a logically structured system of knowledge. See also: science.

Epistemology: the branch of philosophy that studies the source and the validation of knowledge, especially in epistēmē.

Ethics: the branch of philosophy that examines the predicate of good and evil.

General expert: an expert who has a broad epistemic surveillance of their field.

Learning: the (invisible) adaptations of the central and peripheral nervous system in response to external or internal stimuli. See also: performance.

Method: a system of tools used under a specific theoretical approach. See also: methodology.

Methodology: the epistemological examination of knowledge. See also: method.

Motor expertise: repeatedly superior and superiorly repetitive, demonstrative performance of motor skills.

Neuro-Linguistic Programming: a psychotherapeutic method based on the effect of language and linguistic

structures on the mind and behaviour.

Performance Spiral: a method of progressive periodisation.

Performance: the process of acting based on current psychomotor and physical capacities. See also: learning.

Philosophy: the field of knowledge that examines the relationship between ideas.

Physical literacy: an umbrella term related to both declarative and procedural knowledge about physical activities, combined with the notions of motivation, values, understanding and consistency regarding physical activities.

Proximal adaptations: short-term adaptations to stimuli (e.g., the increase in heart rate when one engages in an aerobic activity). See also: distal adaptations.

Psychotherapy: a process of both self-discovery and releasing neurotic behaviour and trauma, resulting in increased life-satisfaction and joy.

Schools (with capital "S"): educational systems providing teachings and tools for the development of individuals, for example, martial arts systems, but also asceticism, etc.

Science: an empiricist system of knowledge. See also: epistēmē.

Simplification: any method of reducing the complexity of practice.

Structure: the process of inclusion in subsets. See also: abstraction.

Synthesis: the process of combining analytical fragments of an entity. If the initial entity is the result of synthesis, then the process is called resynthesis (Greek: anasynthesis). See also: analysis.

System: a set of interactive components.

Technical form (technique): the application of a biomechanical model to the human body. See also: technical style.

Technical style: the adaptation of the individual's technical form after prolonged training. See also: technical form.

Theatre pedagogy: a general pedagogical system based on theatrical activities and theatrical games.



**DISTALNA METODA ZA USAVRŠAVANJE TRENERA TENISA: NOVA PARADIGMA U OBRAZOVANJU TRENERA**

Programi za usavršavanje trenera imaju višestruke ciljeve, na primjer, dati trenerima i obrazovnim djelatnicima znanje i alate kako bi bili u toku sa novinama ili osvježili već postojeće koncepte. Distalna metoda je generička metoda za postizanje motoričke stručnosti. Kreirana je na osnovu saznanja iz naučnih disciplina koje se odnose na motoričku stručnost kako bi se usavršili prvoklasni izvođači u domenama vezanim za motoričku stručnost. Ovdje je predstavljena distalna metoda za usavršavanje trenera tenisa (engl. DMCD - Distal Method Coach Development). DMCD ide u korak sa modernim obrazovnim paradigmama poput fizičke pismenosti (pedagogija), namjerne prakse (Nauka izuzetnog postignuća) i Sekundarnog modela sinteze treniranja (engl. SSCM - Secondary Synthetic Coach Model). Cilj ovog članka je dvostruk: I dati sveobuhvatan pregled radova na području DMCD-a za tenis tokom godina i II istovremeno popuniti praznine u sistemima za usavršavanje trenera tenisa i uspostaviti visok standard u tom području.

**Ključne riječi:** motorička stručnost, fizička pismenost, doprinosna stručnost obrazovanje trenera

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# TRANSFORMATION LEVELS OF BASIC AND SITUATIONAL MOTOR SKILLS UNDER THE INFLUENCE OF TRAINING OPERATORS IN 14-16-YEAR-OLD MALE VOLLEYBALL PLAYERS

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## ABSTRACT

The aim of this research was to determine the transformation levels of basic and situational motor skills' morphological dimensions under the influence of training operators in 14-16-year-old male volleyball players. To this end, on a sample of 50 respondents, 14-16-year-old male volleyball players, data was collected on the respondents' success in basic motor skills tests, 9 basic motor skills, and situational motor skills tests, registering the results in 7 situational volleyball tests. In order to test the transformation levels between the two trials, a t-test for two dependent groups (paired samples t-test) was applied. When testing the differences between arithmetic means of the initial and final measurements for situational motor variables, statistically significant differences were achieved at the level of  $\text{sig.} = .00$ , except for the variable Jelka test (SMJET) which determines the speed duration of male volleyball players. In the initial measurement of arithmetic means in 50 volleyball players, the variable repeated volley (SMUOP) had the mean of 20.6 and  $\text{SD} = 4.86$ , and the final measurement had the mean of 25.98 and  $\text{SD} = 4.86$ . Testing the differences between the SMUOP means, we found that the mean value is -5.38 and the t-test resulted in the value of -11.39, which is, along with the degree of freedom (df) of 49, statistically significant at the level of  $\text{sig.} = .00$ . In variables determining the situational motor skills, that is, elements of the technique: repeated bump (SMUOČ), tactical serve accuracy (SMPTS), spiking against the wall (SMSLZ), statistically significant changes were achieved at the level of  $\text{sig.} = .00$ . The variables Japan test (SMJAT) and Abalakov test (SMABT) were also statistically significant at the level of  $\text{sig.} = .00$ .

**Keywords:** volleyball, transformational processes, basic and situational motor skills, programme, cadets

## INTRODUCTION

Volleyball is a dynamic game with a multitude of changes and, as such, it requires a lot from players both from the physical and

psychological traits and skills (Boichuk, Iermakov, Nosko, & Kovtsun, 2017; Sopa, 2019; Zwierko, Osinski, Lubinski, Czepita, & Florkiewicz, 2010). Volleyball is typical for sports education since it promotes the competitive spirit, positive elements of a character

and requires a high degree of personal fitness and training, in addition to developing physical abilities such as reaction speed, flexibility, strength and endurance in combination with many technical skills (Barth & Linkerhand, 2007; Kozina et al., 2018; Kus, 2004; Purkhús, Krusturup, & Mohr, 2016). Volleyball is characterised by polystructural variable movements, which are situationally differentiated, within the movement complex specific for the attack and defence phases (Gebaj, Tomac, & Ajman; Milic, Grgantov, & Katic, 2013; Poček, 2015).

Sports training methods in volleyball can be defined as the manner of conducting certain training activities or parts of individual training sessions (Cronin & Sleivert, 2005; Hakman et al., 2017; Linek, Saulicz, Myśliwiec, Wójtowicz, & Wolny, 2016; Voelzke, Stutzig, Thorhauer, & Granacher, 2012).

These are precisely defined procedures and work methods directed towards the development of the players' abilities or complete acquisition and mastery of technical and tactical knowledge (Education, 2011; Gréhaigne & Godbout, 1995). There are versatile and numerous training methods as well as a multitude of classifications in terms of the selected criteria.

The desired goal determines the fundamental criterion for classifying the training methods. Accordingly, training methods differ depending on whether the primary training goal is the development of certain anthropological dimensions of players or it is the acquisition of new motor knowledge (Flegar, 2019; Mahmutović et al., 2016; Smith, 2003). The aim of this study is to illustrate and analyse the effect of volleyball training on changes in some general and specific motor skills of 14-16-year-old volleyball players, that is, whether the six-month volleyball technique training will affect the changes in the observed variables.

## WORK METHOD

The aim of this research are transformational processes of basic and situational motor skills under the influence of training operators in 14-16-year-old male volleyball players. Determining the dimensions defining the effect of transformational processes in motor skills and situational motor skills is a highly complex and multidimensional issue. Since a favourable structure of anthropological characteristics is the basic prerequisite for efficient application or study of technical and tactical elements in a volleyball game, monitoring the two mentioned anthropological spaces also has relevant meaning. The primary goal of the research was set in such a way that it encompasses the entire research procedure, that is, to conduct the initial and final measurements during the implementation of the programme (the duration of the programme is 6 months) and determine the effect of

the programme on the controlled anthropological characteristics of male volleyball players. The research was conducted on a sample of 50 male volleyball players aged 14-16. The research process includes healthy players who, apart from being included in the volleyball training process, attend physical education classes on a regular basis.

Variables for assessing the basic motor skills are: hand tapping (MBFTAP); bench forward bend (MFLSPK); shoulder rotation flexibility test (MFLISK); pull-ups (MRCZGV); dips (MRCSKR); 30-second torso lift (MRCPRE); lying medicine ball throw 1 kg (MFEBMS); defensive lateral movement (MAGKBO); hand dynamometry (MRADŠA).

Variables for assessing the situational motor skills are: repeated volley (SMUOP); repeated bump (SMUOČ); tactical serve accuracy (SMPTS); spiking against the wall (SMSLZ); Japan test (SMJAT); Jelka test (SMJET); Abalakov test (SMABT).

Motor skills and specific volleyball skills were measured in the afternoon, during the time which is typically reserved for training teams. The measurements were taken at several points. One person took the measurements and one recorded them at each point. There was a maximum of two respondents at each point, simultaneously. The measurements were taken using standard instruments (Janković et al., 1997; Marelić, Đurković, & Rešetar, 2007; Strahonja, Janković, & Šnajder, 1982; Šoške & Rado, 1998; Zoric, 2018). Concerning the experimental treatment which took place during the period of six months, it is important to note that training sessions were conducted 5 times a week with the duration of 1h and 30 min.

The training sessions took place from Monday to Friday. The methods for practicing volleyball elements were conducted according to the principle of standard repetition and variable repetition exercises, while in certain situations, the semi-situational and situational methods were applied. The learning method was dominantly based on the combined method of synthetic and analytic learning.

A lot of attention had been paid to proper performance of volleyball technique elements during training, alongside the possible error correction. The obtained results were analysed using the SPSS 21.0 software. In the area of comparative statistics, a t-test for small dependent samples was used when testing the significance between the average results obtained at the initial and final measurements for each variable treated in this research.

## RESULTS

In order to determine the transformation levels of basic and situational motor skills under the influence of training operators in 14-16-year-old

male volleyball players, we used a t-test for dependent samples (paired samples t-test). This research was based on monitoring the transformation levels under the influence of training operators.

**Table 1:** Testing the differences between arithmetic means of variables for assessing the basic motor skills

		Paired Differences				
VARIABLES		Mean	Std. Deviation	t	df	Sig.
Pair 1	MBFTAPI - MBFTAPF	-3.98000	2.30784	-12.194	49	.000
Pair 2	MFLSPKI - MFLSPKF	-42.2000	24.34866	-12.255	49	.000
Pair 3	MFLISKI - MFLISKF	54.40000	19.39493	19.833	49	.000
Pair 4	MRCZGVI - MRCZGVF	-3.90000	2.37547	-11.609	49	.000
Pair 5	MRCSKRI - MRCSKRF	-7.74000	2.99530	-18.272	49	.000
Pair 6	MRCPREI - MRCPREF	-4.80000	2.42437	-14.000	49	.000
Pair 7	MFEBMSI - MFEBMSF	-44.8000	44.68666	-7.089	49	.000
Pair 8	MAGKBOI - MAGKBOF	.98600	.50950	13.684	49	.000
Pair 9	MRADŠAI - MRADŠAF	-5.56000	2.67383	-14.704	49	.000

Analysing the difference between the initial and final measurements of hand tapping in the group of 50 male volleyball players, we determined that it is statistically significant since the difference between these two arithmetic means amounted to 3.98 in favour of the final measurement and the t-test resulted in the value of -12.19 which is, along with the degree of freedom (df) of 49, statistically significant at the level of .00 (sig. (2-tailed)). When testing the differences of arithmetic means between the initial and final measurements for the variable MFLSPK, bench forward bend, the mean was 42.2 in favour of the final measurement, making it statistically significant with the t-test resulting in the value of 12.25 which is, along with the (df) of 49, statistically significant at the level of sig. = .00. For the shoulder rotation flexibility test, the arithmetic mean was 54.4 mm and the t-value of differences between the initial and final result means was 19.83, along with the (df) of 49, which is also statistically significant at the level of sig. = .00. The arithmetic mean of the differences between the initial and final result means of MRCZGV (pull-ups) was 2.37 in favour of the second measurement, and the t-test resulted in the value of -11.60 which is, along with the (df) of 49, statistically significant at the level of sig.

= .00. In dips (MRCSKR), the difference between the arithmetic means of the initial and final measurements, that is, the arithmetic means of the treated groups, is 2.99 in favour of the final measurement and the t-test resulted in the value of 18.27 which is, alongside the (df) of 49, statistically significant at the level of sig. = .001. In the variable 30-second torso lift (MRCPRE), the difference between the arithmetic means of the initial and final measurements was 2.42 and the t-test resulted in the value of 14 which is, along with the (df) of 49, statistically significant at the level of sig. = .00. Testing the differences between arithmetic means of the two measurements made for the medicine ball throw 1 kg, we have obtained the mean of -44.8 and the t-test resulted in the value of 7.08 which is significant at the level of sig. = .00.

Defensive lateral movement (MAGKBO) arithmetic mean of the differences between the initial and final measurements was .509 and the t test value was 13.68 which is, alongside the (df) of 49, statistically significant at the level of sig. = .00. Testing the differences between the arithmetic means of the initial and final measurements taken for the hand dynamometry (MRADŠA), it was determined that the mean was 2.67 in favour of the second measurement with the t-test value of 14.7 which is, alongside the (df) of 49, statistically significant at the level of sig. = .00.

**Table 2:** Testing the differences between arithmetic means of variables for assessing the situational motor skills

	VARIABLES	Paired Differences		t	df	Sig.
		Mean	Std. Deviation			
Pair 1	SMOUP - SMOUPF	-5.38000	3.33742	-11.399	49	.000
Pair 2	SMOUČ - SMOUČF	-8.52000	2.16880	-27.778	49	.000
Pair 3	SMPTSI - SMPTSF	-7.98000	2.15227	-26.218	49	.000
Pair 4	SMSLZI - SMSLZF	-9.36000	2.40544	-27.515	49	.000
Pair 5	SMJATI - SMJATF	1.04300	.33685	21.894	49	.000
Pair 6	SMJETI - SMJETF	.02400	.16971	1.000	49	.322
Pair 7	SMABTI - SMABTF	-4.98000	3.44484	-10.222	49	.000

In Table 2, we can see that statistically significant differences were achieved at the level of sig. = .00, except for the variable Jelka test (SMJET) which determines the speed duration of male volleyball players. For the variable repeated volley (SMOUP), when testing the differences of SMOUP arithmetic means, we found that the mean value is -5.38 and the t-test resulted in the value of -11.39, which is, along with the degree of freedom (df) of 49, statistically significant at the level of sig. = .00. In variables determining the situational motor skills, that is, elements of the technique: repeated bump (SMOUČ), tactical serve accuracy (SMPTS), spiking against the wall (SMSLZ), statistically significant differences were achieved at the level of sig. = .00. The variables Japan test (SMJAT) and Abalakov test (SMABT) were also statistically significant at the level of sig. = .00.

## DISCUSSION

Nowadays, volleyball represents the area of human activity in which there is a rapid development of technology when it comes to preparing athletes and teams (Abdukić, Mahmutović, Mahmutović, & Čosović; Nešić, 2005; Šmigalović, Bajrić, & Lolić, 2012). This phenomenon requires a considerable inclusion of experts and scientists in the selection, direction, training and management processes for athletes and teams. In order for the male volleyball players to reach the stage of producing maximum results, they have to go through certain transformational processes. A dominant position in volleyball is occupied by specific motor skills, that is, game technique (with and without the ball) (Katić, Grgantov, & Jurko, 2006; Roure et al., 1998; Šimonek, 2014a). In volleyball, technique has a central position, directly affecting the result (Đurković, Marelić, & Zekić, 2019; Montuori et al., 2019). It is not possible to perform any technical element of the volleyball game without proper fitness (e.g., a ball hit will not be efficient if the male volleyball player does not meet the optimal

level of speed-strength, a spike jump requires the manifestation of explosive leg strength, etc.) (Boichuk, Iermakov, Nosko, & Kovtsun, 2017; Lidor & Ziv, 2010; Scates, Linn, Linn, & Kowalick, 2003). The quality of the game and, finally, winning the match depend on it, which is a factual imperative of each game. Special preparation in terms of strength consists of developing the strength of those muscles which directly participate in achieving the result (Gamble, 2013; Kraemer & Fleck, 2005; Marques, Van Den Tillaar, Vescovi, & González-Badillo, 2008; Voelzke et al., 2012). It is important to maintain the same muscle coordination which is manifested when performing competitive exercises in competitive conditions when working on this type of strength. Therefore, special preparations in terms of strength can be achieved in two ways. The first would use basic competitive exercises according to the rules of the competitions and the second would be based on using special trainers or props enabling to, apart from the training effect, maintain the same muscle coordination present in the first way (Haff & Triplett, 2015; Pomeschchikova et al., 2016). There are several requirements that have to be met here. First of all, the movements are the same as during a competition. It is necessary to load the male volleyball player in such a way so as to avoid disturbing both the external and internal coordination in order to achieve the best "transfer" of strength (Passos, Araújo, & Volossovitch, 2016; Sadeghi, Shariat, Asadmanesh, & Mosavat, 2013; Wulf & Lewthwaite, 2010). When an athlete performs at a competition, during the execution of the basic competitive exercise, the muscles work in certain coordination (Boichuk et al., 2018; Kozina et al., 2018; Temprado, Della-Graza, Farrell, & Laurent, 1997). Special strength can be developed under the condition that the same coordination is maintained during training when working on strength. If the player has too much load, a change might occur in muscle coordination. In this case,

strength (but not the special type) is developed, and in the second case, coordination is developed, which should be avoided (Hadzic, Sattler, Veselko, Markovic, & Dervisevic, 2014; Junior, 2020; Sopa, 2019). This, of course, only applies to top players. Flexibility is the ability of the locomotor system in performing the maximal amplitude of movements in a joint or a series of joints, and this ability primarily depends on joint structure and ligaments which participate in the movement. Flexibility is specific for each joint, so some joints may be more and some may be less limber (Dopsaj, 1994; Lazić, 2016). Considering that the development of joint morphological structure cannot be affected at a later stage in life, the development of this ability is exclusively affected at a very early age (from the age of 5) while the locomotor system is still developing (Majstorović, 2019; Matijašević, 2018). In volleyball training, increasing flexibility significantly reduces the possibility of injury to the ligaments and muscles, and enhances the total stability of the locomotor system, especially during the age we have treated in this research, namely, the age of 14-16 (Janković, Janković, & Đurković, 2003; Manshouri, Rahnama, & Khorzoghi, 2014; Silva et al., 2019).

For the shoulder rotation flexibility test (MFLISK), measuring the shoulder girdle flexibility, based upon the determined differences between the initial and final measurements, we can conclude that, by implementing the programme in this experimental research, there has been progress in the development and flexibility of the shoulder girdle in male volleyball players. Strength endurance in male volleyball players has been present in such activities where long duration of muscle tension is necessary. It is possible to differentiate between two types of strength endurance: dynamic and static (Hespanhol, Silva Neto, Arruda, & Dini, 2007; Marelić, Đurković, & Rešetar, 2008; Sozen, 2012). Dynamic strength endurance is specific for exercises of both cyclic and acyclic character. These exercises are performed with a relatively moderate intensity, and the exercises of cyclic and acyclic character, alongside strength endurance, need speed and explosive strength (di Cagno et al., 2019; Eylon, Daglioglu, & Guçenmez, 2017; Faizrahmanov, Allanina, & Talantuly, 2017).

Static strength endurance is typical for activities in which it is necessary to maintain a certain position during longer periods of time as well as for activities in which it is necessary to develop maximal and submaximal tension (Alipasali et al., 2019; Amasay, 2008; Eylon et al., 2017; Khuman, Kamlesh, & Surbala, 2014; Васкевич, 2020). Volleyball belongs to the group of sports which are characterised by a complex manifestation of motor skills during different levels of their development.

Based upon the analysis of competitive activity, it is easier to determine which forms of strength are the most represented ones in volleyball. It is typical for this sport that explosive strength and speed-strength are mostly manifested (Grgantov, Milić, & Katić, 2013; Jastrzebski, Wnorowski, Mikolajewski, Jaskulska, & Radziminski, 2014; Lehnert, Lamrová, & Elfmark, 2009; Ramkumar, 2014). In addition to speed-strength exercises, exercises developing endurance for engaging in activities of variable intensity with a significant manifestation of strength should be present here alongside coordination exercises.

All of this is closely connected with developing special endurance which has to be mastered considering the total duration of a specific activity which is limited by the rules of the competition. It is characteristic of volleyball that, when working on mastering strength, methods and means are used from all four groups of sports, especially the first one (1. Sports of the speed-strength type which are characterised by maximum muscle tension. 2. Sports which are characterised by a high level of endurance manifestation. 3. Sports which are characterised by a high level of coordination development in performing the movements according to a certain programme. 4. Sports which are characterised by a complex manifestation of anthropomotor skills during different levels of their development (sports game) (Behm, 1995; Birrer & Morgan, 2010; Bompa & Buzzichelli, 2015; Foran, 2001; Gamble, 2013; Smith, 2003). Therefore, the development of muscle strength is of great importance for volleyball, and the increase of movement speed in male volleyball players is mostly dependent upon it. Consequently, when it comes to male volleyball players, their progress in achieving results is greatly connected with the increase of their special preparation in terms of strength. Working on strength in male volleyball players has primary significance not only during working on strength in general but also within special physical preparation, which, of course, does not exclude the application of means for general physical preparation.

In all variables of the basic motor skills which were selected in this experimental programme, there was a statistically significant transformational process. Coordination is the ability to accomplish movement tasks that demand cooperation of several body parts without mental tension or mistakes, and with minimum effort. (Drabik, 1996). Simply put, coordination is described as the ability to perform simple and complex movements, i.e., the ability to perform complex movements in addition to learning the new movements fast and rapidly switching from one movement to the other (Boichuk, Iermakov, Nosko, Kovtsun, & Nosko, 2017; Drabik, 1996; Hughes & Watkins, 2008; Kozina et al., 2018; Šimonek, 2014b; Temprado et al., 1997). The physiological basis of coordination lies in synchronising the neuromuscular system and transferring the stimuli from one motor cortex to other motor cortices which manage other body parts.



A well-developed sense of motion (kinaesthetic sense) is important for good coordination. This sense, along with the presence of visual and auditory information, allows the male volleyball player to receive information on the position of different body parts, tension and activities of different muscles as well as on the physical, spatial position and movement dynamics. In volleyball, coordination occupies one of the most significant positions in the volleyball success equation (Boichuk et al., 2019; Gabbett, Georgieff, & Domrow, 2007).

## CONCLUSION

In order for the male volleyball players to reach the stage of producing maximum results, they have to go through certain transformational processes. In volleyball, technique has a central position, directly affecting the result. The modern method of playing requires the players to master the elements of the

technique (rational execution of movements with the ball or without it, with the goal of completing certain tasks). In order to achieve this, first, it is necessary to adequately prepare the male volleyball player with an optimal level of fitness as the fundamental part of all movements at the volleyball field. Utmost attention must be paid to the stages of learning, acquisition or perfect execution of these elements so that they can be performed as fast, strong and precise as possible.

Therefore, it is not possible to perform any technical element of the volleyball game without proper fitness (e.g., a ball hit will not be efficient if the male volleyball player does not meet the optimal level of speed-strength, a spike jump requires the manifestation of the explosive leg strength, etc.). The quality of the game and, finally, winning the match depend on it, which is a factual imperative of each game.

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**NIVOI TRANSFORMACIJA BAZIČNIH I SITUACIONO MOTORIČKIH SPOSOBNOSTI POD UTJECAJEM TRENAŽNIH OPERATORA KOD ODBOJKAŠA UZRASTA 14-16 GODINA**

Cilj ovog istraživanja bio je utvrditi nivoe transformacija morfoloških dimenzija, bazično-motoričkih i situaciono-motoričkih sposobnosti pod utjecajem trenažnih operatora kod odbojkaša uzrasta 14-16 godina. U tu svrhu su na uzorku od 50 ispitanika, odbojkaša uzrasta od 14 do 16 godina, prikupljeni podaci o uspješnosti ispitanika u bazično-motoričkim testovima, 9 bazično-motoričkih sposobnosti, i situacionim motoričkim testovima, registracijom rezultata u 7 situacionih odbojkaških testova. Za testiranje nivoa transformacija između dva izvođenja, primijenjen je t-test za dvije zavisne grupe (engl. paired samples t-test). Kod testiranja razlika aritmetičkih sredina inicijalnog i finalnog mjerenja situaciono-motoričkih varijabli ostvarene su statistički značajne razlike na nivou sig. = ,00, izuzev varijable Jelka test (SMJET) koja nam određuje brzinsku izdržljivost kod odbojkaša. Kod varijable uzastopno odbijanje prstima (SMUOP) u inicijalnom mjerenju AS kod 50 odbojkaša ispitanika je iznosila 20,6, SD = 4,86, dok je u finalnom mjerenju AS iznosila 25,98, SD = 4,86. Testirajući razlike AS sredina SMOUP dobili smo da je AS 5,38, t-test je iznosio -11,39, što je uz stepen slobode (df) od 49, statistički značajno na nivou sig. = ,00. Kod varijabli koje određuju situacionu motoričku sposobnost, odnosno elementi tehnike: uzastopno odbijanje čekičem (SMUOČ), preciznost taktičkog serviranja (SMPTS), smećiranje lopte o zid (SMSLZ) ostvarene su statistički značajne promjene na nivou sig. = ,00. Varijable Japan test (SMJAT) i Abalakovljev test (SMABT) su također statistički značajne na nivou sig. = ,00.

**Ključne riječi:** odbojka, transformacioni procesi, bazične i situaciono motoričke sposobnosti, program, kadeti

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# SPORTS CULTURE AMONG THE STUDENTS OF THE HASHEMITE UNIVERSITY

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## ABSTRACT

This study aimed at identifying the sports culture level among the students of the Faculty of Physical Education and Sport Science at the Hashemite University. The researcher used a descriptive approach, and the study population consisted of all students of the Faculty of Physical Education and Sports Science at the Hashemite University attending the first semester of the academic year 2019/2020 ( $n = 1021$ ). The sample of the study consisted of (500) male and female students, at the rate of (49%) of the study population, which were chosen in a stratified random manner. The researcher constructed a questionnaire to measure the sports culture among the students of the Faculty of Physical Education and Sport Science at the Hashemite University. It consisted of (45) items distributed over six domains (moral values and sports spirit, health, fitness, history of sports games, skill performance, and camping and scouting games). The coefficients of the instrument were calculated by obtaining content validity, and the total reliability coefficient amounted to (0.91). Means, standard deviations, t-test and one-way ANOVA were also calculated to find the differences between the means and answer the study questions. The results showed that the level of the students attending the Faculty of Physical Education and Sport Science at the Hashemite University was medium in all the domains. The overall mean was (3.17), with (63.40) relative significance. There were no statistically significant differences at ( $p < 0.05$ ) level in the sports culture level attributed to the gender variable. Meanwhile, there were statistically significant differences at ( $p < 0.05$ ) level in the sports culture level regarding the health area, which were in favour of sports rehabilitation. The study further showed statistically significant differences in the skill performance domain, which were in favour of the coaching and sport management major. Finally, there were statistically significant differences in (health, fitness and skill performance) among the first- and fourth-year students, which were in favour of the fourth-year students.

**Keywords:** sports culture, students, the Hashemite University

## INTRODUCTION

**P**rogress of the societies in the modern era is not only measured by the wealth they possess, but also by the amount of intellectual minds and skilful hands they possess. The actual progress of the society is based on many humanitarian, cultural, and social factors, as well as spiritual and ethical values, which could be inherited only through the family and acquired by education (Jamal, 2005). Education is the true expression of culture, and is the tool that can face the contradictions that hinder it. Education ranks a high position in the community culture, which

is transmitted and continued through interaction and upbringing. It is a means by which the new generations recognise the content of the previous generations' culture. Within the content, an inclusive social process contributes in developing the creative, innovative and self-developing personality, for itself, its community and its environment. It also works towards the development of the human in the community through his culture so that he can coexist with this community and move it to a better future.

Several recent writings in education called for expanding the educators' circle of interest to take them beyond the scope of their societies; to pay more attention in their writings to a call for universality in



culture and education (Khuwailah, 2016; Al-Rahahleh & Showkah, 2007).

The education institutes, institutions, and universities are interested in introducing culture to a wide extent in the study domains to blend the different disciplines. They maintain the values and cultural heritage of the community, and they are a vehicle to bring up the individuals and work to make them adapt with the surrounding environment. This attitude implies the role and function of the educational institutions in the cultural preparation through providing the learner with the different aspects of culture (Abu Shoosha, 2009). Culture and the type of education are the landmark that distinguishes the individuals of the community from others. Therefore, societies are keenly interested in teaching young people the basics of their culture and principles of their education, to enable them to come to life socially and intellectually consistent so that they will not easily blend in other societies (Sha'aban, 2018).

Generally, the culture concepts refer to all the human behavioural patterns that the individual acquires socially, which are socially transmitted to the members of the human community. It can be said that culture includes everything that has been achieved in the human groups, which includes art, language, industry, religion, science, law and ethics. Accordingly, culture is one of the bases that the human communities rely upon in expressing their heritage and history; and it is everything that any nation makes of systems, social life, instruments, industries and ideas. Furthermore, it is a pool of the social, educational and health values, such as the morals, behaviours, ideas, social traditions and cultural traditions, to which the individual's activity is based in the different areas or communities (Al-Khouli & Jamal, 1999; Allawi, 1998).

Sports, in the modern era, play roles inside the social system, and are not a type of futility from the societal perspective, as may be viewed by some people. Rather, they are the civilisation's healthy necessity if we are to upgrade the community and release its creativities in the wake of the knowledge and information revolution, as well as the challenges of the current century (Al-Sayyid, 2006). Culture represents one of the significant pillars for the development of physical and sports education. It expresses an outstanding cultural and civilised aspect, and guides people to know how to practice sports. In addition, we should not look at the sports culture role as a marginal one, especially among the circles of the youth, which forms an important requirement for them (Ghaith, 1995). We have to raise the slogan "sports, culture and health for all" in word and deed. Sports are constructive, productive and supportive of the educational, moral, social, cultural, and health values; free from fanaticism, exaggeration or profiteering. They should be practiced as a pure hobby in every place and time, paving the way for those with talents, excellence and physical and skill readiness

to develop their talents and abilities, to the farthest extent their abilities can afford in the type of the practiced activity.

Physical education, in its modern education concept, became a positive and effective way to prepare the human resources in an inclusive and integrative manner in terms of the social, cultural, psychological and mental aspects. There is an increasing interest in sports at all levels due to their importance in developing the individual's personality, to the extent that they occupy a prominent status in the community. Sports became a new civilisation standard and an investment concept of the promotion and development of the communities, especially in the last quarter of the twentieth century (Al-Adwan, 2011).

Students of the university stage should possess the sports culture that raises in them desire and motivation to perform the different and sufficient sports activities; activities that help them take part in sports performance and provide them the ability to continue their practice through meaningful, well-planned training. University students are characterised by excessive energy, vitality, speed, anxiety, dissatisfaction and enthusiasm. All these factors require increasing the students' motives to practice multiple sports activities to absorb such energies. Sports culture, by its nature, has a social character with positive effects to achieve both the psychological and social harmony in the students' personality. The higher the level of the sports culture among the students, the higher the psychological and social harmony is in their personality (Kawash & Ba'oush, 2017).

Sports culture is a type of general culture that includes values, beliefs, attitudes, behaviours, opinions and both the physical and moral characteristics. In other words, it is characterised by movement and dynamism; by its deepened theoretical research; and by its coherent rules, traditions and different systems (Al-Adwan 2011). It further extends over the principles of the human and natural sciences, and its physical and moral aspects overlap into one unit to contribute in providing the images of the behaviour the community members should hold. Sports culture is also characterised by membership, meaning that the human's activity and perception crystallise the sports culture through developing random motions into wonderful performance motions of very high benefits, and through upgrading it from physical activity to an important educational vehicle (Abu Shoosha, 2013; Ahmad & Mahdi, 2012).

The sports culture aspect represents the most important features of the cultural preparation for the university stage students.

Sports culture involves knowledge, values and trends related to the participation and practice of the sports activities to which the student is exposed. The scientific and technological progress in the twenty-first century led to a massive information and technology revolution in culture, in general, and in cognitive inflation, in particular (Kaplan & Akkaya, 2014; Abdul Muttaleb, 2015).

Sports is a favourable practice for all people of different cultural, social and age levels as it contributes to the existence of a fit person in terms of the emotional and health aspects, and is characterised by the spirit of altruism, sacrifice and cooperation (Khuwaila, 2016).

## STUDY SIGNIFICANCE

The significance of this study lies in the fact that it aims to identify the level of the sports culture among the students of the Faculty of Physical Education and Sports Science. It is also an attempt to focus, through the academic courses, on increasing the cultural wealth among the students due to its effective and influential role in spreading out awareness and blocking the undesired behaviour. The study further highlights the role of the media and communication institutions as well as stakeholders, to reconsider the formation of our sports philosophy and policies in compliance with the scientific standards. Such objectives could be achieved by specialists in physical education, who carry out actual follow-up of what is taught at the Faculty of Physical Education and what is published through the different media.

## STUDY PROBLEM

The researcher, as a faculty member, through his work in university teaching, found a significant weakness in sports culture among the students. In addition, the physical education philosophy is no longer taught, although it was previously taught, which contributes to the increase in the cognitive outcome of the different sports-related areas. These facts motivated the researcher to conduct this study and contribute to the spread of awareness and publishing sports culture among the students, in terms of all the personal, physical, health and social aspects.

## OBJECTIVES

1- Identifying the sports culture level of the students attending the Faculty of Physical Education and Sport Science at the Hashemite University by the study domains: (moral values and

sportsmanship, health, fitness, history of sport games, skill performance, camping and scouting games).

2- Identifying the differences in the sports culture level of the students attending the Faculty of Physical Education and Sport Science at the Hashemite University by: (gender, specialisation, and academic year).

## QUESTIONS

1- What is the sports culture level of the students attending the Faculty of Physical Education and Sport Science at the Hashemite University by the study domains: (moral values and sportsmanship, health, fitness, history of sport games, skill performance, camping and scouting games)?

2- Are there statistically significant differences at ( $p < 0.05$ ) level in the sports culture level of the students attending the Faculty of Physical Education and Sport Science at the Hashemite University by: (gender, specialisation, academic year)?

## MATERIAL AND METHODS

### Participants

The researcher used a descriptive approach, and the study population consisted of all students of the Faculty of Physical Education and Sports Science at the Hashemite University ( $n = 1021$ ). The sample of the study consisted of (500) male and female students, at the rate of (49%) of the study population, which were chosen in a stratified random manner.

### Variables

The independent variables are gender (male, female); specialisation (coaching and sport management, sports rehabilitation); and academic year (first, second, third, fourth). The dependent variables are the domains of sports culture (moral values and sportsmanship, health, fitness, history of sport games, skill performance, camping and scouting games).

### Instruments

The researcher constructed a special questionnaire to identify the level of sports culture among the students of the Faculty of Physical Education and Sport Science at the Hashemite University. He benefited from (Abd Al Muttalib, 2015; Abu Shoosha, 2013; Al-Sayyid, 2006) in building the questionnaire items. The questionnaire included (45) items, which were distributed over six domains (moral values and sportsmanship, health, fitness, history of sport games, skill performance, and camping and scouting games).

The researcher used the tripartite classification in measuring the means (Ms) as follows: (1.00-2.33): low level, (2.34-3.66): medium level, and (3.67-5.00): high level. The questionnaire was distributed and collected between 03/11/2019 and 10/11/2019 in the first semester of the academic year 2019/2020.

## PSYCHOMETRIC PROPERTIES

### Statistical analysis

The researcher carried out the data analyses, and the instrument validity was verified by presenting it to five specialists in the physical education field, who made certain comments, which the researcher implemented after making the required amendments. The reliability coefficient was calculated using Cronbach's Alpha (0.91).

Moreover, the researcher applied the Statistical Package for Social Sciences (SPSS) software for the descriptive statistics (i.e., M, SD, Relative Importance Index (RII), t-test, and one-way ANOVA, as well as the Scheffe test to answer the questions.

## RESULTS

First question: "What is the sports culture level of the students attending the Faculty of Physical Education and Sport Science at the Hashemite University by the study domains: (moral values and sportsmanship, health, fitness, history of sport games, skill performance, and camping and scouting games)?" Tables (1, 2, 3, 4, 5, 6 and 7) illustrate this:

**Table 1:** Data on the participants' (M, SD and RII) level of sports culture in the domain of moral values and sports spirit

Items	M	SD	RII	Level
Students learn moral standards, such as justice, truthfulness and cooperation from the university sports activities.	3.77	0.96	75.4	High
Sports are a successful means in education.	3.76	1.01	75.20	High
Aggressiveness is one of the psychological traits that the students acquire through practicing sports activities.	3.67	1.02	73.40	High
Sports practice has a role in increasing selfishness.	3.32	1.20	66.40	Medium
Sports practice increases self-confidence.	3.14	1.28	62.80	Medium
Sports help in getting rid of the nervous tension.	2.93	1.22	58.60	Medium
Sports contribute to the respect of law and adherence to the instructions and systems.	2.69	1.18	53.80	Medium
Overall Average	3.33	1.21	66.60	Medium

Table (1) shows that the overall average of the sports culture level which is related to the moral values and sports spirit domain was medium ( $m = 3.33$ ), with

(66.60) relative importance. The first three items had a high level, and the remaining items were had a medium level.

**Table 2:** Data on the participants' (M, SD and RII) level of sports culture in the domain of health

Items	M	SD	RII	Level
The size of the athlete's heart muscle is larger than that of the non-athlete.	3.90	0.92	78.00	High
When putting in any slight sports effort, the heart rate increases quickly to become (120-180) bpm.	3.71	1.13	74.20	High
The diabetic cannot practice any sports activity.	3.45	1.16	69.00	Medium
Sitting in the desk chair for long times is a reason of the lower back pain.	3.30	1.10	66.00	Medium
Sports activity should be stopped at feeling a chest pain.	3.28	1.17	65.60	Medium
Practice of the sports activities assists in the treatment of hypertension.	3.26	1.11	65.20	Medium
It is necessary to make a medical examination before taking part in the sports activities.	3.14	1.28	62.80	Medium

Practice of sports directly after eating increases the burn out of the calories.	3.04	1.23	60.80	Medium
Cardiac patients can practice light sports activities.	2.92	1.17	58.40	Medium
The athlete quickly returns to the natural state after the physical exertion. .	2.90	1.23	58.00	Medium
Overall Average	3.29	1.15	65.80	Medium

Table (2) shows that the overall average of the sports culture level which is related to the health domain was medium ( $m = 3.29$ ),

with (65.80) relative importance. The first and second items had a high level, and the remaining items had a medium level.

**Table 3:** Data on the participants' (M, SD and RII) level of sports culture in the domain of fitness

Items	M	SD	RII	Level
Marathon depends on endurance.	3.73	1.00	74.60	High
The muscular endurance exercises affect the muscles elasticity.	3.69	1.02	73.80	High
Muscle stretching is done at the end of the sports exercise.	3.58	1.05	71.60	Medium
The fitness elements are developed through the muscular power exercises only.	3.14	1.25	62.80	Medium
Strength is the individual's ability to continue performing for the longest possible period.	2.93	1.22	58.60	Medium
Warm-up before practicing sports prepares the individual psychologically, physically and physiologically.	2.90	1.23	58.00	Medium
The zigzag running test between cones is used to measure agility.	2.69	1.18	53.80	Medium
Overall Average	3.24	1.09	64.80	Medium

Table (3) shows that the overall average of the sports culture level which is related to the fitness domain was medium ( $m = 3.24$ ),

with (64.80) relative importance. The first and second items had a high level, and the remaining items had a medium level.

**Table 4:** Data on the participants' (M, SD and RII) level of sports culture in the domain of history of sport games

Items	M	SD	RII	Level
Jordan won the first Olympic medal in 2016.	3.77	0.96	75.40	High
The idea of reviving the modern Olympic games dates back to Pierre de Coubertin.	3.65	1.15	73.00	Medium
The first modern Olympics were held in England in 1896.	3.32	1.17	66.40	Medium
The world Olympic games are held every 5 years.	3.14	1.28	62.80	Medium
The Egyptians were the first who practiced wrestling.	2.69	1.18	53.80	Medium
Basketball game was originated in the Soviet Union.	2.65	1.20	53.00	Medium
The next World Football Cup Championship will be held in Russia.	2.60	1.23	52.00	Medium
Overall Average	3.12	1.30	62.40	Medium

Table (4) shows that the overall average of the sports culture level which is related to history of the sports games domain was medium ( $m = 3.12$ ),

with (62.40) relative importance. The first item had a high level, and the remaining items had a medium level.

**Table 5:** Data on the participants' (M, SD and RII) level of sports culture in the domain of skill performance

Item	M	SD	RII	Level
Jumping on the vaulting horse in gymnastics is done by the two feet together.	3.76	1.01	75.20	High
In long jump, the two feet should touch the white beam.	3.64	1.06	72.80	Medium
Kicking the ball with foot is not allowed in volleyball.	3.54	1.28	70.80	Medium
Wrist pass in handball is performed by both hands.	3.14	1.30	62.80	Medium
In freestyle swimming, the two legs are under water.	2.55	1.29	51.00	Medium
The goalkeeper in football is not allowed to touch the ball by hand after line 18.	2.45	1.25	49.00	Medium
Passing the ball in basketball is allowed either by one hand or both hands.	2.44	1.25	48.80	Medium
Overall Average	3.10	1.28	62.00	Medium

Table (5) shows that the overall average of the sports culture level which is related to skill performance domain was medium ( $m = 3.10$ ),

with (62.00) relative importance. The first item had a high level, and the remaining items had a medium level.

**Table 6:** Data on the participants' (M, SD and RII) level of sports culture in the domain of camping and scouting games

Items	M	SD	RII	Level
Scouting games are remedial ways to solve the problems and disturbances.	3.68	1.01	73.60	High
Scouts acquire the spirit of courage, love of goodness, and self-confidence.	3.45	1.17	69.00	Medium
The most important tools of the scouting trip are the map and the compass.	3.14	1.25	62.80	Medium
Scouting games develop leadership qualities and obeying the orders.	2.72	1.22	54.40	Medium
Sports camping help in gaining new experiences.	2.60	1.18	52.00	Medium
Scouting games help in creating happiness and joy.	2.54	1.17	50.80	Medium
Recreational sports are classified as curative sports.	2.40	1.04	48.00	Medium
Overall Average	2.91	1.30	58.20	Medium

Table (6) shows that the overall average of the sports culture level which is related to camping and scouting games domain was medium ( $m = 2.91$ ), with (58.20) relative importance. The first item had a high level, and the remaining items

had a medium level.

Table (7) shows that the overall average of the sports culture level among the students of the Faculty of Physical Education and Sports Science was medium ( $m = 3.17$ ), with (63.40) relative importance.

**Table 7:** Data on the participants' (M, SD and RII) level of sports culture in a descending order

Domain	M	SD	RII	Level
Moral Values and Sports Spirit	3.33	1.21	66.60	Medium
Health	3.29	1.15	65.80	Medium
Fitness	3.24	1.09	64.80	Medium
History of Sport Games	3.12	1.30	62.40	Medium
Skill Performance	3.10	1.28	62.00	Medium
Camping and Scouting Games	2.91	1.30	58.20	Medium
Overall Average	3.17	1.20	63.40	Medium

Second Question: "Are there statistically significant differences at ( $p < 0.05$ ) level in the sports culture level of the students attending the Faculty of Physical

Education and Sports Science at Hashemite University by (gender, specialisation and academic year)?" Tables (8, 9, 10, 11 and 12) illustrate this:

**Table 8:** Data on the participants' (t-test) level of sports culture by gender

Domain	Gender	Mean	SD	T	P-Value
Moral Values and Sports Spirit	Male	3.36	0.93	2.80	0.340
	Female	3.30	0.91		
Health	Male	3.35	0.67	2.85	0.889
	Female	3.23	0.75		
Fitness	Male	3.28	0.81	2.80	0.092
	Female	3.20	0.79		
History of Sport Games	Male	3.14	0.69	2.34	0.380
	Female	3.10	0.66		
Skill Performance	Male	3.15	0.78	2.67	0.554
	Female	3.05	0.73		
Camping and Scouting Games	Male	2.95	0.74	2.15	0.248
	Female	2.87	0.66		

Table (8) shows that there are no statistically significant differences at ( $p < 0.05$ ) level in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite

University ascribed to the gender variable. Values of the t-test ranged between (2.15-2.85), and the significance level was ( $p < 0.05$ ) for all the domains of the sports culture.

**Table 9:** Data on the participants' (t-test) level of sports culture by specialisation

Domain	Specialisation	Mean	SD	T	P-Value
Moral Values and Sports Spirit	Coaching and Sport Management	3.27	0.91	2.72	0.381
	Sport Rehabilitation	3.39	0.85		
Health	Coaching and Sport Management	3.06	0.77	2.68	0.000
	Sport Rehabilitation	3.53	1.01		
Fitness	Coaching and Sport Management	3.29	0.75	2.85	0.456
	Sport Rehabilitation	3.19	1.12		
History of Sport Games	Coaching and Sport Management	3.17	1.14	2.74	0.887
	Sport Rehabilitation	3.07	1.08		



Skill Performance	Coaching and Sport Management	3.44	1.10	2.61	0.000
	Sport Rehabilitation	2.76	1.25		
Camping and Scouting Games	Coaching and Sport Management	3.01	1.14	2.51	0.211
	Sport Rehabilitation	2.81	1.05		

Table (9) shows that there are no statistically significant differences at ( $p < 0.05$ ) level in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University ascribed to the specialisation variable in (moral values and sports spirit, health, fitness, history of sport games, skill performance, and camping and scouting games)

domains. Meanwhile, there are statistically significant differences at ( $p < 0.05$ ) level in the sports culture level in the health domain, which were in favour of the sports rehabilitation major. Furthermore, there are statistically significant differences at ( $p < 0.05$ ) level in the sports culture level in the skill performance domain, which were in favour of the coaching and sport management.

**Table 10:** Data on the participants' (Mean, SD) level of sports culture by academic year

Domain	Academic Year	Mean	SD
Moral Values and Sports Spirit	First Year	3.27	1.28
	Second Year	3.22	1.30
	Third Year	3.31	1.11
	Forth Year	3.52	1.15
Health	First Year	2.88	1.14
	Second Year	3.24	0.99
	Third Year	3.26	1.11
	Forth Year	3.78	1.36
Fitness	First Year	2.85	1.15
	Second Year	3.26	1.30
	Third Year	3.29	0.87
	Forth Year	3.56	1.04
History of Sport Games	First Year	2.95	1.18
	Second Year	3.00	1.29
	Third Year	3.20	1.30
	Forth Year	3.33	1.43
Skill Performance	First Year	2.73	1.18
	Second Year	3.08	1.15
	Third Year	3.11	1.25
	Forth Year	3.48	1.54
Camping and Scouting Games	First Year	2.90	1.25
	Second Year	3.14	1.20
	Third Year	2.85	1.28
	Forth Year	2.75	1.47

Table (10) shows statistically significant differences at ( $p < 0.05$ ) level in the sports culture level among students of the Faculty of Physical Education and Sports Science at the Hashemite University ascribed

to the academic year variable. To determine whether there are statistically significant differences at ( $p < 0.05$ ) level among the means, a one-way ANOVA analysis was applied, as illustrated in Table (11).

**Table 11:** Data on the participants' (one-way ANOVA) level of sports culture by academic year

Domain	Source of Variance	Sum of Squares	Gl	Mean Squares	F	P-Value
Moral Values and Sports Spirit	Inter-Groups	472.28	4	54.102	7.478	0.311
	Intra- Groups	2796.40	570	4.8019		
	Total	3268.68	574			
Health	Inter-Groups	235.72	4	57.384	3.145	0.048
	Intra- Groups	2899.97	570	5.124		
	Total	3135.68	574			
Fitness	Inter-Groups	125.47	4	2.741	3.554	0.042
	Intra- Groups	2415.43	570	2.419		
	Total	2540.90	574			
History of Sport Games	Inter-Groups	56.54	4	14.235	6.178	0.125
	Intra- Groups	3556.14	570	6.142		
	Total	3612.69	574			
Skill Performance	Inter-Groups	143.52	4	34.014	2.897	0.035
	Intra- Groups	3321.25	570	8.949		
	Total	3464.77	574			
Camping and Scouting Games	Inter-Groups	145.33	4	31.254	6.231	0.262
	Intra- Groups	5462.58	570	4.584		
	Total	5607.91	574			

Table (11) shows statistically significant differences at ( $p < 0.05$ ) level in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University

ascribed to the academic year variable.

To determine the sources of differences, Scheffe post-hoc test was applied, as shown in Table (12).

**Table 12:** Sheffe results of the (post-comparisons) related to the sports culture level by academic year

Domain	Mean	Year Academic	First Year	Second Year	Third Year	Forth Year
Health	2.88	First Year				*
	3.24	Second Year				
	3.26	Third Year				
	3.78	Forth Year				
Fitness	2.85	First Year				*
	3.26	Second Year				
	3.29	Third Year				
	3.56	Forth Year				
Skill Performance	2.73	First Year				*
	3.08	Second Year				
	3.11	Third Year				
	3.48	Forth Year				

Table (12) shows statistically significant differences at ( $p < 0.05$ ) level in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University ascribed

to the academic year variable. The differences were in (health, fitness and skill performance) domains among the first-year students and those of the fourth year, which were in favour of the fourth-year students.

## DISCUSSION

The study results showed the students' interest in moral values and sports spirit, which belong to the main domains of sports culture, through the study of courses that include these values. The study of Abd Al Muttaleb (2015) emphasised the importance of moral values and sports spirit domain to identify the sports culture level, which reflects the role of sports in raising young people in terms of the physical, psychological and health as well as other aspects.

The results further showed a shortage in highlighting the effect of sports on health and its role in the prevention and treatment of the diseases of the time (hypomobility diseases).

Moreover, there are no educational seminars at the university that explain the importance of sports with regard to health; in addition to the lack of holding training courses for the students at the university on the first aid of the diseases and injuries, as well as the preventive and treatment procedures. In this regard, Al-Adwan (2011), Abu Shoosha (2009) and Al-Sayyid (2006) asserted that the media has a wide and important role in the awareness of the sports significance, its relation with health and its positive role in maintaining the community health. The researcher agrees with Abu Shoosha (2013) and Al-Khouli and Jamal (1999) in the fact that the lack of the students' interest in getting information related to physical fitness and its effects on different aspects (health, psychological, physical, etc.) is present because more of their interest is concentrated on football-related information. The students also lack clarification on the importance of all the physical fitness elements and how to develop them through the courses they study such as gymnastic and aerobic exercises as well as rhythm.

Students usually focus on one or two elements of fitness and ignore other important elements. The researcher also found that the faculty lacks informative, guidance billboards to provide information about the regulations and rules of practicing different sporting activities. Moreover, there are no illustrations about sports games or elements of fitness.

The researcher sees that non-inclusion of a course on the physical education philosophy and history in the study plan at the faculty, whose contents include many sports culture domains, such as philosophical doctrines, ancient and modern Olympics, origin of the sports games since the ancient times until today, is the reason of the low sports culture level among

the students. Vinga (2015) and Al-Adwan (2011) emphasised that the poor sports culture among the university students is present because the media did not highlight the athletic champions and famous achievers in different sports games, as there is a focus on football players only. The researcher further found other reasons that lead to the poor turnout of the students to practice sports activities inside the university. In this regard, the excessive numbers of students at the university and insufficient playgrounds to practice sports activities inside the university during the working hours constitute the main reason, in addition to the fact that the university day is "crowded" with lectures.

Furthermore, the strategic location of the university plays a role in this regard, as there are large distances between the university and other governorates where students come from and go back to daily. Finally, there is the students' transport problem, as there are definite times for buses of every governorate, which make the students unable to take part in any sport activity after the end of the lectures at the university.

The researcher is in agreement with the results of Qadoumi and Al Amad (2017) that the study of theoretical and practical courses and the follow-up of the social media and sports stations lead to the development of the sports culture among the students. Their study provided reasons for the poor level of sports culture among the students, including the following.

There is a shortage in the courses related to camping and scouting games, in addition to the lack of scouting tools and apparatuses inside the university. Furthermore, there is a lack of holding periodical camps in the scouting domain, as well as rarity of educational courses and brochures to introduce the importance of scouting life and games. In addition, the students lack encouragement to effectively participate in the scouts and introduce the importance of public service for the community. Finally, there is no practical application of the recreational sports course, which contributes to the spread of the sports culture for all.

The researcher also agrees with Zawawi et al. (2019) and Al-Zyoud (2013) that the visible and invisible means of communication at the faculty

do not discriminate between the two genders in obtaining the information. Male and female students study together for most of the theoretical and practical courses and there are equal chances for both genders that enable all the students of the Faculty of Physical Education and Sports Science at the Hashemite University to educate themselves. In addition, all the faculty students of both the sports rehabilitation department and coaching and sport management department take many joint courses, such as the university and faculty requirements, as well as other compulsory courses. There are also some similar courses between the faculty departments, which lead to the nonexistence of statistically significant differences in the sports culture level among the students ascribed to the gender variable.

## CONCLUSIONS

1- The sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University was medium in the (moral values and sports spirit, health, fitness, history of the sports games, skill performance, and camping and scouting games) domains.

2- There are no differences in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University in the sports culture domains attributed to the gender variable.

3- There are no differences in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University in the (moral values and sports spirit, health, fitness, history of the sports games, skill performance, and camping and scouting games) domains attributed to the major variable.

4- There are differences in the sports culture level among the students of the Faculty of Physical Education and Sports Science University in the health domain attributed to the major variable, which were in favour of the sports rehabilitation major.

5- There are differences in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University in the skill performance domain attributed to the major variable, which were in favour of the coaching and sport management major.

6- There are no differences in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University in the (moral values and sports spirit, history of the sports games, and camping and scouting games) domains attributed to the academic year variable.

7- There are differences in the sports culture level among the students of the Faculty of Physical Education and Sports Science at the Hashemite University in the (health, fitness and skill performance) domains attributed to the academic year variable, between the first and fourth academic years, which were in favour of the fourth-year students.

## RECOMMENDATIONS

1- More attention should be paid to the educational programmes, seminars, courses and workshops inside the faculty.

2- Students should participate in sports activities inside the university.

3- The role of the studies, consultation and community service centre at the university should be activated to publish the sports culture among the university students and the local community.

4- Sports culture should be disseminated through the sports channels, different media and communication methods.

5- Work towards developing the sports to face the scientific and technological developments in various aspects.

6- Developing practice culture among all the community members.

## LIMITATIONS

The study has several limitations.

First, the way the researcher chose the study sample, which was by stratified random method. Second, the results are generalisable only to the target population and to the same setting (i.e., students of Faculty of Physical Education and Sports Science at the Hashemite University).

Finally, the results of the study were based on the perspective of the participants themselves.

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### SPORTSKA KULTURA KOD STUDENATA HASHEMITE UNIVERZITETA

Ova studija je imala za cilj identifikovati nivo sportske kulture kod studenata Fakulteta fizičkog obrazovanja i sportske nauke Hashemite univerziteta. Istraživač je koristio deskriptivni pristup, a populacija ovog istraživanja se sastojala od studenata Fakulteta fizičkog obrazovanja i sportske nauke Hashemite univerziteta koji su pohađali prvi semestar akademske 2019/2020. godine ( $n = 1021$ ). Uzorak studije se sastojao od (500) studenata muškog i ženskog spola, uz omjer od (49%) populacije istraživanja, a koji su odabrani korištenjem metode stratificiranog nasumičnog uzorkovanja. Istraživač je napravio upitnik kako bi mjerio sportsku kulturu kod studenata Fakulteta fizičkog obrazovanja i sportske nauke Hashemite univerziteta. On se sastojao od (45) čestica koje su podijeljene na šest domena (moralne vrijednosti i sportski duh, zdravlje, kondicija, historija sportskih igara, izvedba vještina i izviđačke te igre na kampovanju). Koeficijenti instrumenta su izračunati dobivanjem valjanosti sadržaja, a ukupni koeficijent pouzdanosti je iznosio (0,91). Aritmetičke sredine, standardne devijacije, t-test i jednostruka ANOVA su izračunate kako bi se pronašle razlike između aritmetičkih sredina i odgovorilo na pitanja studije. Rezultati su pokazali da je nivo studenta koji pohađaju Fakultet fizičkog obrazovanja i sportske nauke Hashemite univerziteta bio srednji u svim domenama. Ukupna aritmetička sredina je bila (3,17), uz vrijednost od (63,40) relativnog značaja. Nisu pronađene statistički značajne razlike na nivou ( $p < 0,05$ ) kada je u pitanju nivo sportske kulture za varijablu spola. Međutim, pronađene su statistički značajne razlike na nivou ( $p < 0,05$ ) kada je u pitanju nivo sportske kulture na području zdravlja, a u korist sportske rehabilitacije. Nadalje, studija je pokazala statistički značajne razlike u domeni izvedbe vještina, a u korist specijalizacije iz predmeta treniranja i sportskog menadžmenta. Konačno, pronađene su statistički značajne razlike po pitanju (zdravlja, kondicije i izvedbe vještina) kod studenata prve i četvrte godine studija, a u korist studenata četvrte godine.

**Ključne riječi:** sportska kultura, studenti, Hashemite univerzitet

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# THE ANALYSIS OF THE APPROACH RUN, TAKE-OFF AND FLIGHT ANGLES IN LONG JUMP

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## ABSTRACT

Long jump is one of the athletic sports which requires physical, technical, strategic and mental performance. To achieve a maximum length of the jump, one should consider the approach run, take-off and flight angles while performing the long jump. This study aims to analyse various lengths of the long jump by considering the approach run, the force during take-off and flight angles. This study involved six national long jump athletes from the Indonesian Athletics Association chapter Aceh. The types of equipment occupied in this study consist of a measuring tape, force plates, a video recorder, Windows Movie Maker 2.6 and Phantom 675.2. The results of this study show that the maximum jump length was achieved at 5.13 m and 237.42 newton. The average flight angle occurred at 45 degrees, which exceed the world long jump athlete record. The flight angle potentially leads to injury such as landing on one foot or body spraining.

**Keywords:** long jump, approach run, take-off, flight angle, national long jump athletes

## INTRODUCTION

Long-jump is one of the athletic sports that require the skill of jumping horizontally as far as possible in one take-off (Winendra, 2008). Long jump involves a unitary movement that is sequential and uninterrupted (Murniasari, 2008). The basic technique used in long jumping has remained unchanged since the beginning of modern athletics in the mid-nineteenth century; it starts with the athlete sprinting down a runway, jumping up from a wooden take-off board, and flying through the air before landing in a pit of sand (Pratap, 2017).

To achieve an optimum long jump, an athlete needs to have a superfine physical and mental condition, and has to master the components and understand the rules of long jump. Physical conditions will influence the appearance of the long jump.

A long jumper must be a fast sprinter, have strong legs for jumping, and be sufficiently coordinated to perform the moderately complex take-off, flight, and landing manoeuvres (Pratap, 2017). An individual with high physical fitness has a better long jump performance compared to those who have low physical fitness (Kastrena et al., 2020).

Long jump contains interconnected elements: approach run, take-off, flight, and landing (Čoh et al., 2017). The most essential factors amongst those elements which affect the result of the long jump are the approach run and take-off (Čoh et al., 2017). The distance achieved as a result of the vertical speed pertaining to the motion developed when taking off is determined by the pace of the jumper in the approach run (Wahyudi, 2011), followed by a set of capabilities that includes special coordination, rhythm, and body balance.

The aspects that need to be emphasised during the jump include speed during the aiming phase, push-off power in the jump phase, kick-off style in the kick-off phase and body balance during landing (Rahim et al., 2020). The speed of the centre of mass at take-off is generally specified by nearly 90% of the total jump which is accounted for by the flight distance (Takahashi & Wakahara, 2019). The speed consists of two components: the horizontal velocity increased through the approach phase, and the vertical velocity generated during the take-off phase (Muraki et al., 2008; Takahashi & Wakahara, 2019). The power from vertical and horizontal jumps can help maximise take-off velocity to produce greater jumps in long jump performance (Rahim et al., 2020).

A successful performance in the long jump primarily counts on the athletes' capability to alter their horizontal approach velocity into horizontal and vertical take-off velocity throughout the support phase of the jump (Jaitner et al., 2001). Therefore, this study aims to analyse various lengths of the approach run, the force during take-off and flight angles to obtain maximum and optimum jump length within the national long jump athletes from Aceh. Furthermore, the results of the study will support the evaluation for improvement.

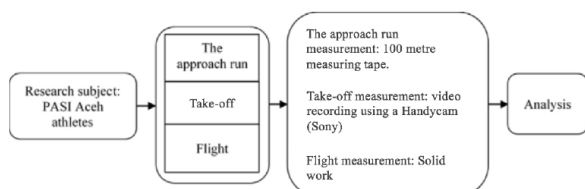
## METHODOLOGY

### A. Participants

There were six long jump athletes from Aceh, who are the national athletes and part of the Indonesian Athletics Association, involved as participants of this study. The participants consist of four male and two female athletes.

### B. Research method

This is an experimental study which held a series of experiment to obtain the ideal condition in long jump based on the length, force, angles, and track given. Therefore, no hypothesis test is necessary. Figure 1 shows the research framework on conducting the study.



**Figure 1** - Research framework

### C. Instruments

This study utilises the types of equipment below to obtain data required for further analysis.

1. A measuring tape, used to measure the approach run in 5 tracks: 15 m, 20 m, 25 m, 30 m and 35 m.
2. Force plates and a video recorder (Handy-cam Sony Model No. DCR-HC38E), used to record the athletes while doing the take-off.
3. Windows Movie Maker 2.6 and Phantom 675.2; used to measure the flight angles.

### D. Data collection

The six participants who are the national long jump athletes performed the approach run, take-off and flight angle 5 times based on the given tracks (5 tracks: 15 m, 20 m, 25 m, 30 m and 35 m). Figures 2 and 3 show male and female participants' posture while performing the scenario.



**Figure 2** - Male participant performing the approach run, take-off and flight angle



**Figure 3** - Female participant performing the approach run, take-off and flight angle

## RESULTS

The following data presented in Table 1 shows the jump length performed by the national (Indonesia) long jump athletes from Aceh. The jump length was measured at various length attempts of the approach run: 15m, 20 m, 25 m, 30 m and 35 m.

The longest total jump distance was achieved at 35 m with the average length of 5.13 m. Table 2 shows force and time measurements during take-off which were obtained from the force plates. The measurements were conducted in the moment of take-off as the athletes' feet stepped on the force plate. The highest force was achieved at 20 m, with the average value of force being 2603.8 N.

The force is calculated using the gravity formula

$F = m \cdot g$ , whereas:

$F$  = force = newton/N

$g$  = a constant value for universal gravitation  
= 9.81 m/s<sup>2</sup>

$m$  = object mass = kg

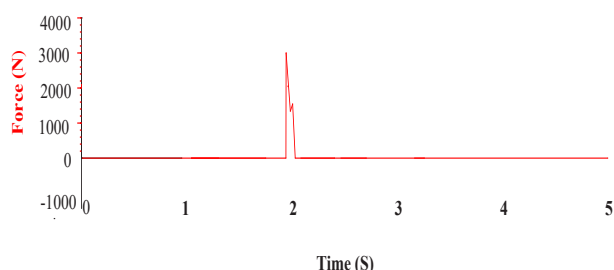
Furthermore, the force to take-off at 15 m, 20 m, 25 m, 30 m and 35 m is illustrated in a line resembling the M letter as shown from Figure 4 to Figure 33.

**Table 1:** Jump length at the approach run (metre)

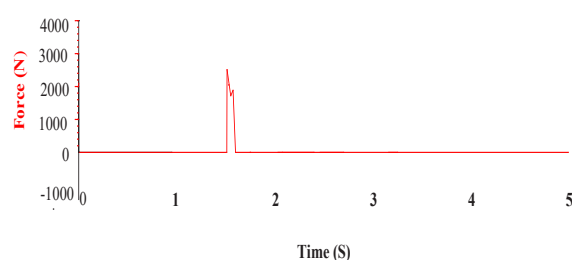
No	Res	15 m	20 m	25 m	30 m	35 m
1	Male	4.56	4.60	4.26	4.16	5.78
2	Male	4.52	4.72	4.22	4.53	5.70
3	Male	4.15	4.16	4.44	4.67	4.92
4	Female	3.85	3.63	4.04	4.95	5.14
5	Female	4.35	3.84	3.72	4.76	4.90
6	Male	4.95	5.34	5.12	5.33	4.36
Total		26.38	26.29	25.8	28.4	30.8
Average		4.39	4.38	4.30	4.73	5.13

**Table 2:** Force and time measurement during take-off at various lengths of the approach run

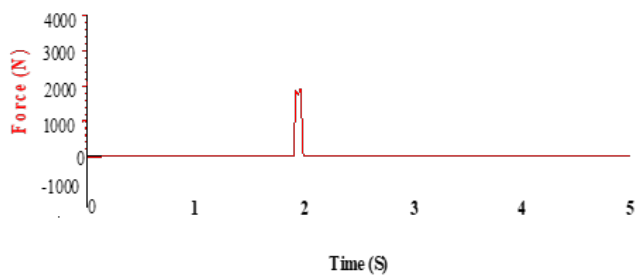
No	Res	15 m		20 m		25 m		30 m		35 m	
		Force	Time	Force	Time	Force	Time	Force	Time	Force	Time
1	Male	3044	0.18	3807	0.16	2487	0.18	3804	-0.22	2731	-0.18
2	Male	2508	0.18	2490	0.14	2325	-0.20	2060	-0.20	2723	-0.20
3	Male	2025	0.18	2362	-0.2	2042	-0.20	2560	-0.20	2754	-0.18
4	Female	1801	0.18	1888	0.18	2036	-0.22	2635	-0.20	1828	-0.18
5	Female	2212	-0.20	2544	0.18	2578	-0.24	2160	-0.22	1928	-0.20
6	Male	2142	0.16	2532	0.18	3166	-0.16	2370	-0.22	2371	-0.22
Total		13732	0.68	15623	0.64	14634	-0.84	15589	-1.26	14335	-1.16
Avg.		2288.6	0.113	2603.8	0.106	2439	-0.14	2598.1	-0.21	2389.1	-0.19



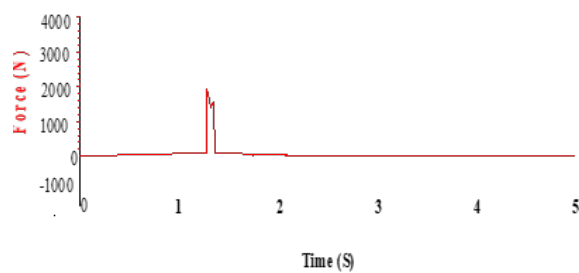
**Figure 4:** Force to take-off at 15 m (1<sup>st</sup> athlete)



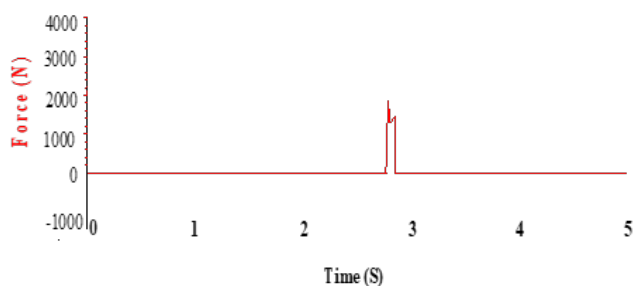
**Figure 5:** Force to take-off at 15 m (2<sup>nd</sup> athlete)



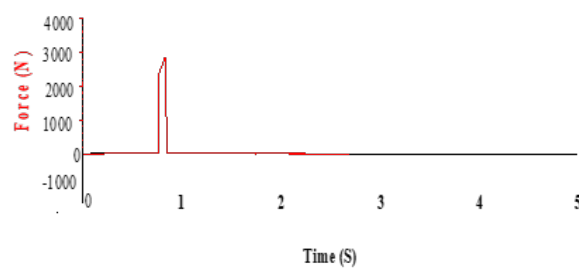
**Figure 6:** Force to take-off at 15 m (3<sup>rd</sup> athlete)



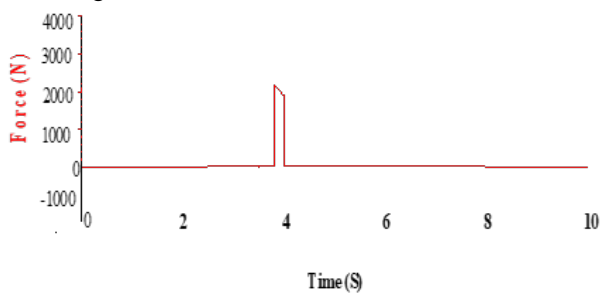
**Figure 7:** Force to take-off at 15 m (4<sup>th</sup> athlete)



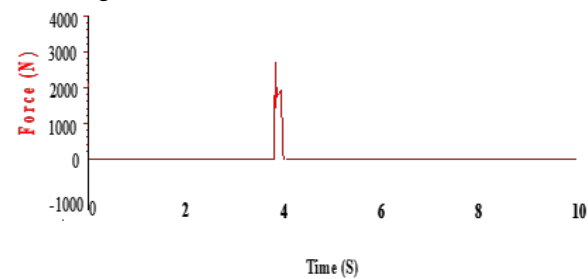
**Figure 8:** Force to take-off at 15 m (5<sup>th</sup> athlete)



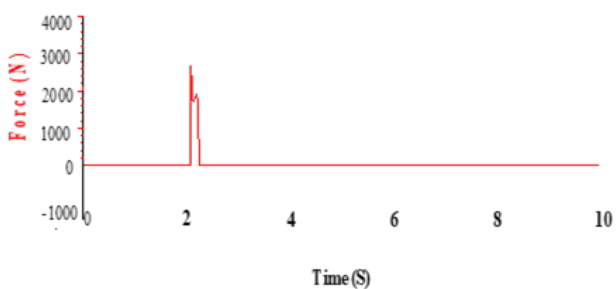
**Figure 9:** Force to take-off at 15 m (6<sup>th</sup> athlete)



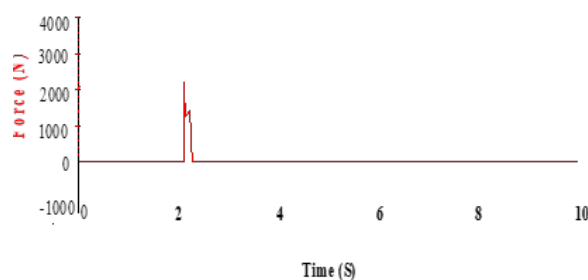
**Figure 10:** Force to take-off at 20 m (1<sup>st</sup> athlete)



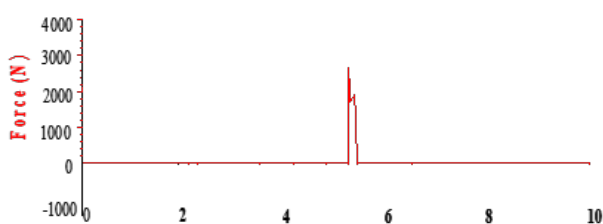
**Figure 11:** Force to take-off at 20 m (2<sup>nd</sup> athlete)



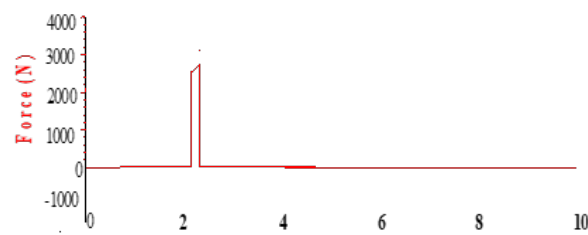
**Figure 12:** Force to take-off at 20 m (3<sup>rd</sup> athlete)



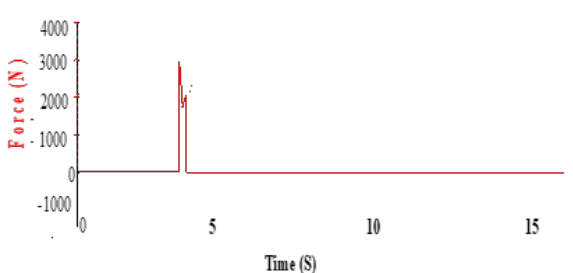
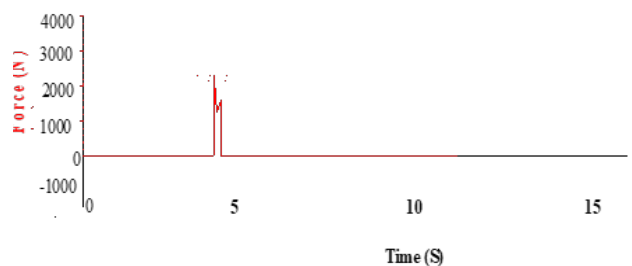
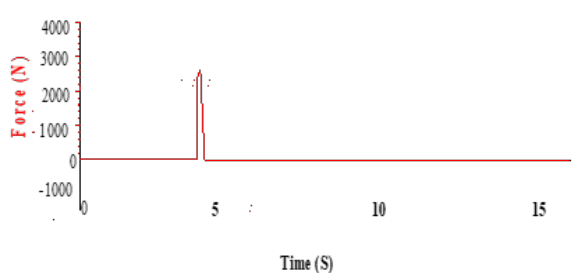
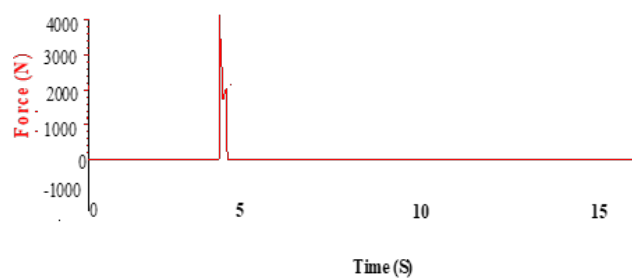
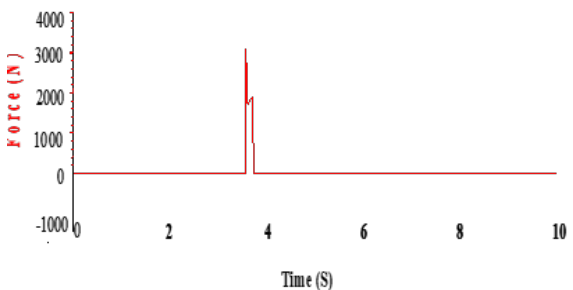
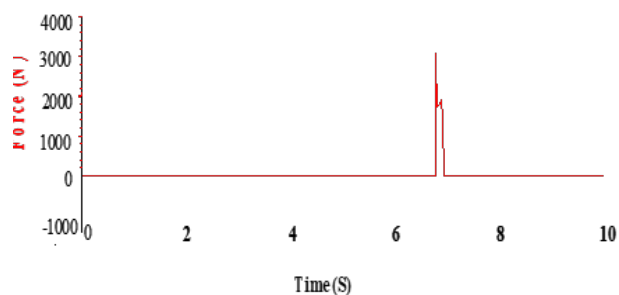
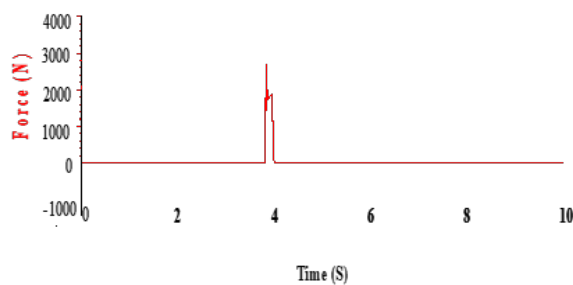
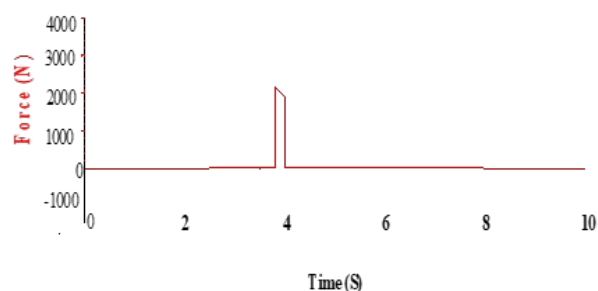
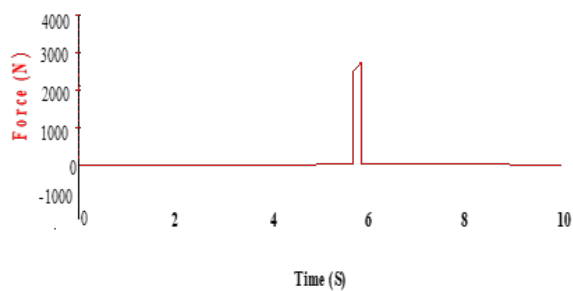
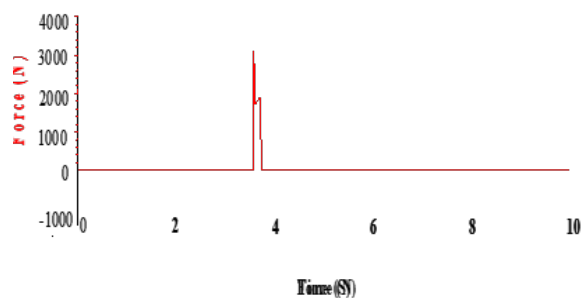
**Figure 13:** Force to take-off at 20 m (4<sup>th</sup> athlete)

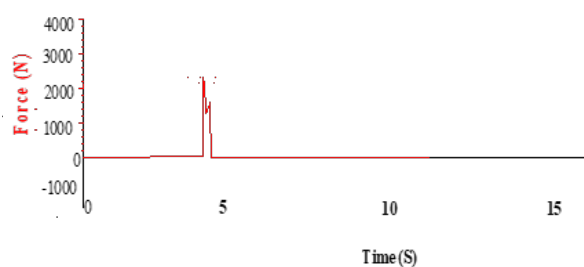


**Figure 14:** Force to take-off at 20 m (5<sup>th</sup> athlete)

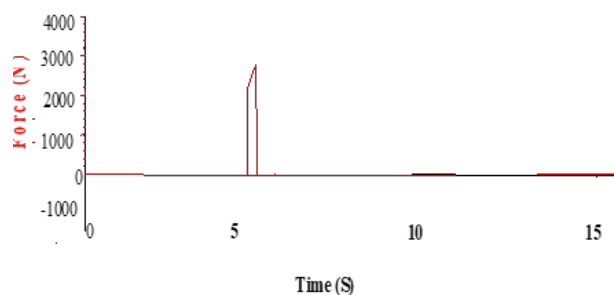


**Figure 15:** Force to take-off at 20 m (6<sup>th</sup> athlete)

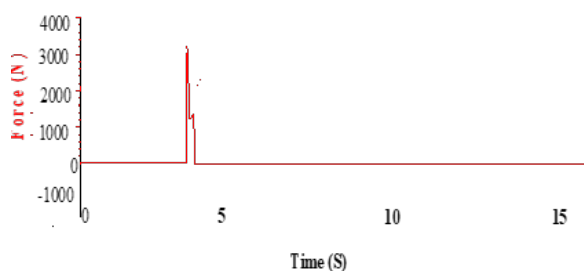




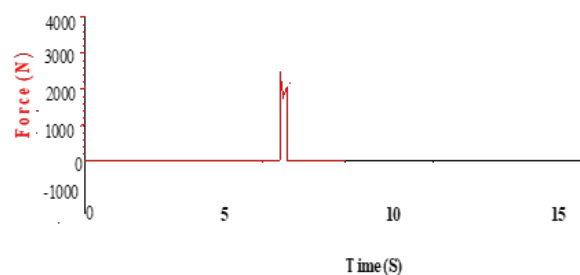
**Figure 28:** Force to take-off at 30 m (5<sup>th</sup> athlete)



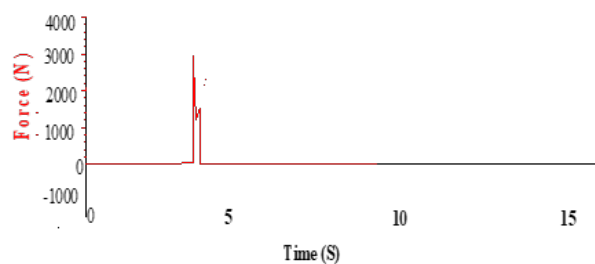
**Figure 27:** Force to take-off at 30 m (6<sup>th</sup> athlete)



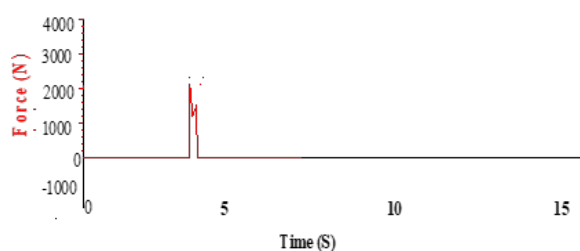
**Figure 28:** Force to take-off at 35 m (1<sup>st</sup> athlete)



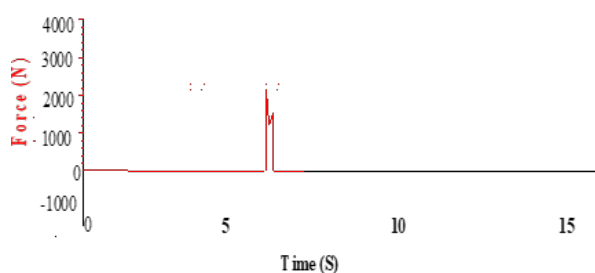
**Figure 29:** Force to take-off at 35 m (2<sup>nd</sup> athlete)



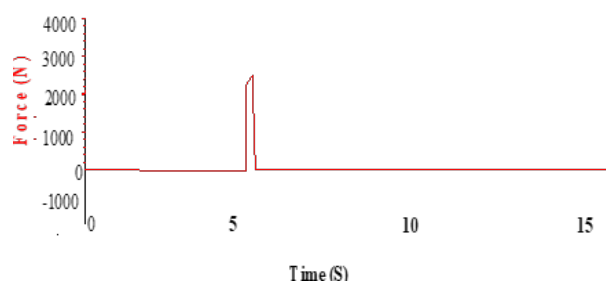
**Figure 30:** Force to take-off at 35 m (3<sup>rd</sup> athlete)



**Figure 31:** Force to take-off at 35 m (4<sup>th</sup> athlete)



**Figure 32:** Force to take-off at 35 m (5<sup>th</sup> athlete)



**Figure 33:** Force to take-off at 35 m (6<sup>th</sup> athlete)

**Table 3:** Force and distance to take-off at various lengths of the approach run

No	Res	15 m		20 m		25 m		30 m		35 m	
		Force	Dist.	Force	Dist.	Force	Dist.	Force	Dist.	Force	Dist.
1	Male	310.29	4.56	388.07	4.60	253.51	4.26	387.76	4.16	241.69	4.36
2	Male	255.65	4.52	253.82	4.72	237.00	4.22	209.98	4.53	277.57	5.78



3	Male	206.42	4.15	240.77	4.16	208.15	4.44	260.95	4.67	280.73	4.92
4	Female	183.58	3.85	192.45	3.63	207.54	4.04	268.60	4.95	186.34	5.14
5	Female	225.48	4.35	259.32	3.84	262.79	3.72	220.18	4.76	196.53	4.90
6	Male	218.34	4.95	225.48	5.34	322.73	5.12	241.59	5.33	241.69	5.70
Total		1399.76	26.38	1559.91	26.29	1491.72	25.8	1589.06	28.4	1424.55	30.8
Avg.		233.29	4.39	259.98	4.38	248.62	4.30	264.84	4.73	237.42	5.13

Table 3 shows the values of force and distance during take-off at various lengths of the approach run (15 m, 20 m, 25 m, 30 m and 35 m). The highest force occurred at 30 m with the value of 264.84 newton, while the longest distance occurred at 35 m with the value of 5.13 m. Moreover, Table 4 shows flight angles of each athlete which was recorded using Windows Movie Maker 2.6.

The recording positions include left and right arms, elbows and legs.

The results show that the national long jump athletes from Aceh have not met an ideal flight angle yet, based on the concept of biomechanics, 40 degrees for flight angle and 45 degrees for elevation angle. Thus, none of the athletes were able to perform an optimum jump.

**Table 4:** Flight angles of each athlete

No	Res	Movement	Body's angles (in degrees)						Angle of Elevation	
			Arm		Elbow		Leg			
			Right	Left	Right	Left	Right	Left		
1	Male	Movement 1	65.6	28.9	113.5	125	175.8	140	-	-
2	Male	Movement 1	60	80.7	48	95.6	170.8	165	-	-
3	Male	Movement 1	72	70.7	95	90.6	148.8	160	-	-
4	Female	Movement 1	52	62.5	0	63.6	128.8	126	-	-
5	Female	Movement 1	40	35	48	55.6	148.5	186	-	-
6	Male	Movement 1	37	55.5	68	78	118.5	156	-	-

## DISCUSSION

According to Table 1, jump length increased following the distance of the approach run. The longest jump was achieved at 35 m track with the average value of 5.13 m. Based on observation, the jump results were also influenced by the force which occurred on the pedestal once the athlete jumped. The value of force decreased following the distance of the approach run. The result from Table 2 explains that the ideal take-off position is performed by using the tip of the toe because it can produce a free swing of the legs quickly to the horizontal position.

Another way to improve the quality of take-off is counting the odd steps. This is an effective way to make sure the footsteps are synchronised with the length of the approach run, and hence, the take-off will happen exactly on the take-off board. The take-off movement can be improved by combining and balancing strength and speed, accompanied by a good coordination of movements.

According to the calculation, the optimal force during take-off is at an average of 237.42 N, which happens at the 35 m approach run. This results in an average jump distance of 5.13 m. As for the forces that occur in the 15, 20, 25 and 30 m approach runs, the jump distance produced is not optimal. If the execution of the take-off is conducted inappropriately, it causes injury for the athletes. Previous research conducted by Sudarminto (2001) suggests that, amongst the world's best long jumpers, the average best flight angle is around 45 degrees.

Meanwhile, the average flight angle produced by Acehese national long jump athletes has exceeded the referred number. This shows that the rhythm and the take-off style of the Acehese long jump athletes do not correspond with the ideal flight angle of 45 degrees. With an angle exceeding this limit, there is an increased risk of injury caused by landing on one foot such as dislocation of a body part.

An ideal flight angle is initiated by an optimal approach run, with an appropriate rhythm and take-off style so as to achieve a jump with a long distance and a good landing. During data collection, one of the subjects reached a flight angle very close to the ideal flight angle at 43 degrees. A flight at this angle produced a jump distance of 5.78 m.

This is influenced by the length of the approach run, the take-off, and the flight angle. As stated by Widya (2009), in the jumping events in athletics, a parabolic motion happens after taking off from the take-off board all the way to landing in the sandbox. The optimal flight angle to do this is at 45 degrees.

## ACKNOWLEDGMENTS

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## CONCLUSION

To conclude, this study has obtained the following circumstances related to the approach run, take-off and flight angles of the Acehnese national long jump athletes:

1. The ideal approach run should consider the speed and the length. The length of an ideal approach run is at 35 meters which is done at a speed of 4.8 m/s. This approach run is found optimal with the rhythm and force during the take-off considered.
2. In an ideal take-off position, the athlete uses the tips of the toes so as to achieve a free swing of the leg quickly to the horizontal position while counting the odd steps. The average force during the ideal take-off is 237.42 newton at a distance of 35 meters, which results in an average jump distance of 5.13 meters.
3. The average flight angle of the national long jump athletes from Aceh has exceeded the world's long jump record with the value of 45 degrees. With the angle exceeding this limit, there is an increased risk of injury caused by landing on one foot such as dislocation of a body part. An ideal flight angle is initiated by an optimal approach run, with an appropriate rhythm and take-off style so as to achieve a jump with a long distance and a good landing.

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### **ANALIZA ZALETA, ODSKOKA I UGLOVA ODRAZA U SKOKU U DALJ**

Skok u dalj je jedan od atletskih sportova koji zahtijeva fizičku, tehničku, stratešku i mentalnu izvedbu. Kako bi se postigla maksimalna dužina skoka, potrebno je uzeti u obzir zalet, odskok i uglove odraza tokom izvedbe skoka u dalj. Ova studija ima za cilj analizirati različite dužine skoka u dalj uzimajući u obzir zalet, silu odskoka i uglove odraza. U ovoj studiji je učestvovalo šest nacionalnih atletičara u skoku u dalj iz odjela Aceh Atletskog saveza Indonezije. Vrste opreme korištene u ovoj studiji obuhvataju mjernu traku, platformu za mjerenje sile reakcije podloge, uređaj za snimanje videa te programe Windows Movie Maker 2.6 i Phantom 675.2. Rezultati ove studije pokazuju da je maksimalna dužina skoka postignuta na 5,13 m uz 237,42 njutna. Prosječni ugao odraza je iznosio 45 stepeni, a što nadmašuje svjetski rekord atletičara u skoku u dalj. Ugao odraza može dovesti do povreda poput doskoka na jednu nogu ili istegnuća tijela.

**Ključne riječi:** skok u dalj, zalet, odskok, ugao odraza, nacionalni atletičari u skoku u dalj

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# COACHING MANAGEMENT IN THE SPORTS INDUSTRY

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## ABSTRACT

Training technologies management is one of the four main bearers in the sports industry. Coaching is one of the most stressful jobs due to exposure to constant pressure from an external factor to win competitions. In this research, by using the empirical method, content analysis method as well as the comparative and descriptive method, we have concluded that the training technologies management is crucial in the process of achieving top results. We analysed which barriers and conflict situations coaches face today, as well as which qualities a modern coach must possess today to successfully perform the coaching job as well as motivate the athletes themselves to compete at the top level.

**Keywords:** training technologies, organisation, sports industry

## INTRODUCTION

**T**raining technologies management has one of the most important roles in the sports industry. The basic task of each coach is to recognise a young, talented and promising athlete, who possesses skills and physical predispositions for a particular sporting branch. It is necessary to point out that not every coach is an expert in all sports, but each one is specialised in specific sports.

Planning is a major part of every coach's job. The basic elements of creating a training programme include training goals, competition calendar, competition goals and test results.

Knowledge of techniques and methodologies for each sport represents the foundation in training technologies for each coach. In this paper, we will pay special attention to the impact of the training technologies management in the sports industry.

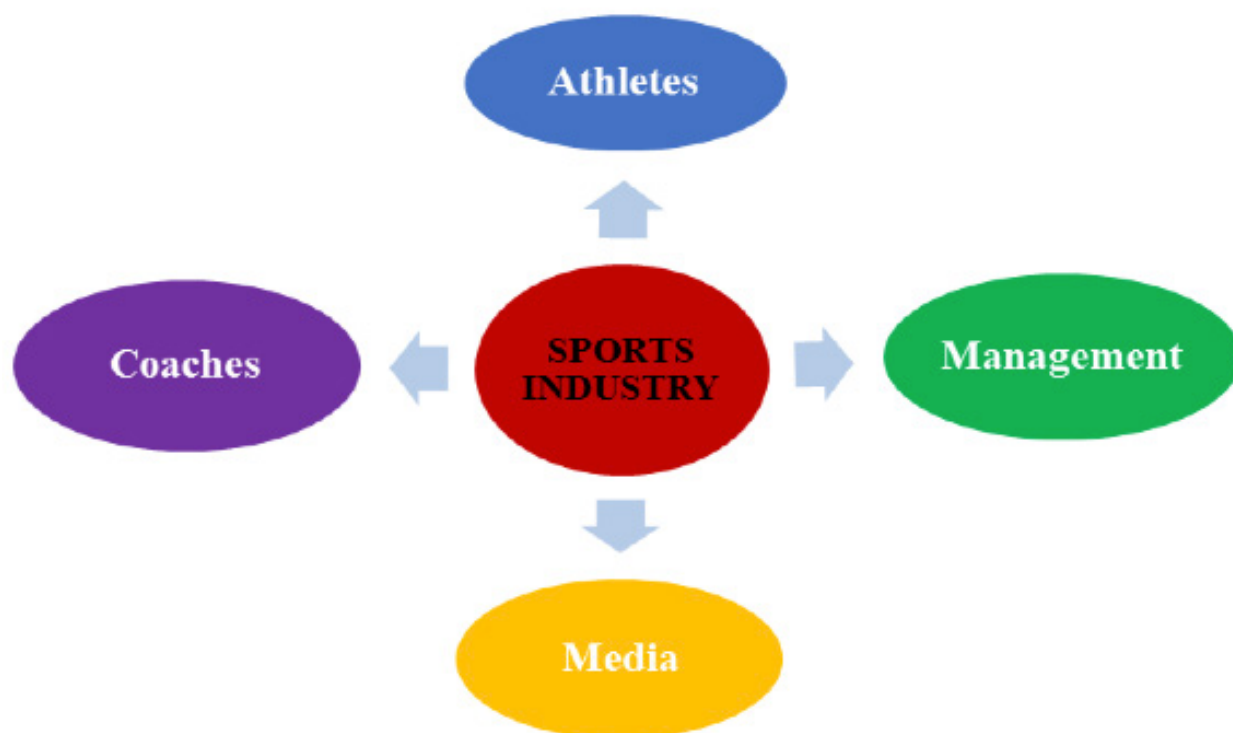
In the last decade, the sports industry has become one of the most valuable economic sectors in terms of the amount of money that is in circulation.

Sport has developed into such a large industry that the establishment of some market data has become a very difficult task (Masterman, 2008, p. 19).

The effects of the sports industry development cannot be expressed only by positive indicators. In the race to win a part of the profits in this industry, everyone involved in it is exposed to the risks. Athletes and their coaches are exposed to the challenges of using doping and other supplements in order to achieve top-notch sports results. (Radošević, 2014).

The sports industry consists of four basic bearers (Figure 1). The first part is represented by coaches, the second place is reserved for athletes and the third place is occupied by sports managers, while the fourth place belongs to the media.

Each of these professions has its role and makes it an indispensable part of the sports industry. It is not uncommon that one person can perform or has performed several functions during his or her career. Within the sports industry, there are different divisions of sports out of which we will, in this work, state the division into team (group) and individual sports, summer and winter sports, profitable and non-profitable sports.



**Figure 1** - The main bearers of the sports industry

Coaches are one of the four basic bearers in the sports industry. Without the participation of quality coaches, the athletes' accomplishments as well as the achievement of new records would be impossible. The coach should first be a pedagogue and then a motivator, facilitator of knowledge, an innovator and an analyst in addition to having experience in working with youth categories and seniors. The coach must be educated and trained at faculties, courses and seminars so as to exchange opinions and experiences with his colleagues in order to improve and advance. The sports industry represents a rapidly developing market and sets new goals and competitions to win every year. In this paper, the aim of the research is to provide a detailed analysis of the coaching management in the sports industry. What are the segments of coaching? What is their main role? What is their contribution to the development of the sports industry? Which new technologies make their day-to-day work easier? Which problems and pressures of the external factors do coaches face in their work? Does anyone interfere with their work method? Do they have good working conditions? Are they paid on time? How do they resolve conflict situations with athletes, management and the media?

## METHODS

In this paper, we have analysed the role of coaches, depending on the type of sport, using the empirical method, the method of content analysis, synthesis,

description and comparison. We have analysed the role of coaches in searching for new talents as well as the process of creating a top athlete, starting from preschool, through primary school, high school and all the way to university sports. We paid special attention to the management of the pedagogical approach in working with children, motivating children to play sports, as well as the parents' role and influence which coaches who work with youth categories face on a daily basis. Using the empirical method, we have analysed the problems which are, for coaches, most difficult to work with. With a comparative method, we have analysed the role of coaches in training technology management in individual and team sports, starting from coaching management in youth categories all the way to senior categories, as well as the role of coaching management in individual training management with athletes. We have analysed the coaching management relationships with the athletes, club management, fans, the media as well as the relations between the coaches themselves.

With the professionalisation of sports, in the period from 1970 to 1980 when the International Olympic Committee had allowed professional athletes to take part in the Olympic Games, sport has turned into a professional competition at the global level while the development of the sports industry began to grow unstoppably each year due to the great interest of spectators and the media, which increased the number of sports competitions, but has also created

the need for coaching management in the sports industry. According to the market research group IBIS World, the value of the sports coaches industry is estimated at 8 billion USD. In the period from 2012 to 2017, this industry, composed of more than 130.000 enterprises, experienced the annual growth of 3%.

Research study: Negative impact of external factors on the organisation of the coaching management

As a part of this paper, we have conducted an empirical study on a sample of 100 football coaches, who worked in Serbia in the period from 2017 to 2020, in order find out the answers to the research topic "Negative impact of external factors on the organisation of the coaching management." In order for the results of the research to be credible, we have decided to make the research anonymous so that the respondents would have the opportunity to express their personal opinions without external pressure on the following questions:

- Do you often face pressure from the club management during your work?
- Do you often face pressure from influential people (politicians, agents, investors, fans and the media) during your work?
- During your work, does the external factor interfere with the way you lead the team during matches or make a list of players who should play?
- Are you satisfied with the conditions you have for coaching /leading matches?
- Are salaries regularly paid on time to coaches and players?

Problems in the coaching management

From the coaching management aspect, the problem of the talent source bases from which talented athletes are selected is the biggest problem. Today, we have a situation that preschool sport in Serbia does not exist, while school sport and university sport in Serbia have been almost marginalised, that students regularly skip physical education classes and that the classes are excluded from the faculty programme, and therefore the collapse of sports in Serbia was also to be expected. For years, we have neglected the role and importance of sport for the health of a nation. The sporting achievements Serbian citizens have been used to from mid-1990s to the beginning of 2002 affected the neglect of the generational shift in the generation of young talented athletes as well as the education of young sports professionals for working with the youth categories. For decades, the best sports coaches worked with the youngest athletes, while the commercialisation of the sports industry led to the fact that the highest quality professional staff is now dedicated exclusively to professional athletes, as it is a career step forward for going abroad where they open up the possibility of signing a professional contract. It is a harsh fact that working with young athletes is not profitable for sports coaches.

The process of creating top-level athletes - a genetic predisposition

Genetics is a very important factor in the evaluation process of a young athlete. For sports such as athletics, basketball, volleyball, swimming and water polo, the height and length of the limbs represent a crucial factor. Coaching management is focused on analysing the data on the parents' height in order to make an assessment of the physical growth and development of each individual athlete. For sports such as basketball, volleyball, swimming and water polo, children whose parents are tall have a greater potential to be tall. Also, in addition to the parents' height, sports pedigrees are also important. Children whose parents are former athletes are considered to have sports pedigrees. Coordination and technique, in the first contact with sports disciplines, shows a lot about the talent and potential of the child. The process of creating a top-level athlete starts from the earliest age.

Preschool sport

The creation of a top-level athlete starts from the earliest age and depends mostly on the family and the environment in which the child grows up. In the period between 2 and 5 years of age, children begin to create the need for running and, subsequently, it becomes a crucial period for developing explosive muscle fibres that will be of the utmost importance in their sports career. At that age, children need to be encouraged to move freely, while they should not be restrained, often scared of falling, injuries and potential material damage. In preschool age, for the creation of future athletes, it is recommended to engage children in basic sports: athletics, gymnastics and swimming. These sports are considered as a foundation for the future healthy psychophysical development of each individual. Of course, the conditions for engaging in basic sports, especially in preschool institutions, should be taken into account. (Radošević, 2017) Modernisation, new technologies and ideas have made a management strategy of opening sports preschools that are necessary for the creation of future athletes from the very beginning. The basic conditions that must be provided are quality professional staff for working with children as well as training conditions within preschool institutions in the form of children's athletic trim trails that do not occupy a large area and which would be built in all preschools. For gymnastic exercises, conditions already exist in the form of classrooms or halls where there is still a need for experts. The most difficult conditions include swimming because the construction of small pools is too expensive, requires a large area and is also expensive for maintenance. Currently, the only solution can be found in pre-existing swimming pools and swimming schools for children. Children do not need to be forced to play sports against their will because it will create an opposite effect. Fun is the best way to motivate children to love sports, while organising children's competitions is the best



way for children to select and focus on sports in which they are talented. Unfortunately, the current situation in preschools across Serbia has shown a lack of desire, wish and conditions for working with children in sports because the preschools do not have adequate personnel, such as physical education teachers who would be involved in directing children towards sports, while teachers perceive that it is enough to let the children play by themselves on a playground.

#### Primary school sport

During primary school (7-14 years), children show interest and slowly focus on collective sports (football, basketball, volleyball, water polo and handball) and individual sports (tennis, swimming and athletics). In this period, it is very important to devote to individual work with children in learning and improving the techniques of running, swimming, changing the rhythm and direction, as well as controlling the ball. The children's interest in sports also implies changes in sports in accordance with the stages of interest. School peers can influence new interests, while clubs that use the school gym attract children to try new sports. This period is crucial for choosing the sport that the child will engage in. Following the basic sports which are necessary as the foundations for the physical development of every child, it leads to directing children to sports that they have shown interest and talent for. Most children choose a local sports club in which their friends began to train at a local school.

#### High school sport

The period of high school (14-18 years) is called the period of puberty and is considered to be the most sensitive period when young athletes must be approached with special care, primarily in psychological terms. In that period, young athletes become much more sensitive because they slowly develop as individuals, both physically and mentally. Often, there are cases where some athletes begin to practice twice a day, so neglecting education is inevitable. In such cases, most athletes switch to part-time education, which clubs deem necessary to create a top-level athlete but, at the same time, poses a potential danger because a large number of athletes, due to the lack of free time, rarely return to finish school. This is followed by a situation where we have uneducated top athletes who have only completed elementary school and who are considered illiterate by the society. The solution to this type of training and education can be found in the American school system where students have classes from 10h to 15h, while the trainings are adjusted and take place before and after classes at school.

#### University sport

The university period, that is, the period starting from 18+ in Serbia, is unachievable for over 90% of athletes. One third of athletes does not have a high school diploma, the second third is uninterested in studying

and personal improvement, while the last third, despite the willingness to study and because of their daily professional obligations, is unable to dedicate themselves to study and take exams. An increasing number of athletes from Serbia continue their career at the universities in North America. The American university sports system has proven to be effective because university campuses are created where young athletes have ideal conditions for training and study. Lectures and exams at universities are adapted to sports obligations in the form of daily training. The professors have an understanding of athletes among which some of them will become basketball (NBA), hockey (NHL), American football (NFL) and baseball (MLB) professionals. Young athletes have a privileged status because they represent their universities through sporting competitions throughout the USA, affecting their ratings which are evaluated each year.

#### Coaching management relationship with parents

The coaching management relationship with parents mainly refers to practicing younger players and has a positive and negative side. The positive side refers to parent support for their child to engage in sports, motivation through purchasing sports equipment, and provision of transportation to training and competitions. On the one hand, the negative side includes the parents' lack of interest in the activities of their children, demotivation of children that they are not talented enough to become successful athletes as their idols, while on the other hand they include overambitious parents who want to profit through their children, situations where parents often interfere in the work of coaches, presenting themselves as experts and expressing dissatisfaction that their child has not been given more attention in individual work during training and the competition. It is unfortunate that parents try to bribe coaches, offering them help in the purchase of sports equipment for the team, ensuring the transport of athletes when travelling to the competition, and even financial stimulation of the coaches in order to put their child in the game.

#### The role of the athletic coach

The role of the athletic coach is to prepare athletes for their forthcoming efforts, to perform proper warm-ups before practice and competitions as well as subsequent stretching, to maintain their athletic form depending on the competitions calendar, to rehabilitate athletes after a great effort or possible injuries in cooperation with the medical team, and take care of their nutrition and supplementation in cooperation with nutritionists. The quality of the work performed by an athletic coach depends on how the athletes will physically endure the season, whether the athlete will be injured during in-season training

while performing inadequate exercises, not being ready to physically withstand a difficult season or he will, with less effort, leave the impression that he is full of strength and energy, being ready for challenges and competitions.

#### Coaching management in individual sports - youth athletes

The process of preparing young athletes for the competition begins when the basic skills and techniques are mastered, when they learn the rules of the game and when the conditions for the competition are achieved. It depends on the coaching management attitude towards young athletes whether the children will love the sport they play or whether they will quit and change sports or even stop playing due to their non-pedagogical approach. There are a lot of children who, due to the non-pedagogical approach of the coaching management (shouting, insulting, pressuring), become frustrated and lose their motivation, will and desire to engage in sports.

#### Coaching management in individual sports - senior athletes

The role of coaching management in senior athletes is much different compared to youth athletes. Senior athletes have already been formed as personalities and athletes, have self-confidence and the awareness of their actions, know all the details related to the sport they are playing, have years of experience behind them and now pay attention to practice with coaches, with finesse to further improve their knowledge and skills. In individual sports (athletics, swimming, tennis, gymnastics, skiing, martial arts), all the attention of the coach is dedicated to the individual, their individual practice and preparation for the competitions. In individual sports, a whole team of experts takes care of one athlete, starting from the coach who is preparing the athlete for competition, followed by an athletic coach, a physiotherapist and a nutritionist, a sports psychologist and agent - responsible for taking care of the athlete, his/hers attitude towards fans, the media and sponsors, as well as departures and accommodation at tournaments and competitions.

#### Coaching management in team sports - youth athletes

During coaching management with youth categories in team sports, the coach must have the authority and respect of young athletes, with the mission of transferring their knowledge and skills. It is also necessary to have a friendly and paternal relationship, especially outside of the training, where the coach should be familiar with the personal situation of each young athlete, the obligations at school as well as personal interests beyond the sport.

In youth categories, sports should be fun, children should play for the love of sports, not for the purpose of obtaining financial resources or achieving parental ambitions.

#### Coaching management in team sports - senior athletes

Unlike individual sports, in team sports (football, basketball, volleyball, water polo, handball), the attention of the coaching management is dedicated to the entire team, where athletes play in different positions so as to function as a team. Nowadays, the top-level coaches have a whole team of assistants hired to work for the club, with their own responsibilities, while the job of the head coach is to monitor and make the final decision.

#### Coaching motivation management of top-level athletes

Motivation management requires special attention in professional sports. For young athletes, the desire for winning and earning money, both from prizes and from sponsors, is a sufficient motive to concentrate and dedicate only to the sport. Leading a single live allows young top athletes to devote their time to themselves and their training, while athletes with families have to match their time with their needs. In addition, many athletes who play at the top level often have the problem of physical fatigue and exhaustion due to a large number of matches or games. Money is no longer a priority for many athletes because, in their previous career, they have signed lucrative contracts and have financially provided for their families. The professional athletes' career lasts up to the age between 30 and 35, on average. The competitive form and top results begin to decrease after 30, while physical injuries are more frequent. Although some athletes are still at a premium level, their bodies cannot physically keep up with the pace of the competition, which does not decrease.

#### The negative side of coaching management - lost talents

Many coaches are known for creating a top-level athlete, and such examples are a reference for coaching management that will raise their rating in the sports industry. On the other hand, there are no statistical parameters of how many young and talented athletes' careers have been ruined by low-quality coaching management who consciously sacrificed entire generations of talented athletes in order to make one top-level athlete. The need to win at any cost greatly reduces the opportunity to invest in developing some new talented athletes with whom coaches must be patient while making their mistakes because it is how athletes gain their experience which will be valuable for them to win in the future.

#### Coaching management relations with athletes

Coaching management relations with athletes are the primary basis for successful functioning of the sports team as well as the sports result achievement.

The conflict in the coaching management-athlete relation often arises from the lack of understanding of the profile and character, as well as due to the negative approach and level of their mutual tolerance. The reason is not disrespect but the misunderstanding of the way each person participates in communication. (Conflict resolution). Knowledge of sports psychology as well as methods for solving conflict situations is a great advantage of coaching management in dealing with professional athletes. Today, the coaches who have dedicated their carriers to working with young athletes are poorly valued, risking their position and losing their job due to the tolerance of young and talented athletes whose mistakes should be used to gain experience and make progress. It used to be normal for young athletes from the age of 15-16 to be able to compete in senior competitions, while today, it is impossible because the coaching management do not want to take a chance and lose, risking their future and tolerating the mistakes of young inexperienced athletes.

#### Relations between coaches

Coaching management is one of the most stressful professions and requires great investments and sacrifice. It is not rare that the multi-year investing ends unfavourably for the coaching management, the athlete or the team due to an unfortunate set of circumstances. Coaching management also includes spying on opponents in all possible ways, trying to discover their tactics, plans and strategies before mutual duels. Vanity in coaching management is very pronounced. The roughness of the coaching management is reflected in the fact that their position depends entirely on their results. One lost game or a set of unfortunate circumstances (injury to a player before a decisive competition) may result in the coaching management being fired.

#### Coaching management relationship with agents and managers

In order for the sport to constantly progress, it must follow the ways of successful management and organisation that sports clubs have. Many coaches and clubs have come into conflicts with sports agents who, protecting the interests of the players they represent, have expressed their dissatisfaction due to the insufficient time in the game or unspecified opportunity and lack of trust in the athlete.

## RESEARCH RESULTS

Throughout the history of sports industry, the role of coaching management was considered crucial for achieving top-level results. In this paper we have shown, on various examples, how important the role of coaching management is in the sports industry.

Without the coaching management, young athletes would never be targeted and selected for the sports they have showed talent and interest for, as no athlete

could achieve sports results alone.

Coaching management face a variety of problems in their careers, starting from inadequate conditions for practice, the club management interference in strategy, organisation and tactics before the competition, to financial problems in the form of unpaid wages and bonuses for the achieved results, which additionally aggravate their ability to win.

Through the results of the research (Figure 2), the authors came to the conclusion that 79% of respondents often face pressure from the club management, and that 83% of respondents face pressure from influential politicians, shareholders, sports agents, fans and the media. Interference in the job was reported by 66% of coaches who have an external factor problem which interferes with the way they lead the team during games or wants to participate in compiling a list of players who should play.

The working conditions in coaching management are rarely in line with the results required of them. The results of the survey showed us that only 31% of players answered that they were satisfied with the conditions they have for coaching or leading matches. The most unpleasant surprise of the research was the fact that only 21% of coaches and players receive their salaries on time.

Coaching management must be provided good working conditions allowing them to organise the team or athletes in order to be able to focus on achieving the results that are expected of them.

Otherwise, the pressure created by an external factor (club's management, politicians, shareholders, fans and the media) is unnecessarily an aggravating circumstance in creating future athletes and achieving sports results.

The pressures to which the coaching management is exposed are counterproductive because the external factor thinks it knows the coaching management better than the coaches. Such pressures, in most cases, lead to poor results for which the external factor blames the coaching management, instead of themselves.

The results of the research are devastating because they represent a harsh reality that coaching management encounter on a daily basis.

Pressure, threats, blackmail, humiliation and interference in coaching management are obstacles in achieving the sports results expected of them. The future of sports industry has been declining for decades because an external factor is interfering in other business.

### Negative influence of external factors on the coaching management

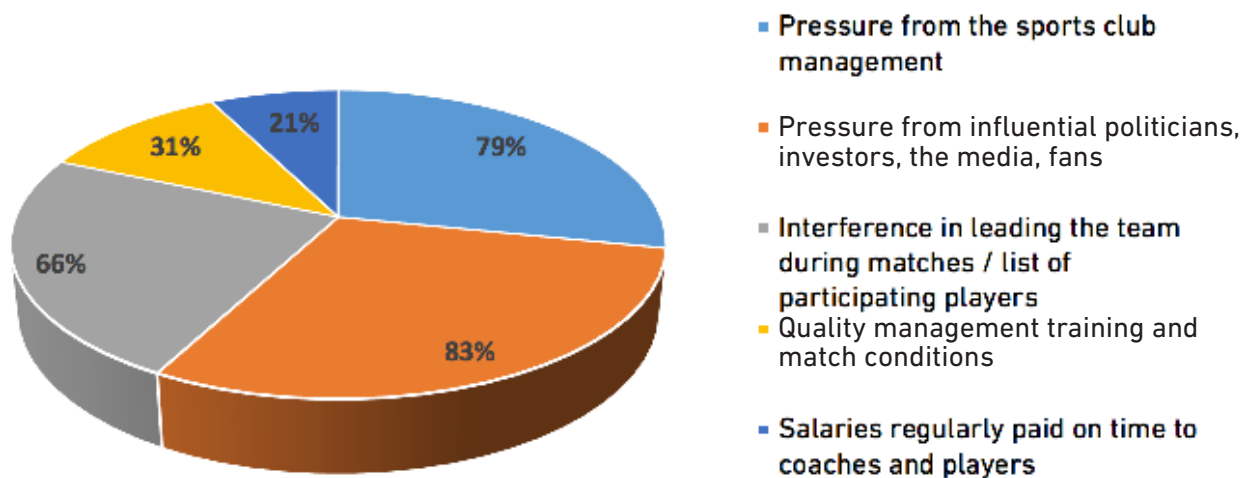


Figure 2 - Negative influence of external factors in coaching management

## DISCUSSION

Analysing the research results, we can conclude that the coaching management role is crucial in the sports industry, a key figure responsible for finding young talents, creating top-level athletes (from youth to senior categories) and achieving sports results in individual or team sports. We have analysed the problems that the coaching management face, from inadequate conditions to irregular income and conflicts with the club's management/athletes/fans/media/parents. The biggest problem is the pressure, interference in the organisation in leading the athletes during competitions, which shows doubt in the coaching management and ruins the authority and motivation in athletes necessary for the competition. The only pressure that the coaching management should have is from a sports competition, whether it is from the opposing team, athletes or the referee. Any pressure that comes from outside the sports fields is counterproductive for achieving sports results.

## CONCLUSION

The sports industry has developed so much that sports coaches have become as popular today as the world's best athletes, which was not the case in the past. Coaching management, in addition to the athletes, managers and the media, are considered the basic bearers of the sports industry. Today, the coaching management are more popular than their players (example: José Mourinho, Jürgen Klopp and

Pep Guardiola). Without the coaching management, the quality of competition would have incomparably lower quality, sports competitions would be uncontrollable, sports goals would be impossible to accomplish, young talented athletes would have no one to direct them on which sports to play or how to practice, while none of the records would be broken. Coaching management represent the brains of the operational management for each team, and the creators of the strategy that should achieve the victories of the sports club in the competition.

The pressures that coaching management face on a daily basis prevent them from doing their job. Instead of concentrating and focusing their energy on strategic management, techniques and tactics to successfully compete with opponents, the coaching management are forced to waste their energy fulfilling the wishes and requirements of club management on which it depends whether they will stay at the club or will be fired, from shareholders who can vote for their replacement and from fans who can create a pressure atmosphere on the club's management by booing during matches. Finally, we must mention the media pressure on coaching management, always eager for exclusive news, without thinking of the consequences they can cause, publishing unverified information, often misinformation that can harm players, club's management and fans themselves, whose consequences will first hit the coaching management.

A modern coaching management must have authority, to be media acceptable, with a sense of humour, to be able to resolve conflict situations (with players, management, fans and the media), to protect the players' interests, to be a motivator, to have

understanding of the player's personal problems (family members' illnesses, marital problems, childbirth) and to control the athletes not to make scandals by their behaviour that could damage the club's image. We are aware that it is impossible for

the coaching management not to have any pressure, but it is very important to prevent additional pressure from external factors, which will certainly not contribute to or facilitate the achievement of the set goals.

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## MENADŽMENT TRENAŽNIH TEHNOLOGIJA U SPORTSKOJ INDUSTRIJI

Menadžment trenažnih tehnologija predstavlja jedan od četiri osnovna nosioca sportske industrije. Treniranje je jedan od najstresnijih poslova zbog izloženosti konstantnom pritisku od strane spoljašnjeg faktora za pobeđivanjem na takmičenjima. U ovom istraživanju smo, koristeći empirijsku metodu, metodu analize sadržaja, kao i historijsku, komparativnu, sintetičku i deskriptivnu metodu, zaključili da je menadžment trenažnih tehnologija krucijalan u procesu ostvarivanja vrhunskih rezultata. Analizirali smo sa kojim se preprekama i konfliktnim situacijama treneri danas suočavaju, kao i kakve osobine moderan trener danas mora da posедуje za uspešno obavljanje trenerskog posla, kao i motivisanje samih sportista da se takmiče na vrhunskom nivou.

**Ključne riječi:** trener, organizacija, sportska industrija

# ATTRACTIVENESS AND ITS MEASURE: ASSESSING THE GOLDEN PROPORTIONS OF THE FACE IN THE STUDENT POPULATION OF THE SOUTHEAST EUROPEAN COUNTRIES

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## ABSTRACT

**Objectives:** To measure the proportions of the face and determine the deviation from the divine proportion (golden ratio), and establish a correlation with the attractiveness/beauty of the face. **Methods:** Measurement of specific facial dimensions and determination of proportion deviations from the golden ratio was performed on 100 students aged from 19 to 26 years from the countries of Southeast Europe. Out of 500 students, 100 students (50 male and 50 female) were selected who, according to the Commission, had the most attractive, most beautiful face. After measuring and processing the results, the groups were compared and the results were discussed. **Findings:** The majority of the proportions related to the horizontal, vertical and mixed (horizontal-vertical) facial characteristics of the student population from the countries of Southeast Europe and Croatia are close to the divine proportion. The ratios of the vertical proportions show slightly larger deviations. **Novelty/Applications:** The results of this study can be used in aesthetic treatment, orthodontic procedures or aesthetic facial correction. **Conclusion:** The results we obtained are similar to the results obtained by measuring the West Indian and Japanese populations, indicating that facial structure is a universal human feature, regardless of race and gender. Our study shows that the ratios of the vertical characteristics of the face deviate slightly more from the gold standard, in contrast to other authors who observed the largest deviations in the ratio of horizontal proportions.

**Keywords:** golden ratio, divine proportion, attractiveness/beauty of the face, students of the Western Balkan countries



## INTRODUCTION

Since Euclid in his Elements (4th century BC) defined the division of the straight line into two parts "so that the greater part refers to the lesser part as the whole to the greater part" [1,2], and in the 12th century, Leonardo Fibonacci provided specific applications in practice and mathematically expressed them by the number  $\Phi$  [2,3], attempts to find the divine proportions in the structure and function of living beings (plants, animals and people) do not stop. One of the great challenges of the human race has always been to establish a correlation between the attractive appearance of human faces and the divine proportion because, in contact with other people, physical appearance, and especially the face, plays a very important role [4] (beautiful smile - the most prominent facial characteristic - an important form of nonverbal communication between people).

Beauty is not an absolute category, but a subjective one, and the question arises as to whether beauty/attractiveness can be somehow quantified, establishing a correlation between beauty and some numbers. According to Webster's Collegiate Dictionary, beauty, as the quality of physical attraction "is the quality or aggregate of qualities in a person or thing that gives pleasure to the senses or pleasurably exalts the mind or spirit" [5].

The concept of the mathematics of harmony [1,2] suggests that facial aesthetics and the associated attractiveness are not just a matter of subjective perception but can be scientifically quantified, and thus set the standard for attractiveness in the form of numbers. The number  $\Phi$ , which expresses the divine proportion and which represents the mathematical ideal of the beauty and attractiveness of the face, is certainly at the centre of such considerations [6,7,8,9,10].

## AIM

The aim of this study is to determine the deviations from the golden proportions of the facial characteristics in the selected student population of Southeast Europe, and to compare the results with other studies with the aim of making conclusions on the dependence of these deviations on gender and race.

## MATERIALS AND METHODS

Measurement of characteristic facial dimensions and determination of proportion deviations from the golden ratio was performed on 100 selected students aged from 19 to 26 years from the countries of Southeast Europe (Bosnia and Herzegovina, Serbia, Montenegro

and Kosovo) and Croatia. Out of 500 students, 100 students were selected (50 male and 50 female) who, according to the three-member Commission (A. Omerbašić, M. Ibranović, and M. Omerbašić), had the most attractive, most beautiful face. Photographs of the selected students ( $n_F = 50, n_M = 50$ ) were printed on A4 paper and the following facial parameters were measured (Fig.1):  $q$ - head length (from the top of the head to the tip of the chin),  $e$ - distance of the top of the head from the pupil of the eye,  $f$ - distance from the pupil of the eye to the tip of the nose,  $t$ - distance from the pupil of the eye to the mouth,  $s$ - width of the nose,  $h$ - (external) distance between the eyes,  $x$ - width of the face,  $y$ - distance from the pupil of the eye to the beginning of the hair on the head,  $z$ - distance from the tip of nose to the chin,  $o$ - distance from the lips to the chin,  $u$ - length of the lips,  $v$ - distance from the tip of nose to the lips,  $m = y + f + z$  the length of the face and  $n = y + f$  distance from the tip of the nose to the beginning of the hair on the head. We statistically processed the results and presented them in the form (mean value standard deviation):

$$(X = \bar{X} \pm \delta, \bar{X} = \frac{\sum_{i=1}^n X_i}{n}, \delta = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n}})$$

and then calculated the (COV):

$$COV(\%) = \frac{SD}{mean} \cdot 100 = \frac{\delta}{\bar{X}} \cdot 100$$

After measurement and results processing, a comparison of groups was made and results were discussed between groups, alongside a comparison with the results of other authors, with subjects belonging to other races. The results are presented in tables (Table 1, Table 2, abbreviated table). We then determined the ratios of the characteristic

vertical dimensions of the face  $(\frac{m}{n}, \frac{z}{o}, \frac{z}{f})$

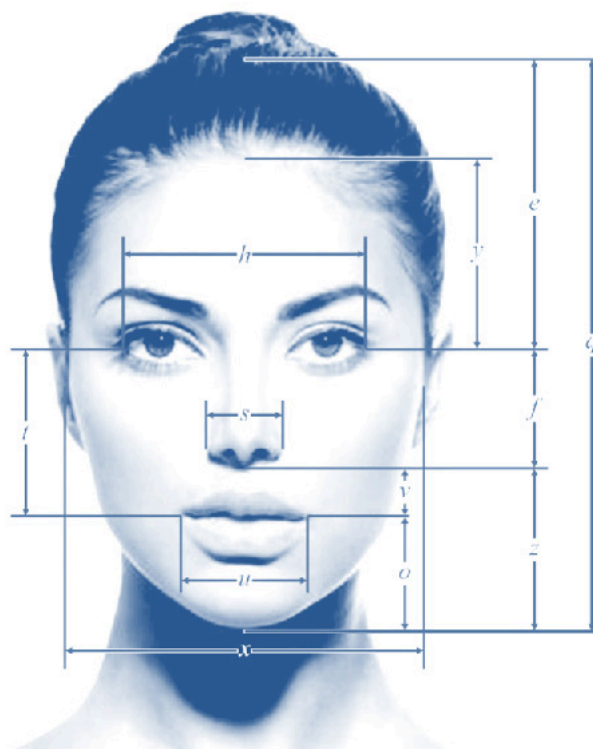
the horizontal dimensions of the face  $(\frac{h}{u}, \frac{u}{s}, \frac{x}{h})$

and the mixed, vertical-horizontal, dimensions

$(\frac{q}{x}, \frac{s}{v}, \frac{m}{x})$  The calculated ratios are shown in tables (Table 3 and Table 4). After statistical processing, the results are presented in standard form  $X = \bar{X} \pm \delta$

$$COV(\%) = \frac{\delta}{\bar{X}} \cdot 100$$

Subsequently, we presented the obtained results graphically, in different ways, which clearly provide an image of the presence of divine proportion in the structure of the face.



**Figure 1** - Presentation of distances measured in attractive faces (Drawing made by: Anando Adzemi, ALAMA, Prizren)

## RESULTS AND DISCUSSION

The measured parameters of the face expressed in cm (vertical, horizontal and mixed)

were presented in tables by groups: Table 1 - group M, Table 2 - group F.

**Table 1:** Presentation of measured values for group M

N <sub>o</sub>	q (cm)	e (cm)	f (cm)	t (cm)	s (cm)	h (cm)	x (cm)	y (cm)	z (cm)	o (cm)	u (cm)	v (cm)
1	24.2	14.2	4.0	6.2	3.2	8.8	14.0	8.5	6.2	4.0	5.5	2.0
2	22.4	14.0	4.1	6.5	4.0	9.5	14.2	7.0	8.9	5.6	5.4	2.3
...					...							...
50	25.0	15.2	4.0	6.8	3.1	11.0	15.5	8.6	6.0	3.5	5.9	2.1

**Table 2:** Presentation of measured values for group F

N <sub>o</sub>	q (cm)	e (cm)	f (cm)	t (cm)	s (cm)	h (cm)	x (cm)	y (cm)	z (cm)	o (cm)	u (cm)	v (cm)
1	23.5	13.5	3.9	6.0	3.0	9.0	14.2	9.0	6.0	4.0	5.5	2.0
2	21.3	12.3	5.0	7.2	4.4	10.5	13.5	7.5	7.8	4.8	5.0	2.6
...					...							...
50	19.5	9.0	3.8	5.4	3.5	9.4	13.2	7.4	5.7	3.9	4.4	2.4

We calculated the relationships of the corresponding parameters, grouping them into three groups. The first group of relationships consists of vertical facial parameters ( $\frac{m}{n}, \frac{z}{o}, \frac{z}{f}$ ) the second group of relationships consists of horizontal facial parameters ( $\frac{h}{u}, \frac{u}{s}, \frac{x}{h}$ ) and the third group consists of the relationships of horizontal and vertical facial dimensions ( $\frac{q}{x}, \frac{s}{v}, \frac{m}{x}$ )

For each parameter relationship, we determined the mean and standard deviation. We then determined the mean and standard deviation for each group of relationships (vertical, horizontal and mixed).

The results of data processing are shown in Table 3 for group M and in Table 4 for group F.

**Table 3:** Presentation of the ratio of measured values for group M

N <sub>o</sub>	$\frac{m}{n}$	$\frac{z}{o}$	$\frac{z}{f}$	$\frac{h}{u}$	$\frac{u}{s}$	$\frac{x}{h}$	$\frac{q}{x}$	$\frac{s}{v}$	$\frac{m}{x}$	Mean
1	1.47	1.55	1.55	1.60	1.72	1.59	1.73	1.60	1.34	1.57
2	1.62	1.59	2.17	1.76	1.35	1.49	1.58	1.74	1.41	1.63
...	...				---		...		...	1.60 ± 0.01
										(COV = 0.6%)

50	1.66	1.71	1.50	1.86	1.90	1.41	1.61	1.48	1.20	1.59
	1.59	1.62	1.72	1.74	1.63	1.51	1.63	1.60	1.34	
Mean	1.64 ± 0.03			1.63 ± 0.02			1.52 ± 0.01			
	1.60 ± 0.02 (COV = 1.2%)									

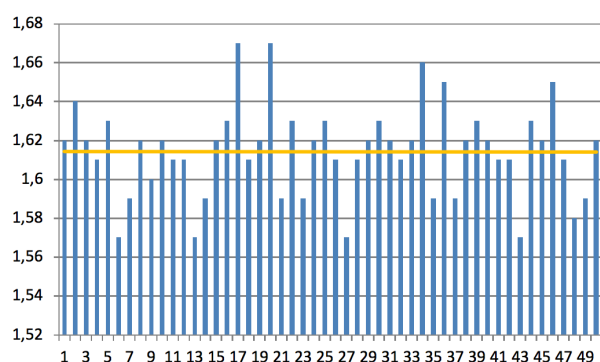
**Table 4:** Presentation of the ratio of measured values for group F

$N_0$	$\frac{m}{n}$	$\frac{z}{o}$	$\frac{z}{f}$	$\frac{h}{u}$	$\frac{u}{s}$	$\frac{x}{h}$	$\frac{q}{x}$	$\frac{s}{v}$	$\frac{m}{x}$	Mean
1	1.47	1.50	1.54	1.64	1.83	1.59	1.65	1.50	1.33	1.56
2	1.62	1.63	1.56	2.10	1.14	1.49	1.58	1.69	1.50	1.59
...	...	...	...	...	...	...	...	...	...	$1.58 \pm 0.08$
50	1.44	1.46	1.50	2.04	1.26	1.41	1.48	1.49	1.28	1.57
	1.51	1.57	1.54	1.88	1.52	1.51	1.58	1.58	1.39	
Mean	$1.54 \pm 0.01$			$1.65 \pm 0.02$			$1.52 \pm 0.01$			
	$1.57 \pm 0.01$ (COV = 0.6)									

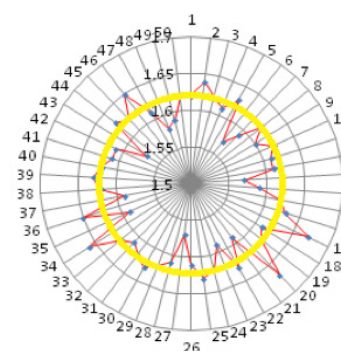
From the obtained results, we notice that the mean value of the ratio of horizontal parameters ( $\frac{h}{u}, \frac{u}{s}, \frac{x}{h}$ ) for group M is 1.63 and that it is closest to the divine proportion 1.618 ... (the deviation is 0.7%). The mean value of the vertical ratios is 1.64, which deviates from the divine proportion by 1.4%. The deviation of the mean value of the mixed parameters (1.52) is 6%. The mean value of all parameters (vertical, horizontal and mixed) in group M is 1.60 (COV = 1.2%), which is only 2.9% of deviation from the divine proportion. In group F, the mean value of the vertical ratios is 1.54 (the deviation is 4.8%), the value of horizontal ratios is 1.65 (the deviation is 2%) and the value of mixed ratios is 1.52 (the deviation is 6%). The mean value of all parameters (vertical, horizontal and mixed) in group F is 1.57 (COV = 0.6%), which is a fantastic 3% deviation from the divine proportion. Analysing the obtained results by comparing group M (50 male respondents) and group F (50 female respondents), we can conclude that both male and female faces are built in divine proportion and the deviations are within limits.

The ratio of horizontal parameters, in both male and female groups, has the smallest deviations from the divine proportion (0.7% and 1.65%, respectively). The obtained results differ from the results obtained in the research of other authors<sup>XA</sup>, who obtained the largest deviations for horizontal parameters. Given that there is a difference in the races of people, we can conclude that the variation of the deviation related to the ratio of facial parameters from the divine proportion depends on the nation, the race. The ratio of mixed parameters in both groups (M and F) deviates 6% from the ideal divine proportion. The deviation of the mean value of all parameters (vertical, horizontal and mixed) from the divine proportion is 1% in group M, and 3% in group F.

For the purpose of obtaining clearer calculation results for one ratio ( $\frac{h}{u}$ ) in both groups, 50 respondents, we made a graphical representation (in two ways): Chart 1a (2-D column) presents the dependence of the indicated ratio in group M as well as Chart 1 b (radar presentation).

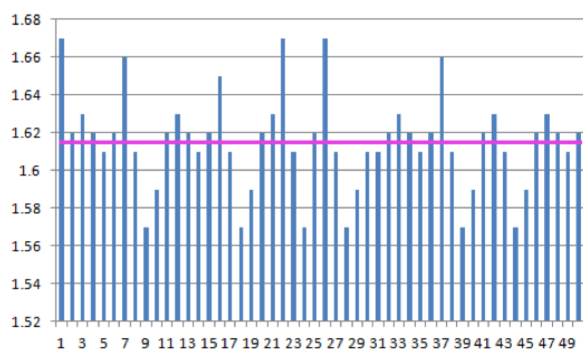


**Chart 1a** - One ratio of characteristic sizes in 50 students of group M

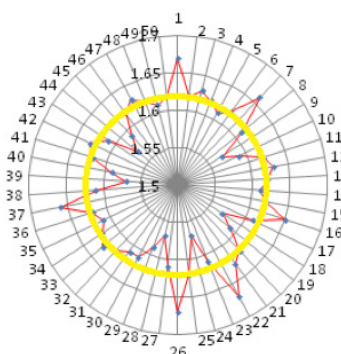


**Chart 1b** - Representation of one ratio of characteristic sizes in all 50 students of group M

Chart 2a and Chart 2b show the dependence of the indicated ratio in different views (2-D column and radar view) for group F.

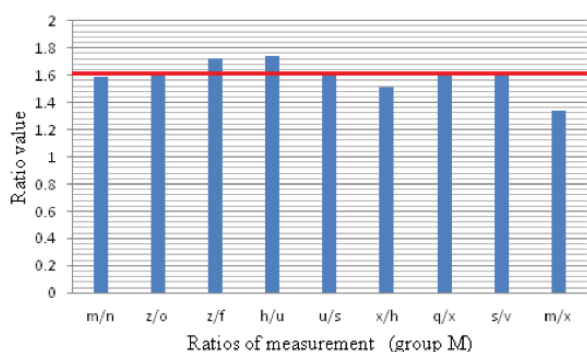


**Chart 2a** - One ratio of characteristic sizes in 50 students of group F

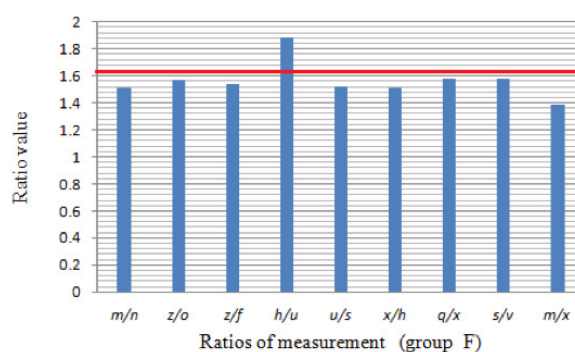


**Chart 2b** - Representation of one ratio of characteristic sizes in all 50 students of group F

Finally, we have graphically shown (Chart 3 and Chart 4) the mean values of all ratios (vertical, horizontal and combined) for group M and group F. By analysing these results, we can conclude that the human face is built in harmony and symmetry expressed by number  $\Phi$ , which confirms the results of numerous authors (in different parts of the world) [4,6,11,12,13]. Regarding the relationship of vertical, horizontal and mixed facial dimensions, our results differ somewhat from the results of other authors who conducted measurements on subjects in Japan, China and India [11,17,18].



**Chart 3** - Mean values of all calculated facial ratios in group M



**Chart 4** - Mean values of all calculated facial ratios in group F

## CONCLUSION

A large number of parameters that characterise the faces of the student population from the countries of Southeast Europe and Croatia are in a proportion that is very close to the divine proportion  $\Phi=1.618$ . Divine proportion is a universal characteristic of the human face structure and it is not possible to draw a conclusion about larger deviations in relation to gender. Deviations of vertical proportions in relation to horizontal and mixed proportions, and in relation to the ideal value of divine proportion, may be different in different races.

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**ATRAKTIVNOST I MJERA: PROCJENA ZLATNIH PROPORCIJA LICA STUDENTSKE POPULACIJE ZEMALJA JUGOISTOČNE EUROPE**

Ciljevi: Izmjeriti proporcije lica i odrediti odstupanje od božanske proporcije (zlatnog reza) te uspostaviti korelaciju sa atraktivnošću/ljepotom lica. Metode: Mjerenje karakterističnih dimenzija lica i određivanje odstupanja njihovih odnosa od zlatnog reza provedeno je na 100 studenata starosti 19-26 godina iz zemalja Jugoistočne Europe. Od 500 studenata odabrano je 100 studenata (50 muškog i 50 ženskog spola) koji su, po mišljenju Komisije, imali najprivlačnije, najljepše lice. Nakon mjerenja i obrade rezultata izvršeno je upoređivanje grupa i diskutovanje rezultata. Rezultati: Većina proporcija horizontalnih, vertikalnih i mješovitih (horizontalno-vertikalnih) karakteristika lica studentske populacije zemalja Jugoistočne Europe i Hrvatske je bliska božanskoj proporciji. Omjeri vertikalnih proporcija pokazuju nešto veća odstupanja. Primjene: Rezultati ovih istraživanja mogu poslužiti pri estetskom tretmanu, ortodontskim zahvatima ili estetskoj korekciji lica. Zaključci: Rezultati do kojih smo došli su slični rezultatima koji su dobijeni mjerenjima na zapadnoindijskom i japanskom stanovništvu, što ukazuje da je građa lica univerzalno svojstvo ljudi, bez obzira na rasu i spol. Naša istraživanja pokazuju da omjeri vertikalnih karakteristika lica nešto više odstupaju od zlatnog standarda, za razliku od drugih autora kod kojih su uočena najveća odstupanja kod omjera horizontalnih proporcija.

**Ključne riječi:** zlatni omjer, božanska proporcija, privlačnost/ljepota lica, studenti zapadno-balkanskih država

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# THE LEVEL OF FUNCTIONAL ABILITIES AND ISOMETRIC MUSCLE POTENTIAL IN WOMEN WITH REGARD TO THE TYPE OF RECREATIONAL EXERCISE

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## ABSTRACT

The research was performed with the aim of determining the differences in functional abilities and isometric muscle potential of female exercisers from three recreational groups (aerobics with Tae Bo elements, cardio boxing and step aerobics). The sample consisted of 45 female exercisers (15 in each group), 30 to 50 years of age, who have been in the process of recreational exercise for at least a year. The Harvard step test, a two-minute step in place test and arterial blood pressure were used to assess functional abilities. Isometric muscle potential was assessed using torso endurance tests: Trunk Flexor Endurance Test, Trunk Extensor Endurance Test - Biering-Sørensen Test and Trunk Lateral Endurance Test - the Side-Bridge Test (left and right side), as well as the Front Plank Test. In addition to descriptive parameters (Mean  $\pm$  SD), analysis of variance for independent samples and subsequent post hoc analysis were used to determine the differences between recreational groups. The results showed that a statistically significant difference was observed in functional abilities in the Harvard step test ( $p = 0.001$ ) and two-minute step in place test ( $p = 0.003$ ). With isometric muscle potential, statistical significance of differences can be observed in all tests (Trunk Flexor Endurance Test 0.017; Trunk Extensor Endurance Test 0.001; Trunk Lateral Endurance Test (left side 0.021; right side 0.011) and the Front Plank Test 0.023).

**Keywords:** aerobics with Tae Bo elements, cardio boxing, step aerobics, female exercisers

## INTRODUCTION

Recreational exercise has an important place in maintaining health and preventing disease (Ole Johan & Wisløff, 2010) because it raises the physical abilities of the body through various forms of movement (Nikić & Milenković, 2018). Due to the modern, sedentary lifestyle, movement is quite reduced and insufficient for normal needs of the human body, and the lack of even minimal physical activity can lead to health problems and serious diseases (Hupin et al., 2017). Research in the field of recreational exercise indicates that the effect of muscle training in recreational terms contributes to general health through the level of motor

abilities (Nikić & Milenković, 2014) and the body composition state (Nikić & Milenković, 2013). Increasing muscle mass significantly affects fat burning (Shenata & Mahmoud, 2018), reducing bone demineralisation (Silva et al., 2015; Watson et al., 2018) which is the cause of the onset and further development of osteoporosis. The development of muscular abilities strengthens the stability and body resistance, which contributes to a better quality of life and mobility until old age (Sharkey & Gaskill, 2008). Regular exercise has a positive effect on heart rate in healthy people (Kemi & Wisløff, 2010), and can also provide significant improvements in patients (Gielen et al., 2015; Grisé et al., 2016). Nowadays, there are different forms of recreational

exercise that are offered to potential male or female exercisers, depending on what results they want to achieve, in what health status they are in and at what age the person is. Aerobics is very popular in women (Ahmad & Rosli, 2015) with different variants of exercise, which is basically work on aerobic endurance through activities composed of simple cyclic contents (Cvetković, 2007). Aerobic exercise is a constant activity lasting at least 20 minutes with the heart rate that should be maintained between 70 and 85% of the maximum with the use of oxygen and body fat which are the main source of working energy (Kostić, 1999). Through the decomposition of glucose and free fatty acids in the presence of oxygen, the working energy has been provided. The aerobic capacity required for such an exercise is defined as the maximum capacity of oxygen uptake, transport and consumption (Sharkey & Gaskill, 2007). Likewise, Pilates should be mentioned in the group of popular ways of exercising (Şavkin & Aslan, 2016) which allows the development of the body as a whole system, as opposed to exercises that isolate muscle groups and encourage individual work on individual parts of the body (Siler, 2000). In any case, any form of recreational exercise, if properly conducted, can contribute to a better and healthier life. When it comes to this particular research, the goal was to determine the differences in functional abilities and isometric muscle potential of female exercisers in three recreational groups: aerobics with Tae Bo elements, cardio boxing and step aerobics.

## METHODS

A total of 45 female exercisers from three recreational groups (15 in each group: aerobics with Tae Bo elements, cardio boxing and step aerobics), 30 to 50 years of age, have participated in this research with the aim of determining the differences in the level of functional abilities and isometric muscle potential. Each female exerciser spent at least a year in the process of recreational exercise within its recreational group. All three programmes have been performed in the "NIA" aerobic studio in Niš with three training sessions per week, each lasting 60 minutes. Before testing was performed, the consent of all female exercisers was obtained for participation in the research, which was organised in accordance with the recommendations for clinical research given by the World Medical Association within the Declaration of Helsinki (2013).

### Functional abilities

The functional tests used in this research were taken from the site Topend Sports <http://www.topendsports.com/testing/tests/index.htm>, as well as from the research of Heimar & Medved, 1997. All tests are reliable and valid for assessing functional abilities: Harvard step test (Yuan, Fu, Zhang, Li, & Shan, 2008;

Cooney et al., 2013), 2-Minute Step in Place Test (Haas et al., 2017), Arterial blood pressure (Pérgola et al., 2007; Mas-Heredia et al., 2014).

1. Harvard step test
2. 2-Minute Step in Place Test
3. Arterial blood pressure

### Isometric muscle potential

Endurance tests of flexors, extensors and lateral torso muscles were performed according to the McGill protocol (McGill, Childs, & Liebenson, 1999). These tests are considered reliable and valid for assessing the isometric muscle potential of the trunk muscles (Evans, Refshauge, & Adams, 2007; Waldhelm & Li, 2012). The Front Plank Test was taken from the site Topend Sports <http://www.topendsports.com/testing/tests/index.htm>, and is reliable and valid for assessing isometric muscle potential (Boyer et al., 2013; Jernstedt, Saporito, Miller, & Coste, 2015).

1. Trunk Flexor Endurance Test
2. Trunk Extensor Endurance Test - Biering-Sørensen Test
3. Trunk Lateral Endurance Test - the Side-Bridge Test (both sides)
4. The Front Plank Test

### Testing organisation and statistics

Testing was performed at the premises of the "NIA" aerobic studio. The respondents were in adequate sports equipment. The instruments used for testing functional abilities were a 40-cm-high platform, a stopwatch, a "Beurer" pressure gauge and a Polar heart rate monitor. A Swedish box, board, stopwatch and mat were used for testing isometric muscle potential. The results were presented through the arithmetic mean (Mean  $\pm$  SD), while analysis of variance for independent samples and subsequent post hoc analysis (Fisher's LSD test) were used for the intergroup difference.

### Recreational exercise programmes

Aerobics with Tae Bo elements – The individual training lasted for 60 min, 3 times a week. The work took place with the music rate of 90-155 bpm. The training structure consists of 4 units: Introductory part – lasting from 5 to 10 minutes – consists of dynamic warm-up and stretching exercises that raise the heart rate and gradually prepare the body for a higher intensity of exercise in the main part. The music tempo varies depending on the phase of the training. In this part of the training, the tempo ranges between

120-134 bpm. The basic elements in this section are: Marching, Step Touch, Double Step Touch, Knee Up, Leg Curl, V-Step. At the end of this part, dynamic stretching of large muscle groups follows with the aim of increasing the efficiency of muscles in movement, increasing the ability of muscles to contract and reducing the possibility of muscle injury.

Main part (it consists of two parts):

The first part is dominated by a cardio exercise programme lasting 20-30 min, whose pace is 140-155 bpm. The cardio programme involves a combination of foot and hand kicks (Jab, Cross, Uppercut, Front Kick, Side Kick, Back Kick), with the performance of various squats, hops and jumps.

In the second part of the main part of the training, physical exercises are performed with the intention of strengthening and shaping the front, back and inner hamstrings of leg muscles, back and abdominal exercises. All exercises are performed on the floor at the heart rate of 115-125 bpm. The number of repetitions ranges from 16 to 20.

Final part - is characterised by static stretching exercises, lasting 5 min, whose pace is 50-90 bpm. The movements are performed slowly, without twitching and with proper breathing. Larger muscle groups are stretched, as well as those muscles that were especially engaged during training. The goal of these exercises is increasing flexibility, joint mobility and reducing the possibility of injuries as well as improving circulation.

Step aerobics – The structure of step aerobics classes is divided into introductory, main and final part:

The introductory part is characterised by the preparation of those muscle groups that will be engaged in the main part of the class, with the application of simpler exercises in the field of coordination and a small range of motion, with a moderate work pace, which is also preparing the body for more intense exercise. The tempo of the music is between 120-134 bpm.

The main part consists of an aerobic part and a part reserved for strength exercises. The tempo of the music in the aerobic part ranges from 122-140 bpm. More complex choreographies with basic steps, lifting steps, outbursts and touch steps are applied. In the main part of the aerobic part, the choreography whose record contains the number of musical blocks and phrases, movements of the legs and arms, the direction of movement and the position of the exercisers' body in relation to the direction of movement were practiced.

Afterwards, the aerobic part is followed by strengthening exercises on the ground with a pace of 115-125 bpm. In this part of the class, exercises are applied for those muscles that were not sufficiently engaged during the aerobic part of the class, such as exercises for strengthening the muscles of the arms and shoulder girdle, abdominal wall muscles, back muscles and gluteal region muscles. The goal of these exercises is to increase muscle endurance, repetitive strength and flexibility.

In the final phase, which is characterised by calming the body through stretching exercises for those muscle groups that were most engaged in the main part, music with a slower tempo of 50-90 bpm is used. Since the experimental programme lasted for three months, the number of repetitions increased every month and new, choreographically more complex steps were introduced. The intensification of the programme was realised in the aerobic part of the training and as part of body shaping exercises. As a component of the aerobic part, intensification was performed in terms of accelerating the tempo of the music, increasing the number of music blocks and the number of steps, as well as introducing more high-intensity steps, moving in multiple directions, increasing the share of hand movements. As a part of the exercises for strengthening the body, the number of sets and repetitions increased and physiologically more difficult exercises were introduced.

Cardio Boxing – The structure of this training model, which is inspired by martial arts, is divided into introductory, main and final part. Cardio boxing is a combination of boxing, martial arts and aerobics elements. The specificity of this programme lies in the use of punching bags, during which kicks and punches are performed, fitting them into simple choreographic blocks. It belongs to a group of high-intensity exercise that aims to increase cardiovascular fitness, strength, endurance, and muscle flexibility.

Trainings were conducted three times a week, each lasting 60 minutes. Each workout is accompanied by music at a tempo of 90 to 160 bpm.

Preparatory part aims to gradually raise body temperature and prepare large muscle groups for further straining. In this part, dynamic warm-up exercises are realised for 5-15 min, which include the muscle groups of the shoulders, arms, back, chest and legs. The tempo varies between 120-140 bpm. In the main part, a bag-punching exercise with the duration of 20-30 min is applied, whose tempo is 140-160 bpm. The basic movements are: Front Kick, Side Kick, Direct, Uppercut, Crotch, Squats, and Lunges (variations of steps forward, squats and jumps). In the second part of the main part, exercises, which are performed, are intended to increase the strength and endurance of the abdominal and back muscles. T

hey are performed on the floor individually or in pairs, with 20-30 repetitions. The final part of the training is designed for static stretching exercises to relax the muscles and increase flexibility. The muscle stretches to a certain limit in 15-60 sec. Greater muscle flexibility reduces the risk of joint, ligament, bone and muscle injuries.

## RESULTS

In Table 1, in addition to descriptive parameters (mean and standard deviation - SD), intergroup differences in functional abilities and isometric muscle potential of recreational groups practicing Tae Bo aerobics, step aerobics and cardio boxing can be seen.

Using the analysis of variance for independent samples, a statistically significant difference was found between recreational groups, both in functional abilities ( $p = 0.000$ ) and in isometric muscle potential ( $p = 0.000$ ).

The individual level of analysis of variance indicates that a statistically significant difference in functional abilities was observed in the Harvard step test (0.001) and 2-Minute Step in Place Test (0.003). Arterial blood pressure (systolic 0.516 and diastolic 0.474) did not affect or show a statistically significant difference between recreational groups. Concerning individual tests of isometric muscle potential, it can be seen that there is a smaller or larger, but still statistically significant difference in all tests.

**Table 1:** The level of functional abilities and isometric muscle potential of recreational groups and intergroup differences

Tests	Tae Bo aerobics	Step aerobics	Cardio boxing	ANOVA
Harvard step test	98.07 ( $\pm 1.39$ )	102.8 ( $\pm 2.4$ )	100.4 ( $\pm 2.16$ )	0.001*
2-Minute Step in Place Test	118.13 ( $\pm 6.32$ )	125.13 ( $\pm 5.51$ )	120.67 ( $\pm 3.48$ )	0.003*
Systolic arterial blood pressure	122.93 ( $\pm 3.49$ )	121.73 ( $\pm 2.6$ )	121.87 ( $\pm 3.16$ )	0.516
Diastolic arterial blood pressure	79.2 ( $\pm 2.31$ )	79.33 ( $\pm 1.59$ )	78.4 ( $\pm 2.69$ )	0.474
Trunk Flexor Endurance Test	101.93 ( $\pm 7.2$ )	98.47 ( $\pm 4.67$ )	104.87 ( $\pm 5.37$ )	0.017*
Trunk Extensor Endurance Test	149.4 ( $\pm 7.24$ )	143.53 ( $\pm 9.15$ )	154.0 ( $\pm 4.36$ )	0.001*
Trunk Lateral Endurance Test (left side)	51.87 ( $\pm 8.78$ )	46.33 ( $\pm 4.35$ )	52.33 (4.78)	0.021*
Trunk Lateral Endurance Test (right side)	57.6 ( $\pm 8.54$ )	54.4 ( $\pm 4.52$ )	61.13 ( $\pm 2.77$ )	0.011*
The Front Plank Test	98.73 ( $\pm 5.28$ )	95.2 ( $\pm 3.95$ )	99.13 ( $\pm 2.75$ )	0.023*

The data represent Mean ( $\pm$ SD)

MANOVA

\*Differences between groups are presented at the level of  $p < 0.05$

$F = 7.01$   $p = 0.000^*$  – functional abilities

$F = 4.67$   $p = 0.000^*$  – isometric muscle potential



**Table 2:** Post hoc analysis of functional abilities (Fisher's LSD test)

Harvard step test	{1} 98.07	{2} 102.80	{3} 100.40
1 - Tae Bo aerobics		0.000*	0.003*
2 - Step aerobics	0.000*		0.002*
3 - Cardio boxing	0.003*	0.002*	
2-Minute Step in Place Test	{1} 118.13	{2} 125.13	{3} 120.67
1 - Tae Bo aerobics		0.001*	0.193
2 - Step aerobics	0.001*		0.025*
3 - Cardio boxing	0.193	0.025*	

Post hoc analysis was used to determine in more detail the statistical significance of differences between recreational groups in order to precisely determine the groups between which there is a difference. The Fisher's LSD test for functional abilities (Table 2) was performed only for the tests which showed a statistically significant difference between recreational groups in the analysis of variance. In the Harvard step test, there is a statistical significance

of differences between all groups (Tae Bo aerobics - step aerobics 0.000; Tae Bo aerobics - cardio boxing 0.003; cardio boxing - step aerobics 0.002). In the 2-Minute Step in Place Test, there was a statistical significance of differences between the groups that practiced Tae Bo aerobics and step aerobics (0.001) as well as step aerobics and cardio boxing (0.025). There was no statistically significant difference between the groups that practiced Tae Bo aerobics and cardio boxing.

**Table 3:** Post hoc analysis of isometric muscle potential (Fisher's LSD test)

Trunk Flexor Endurance Test	{1} 101.93	{2} 98.47	{3} 104.87
1 - Tae Bo aerobics		0.112	0.177
2 - Step aerobics	0.112		0.005*
3 - Cardio boxing	0.177	0.005*	
Trunk Extensor Endurance Test	{1} 149.4	{2} 143.53	{3} 154.0
1 - Tae Bo aerobics		0.031*	0.037*
2 - Step aerobics	0.031*		0.000*
3 - Cardio boxing	0.037*	0.000*	
Trunk Lateral Endurance Test (left side)	{1} 51.87	{2} 46.33	{3} 52.33

1 - Tae Bo aerobics		0.021*	0.840
2 - Step aerobics	0.021*		0.012*
3 - Cardio boxing	0.840	0.012*	
Trunk Lateral Endurance Test (right side)	{1} 57.6	{2} 54.4	{3} 61.13
1 - Tae Bo aerobics		0.139	0.103
2 - Step aerobics	0.139		0.003*
3 - Cardio boxing	0.103	0.003*	
The Front Plank Test	{1} 98.73	{2} 95.2	{3} 99.13
1 - Tae Bo aerobics		0.024*	0.792
2 - Step aerobics	0.024*		0.012*
3 - Cardio boxing	0.792	0.012*	

The Fisher' LSD test of isometric muscle potential (Table 3) was done for all tests. In the case of Trunk Flexor Endurance Test, there is a statistical significance of differences only between the groups that practiced step aerobics and cardio boxing (0.005), which is also the case with the Trunk Lateral Endurance Test (right side) (0.003).

Trunk Extensor Endurance Test indicates the statistical significance of the differences between all recreational groups (Tae Bo aerobics - step aerobics 0.031; Tae Bo aerobics - cardio boxing 0.037; cardio boxing - step aerobics 0.000).

In the Trunk Lateral Endurance Test (left side), the statistical significance of differences between the groups that practiced Tae Bo aerobics and step aerobics (0.021) as well as cardio boxing and step aerobics (0.012) can be seen. Differences between the same groups also exist in The Front Plank Test (Tae Bo aerobics - step aerobics 0.024; cardio boxing - step aerobics 0.012). In both tests, there is no statistical significance of differences between the groups that practiced Tae Bo aerobics and cardio boxing (0.840 and 0.792)

## DISCUSSION AND CONCLUSION

Regardless of the similar character for certain types of exercise, the results that can be obtained by researching their effect on the body indicate greater or lesser differences, which is expressed in this paper. This study examined the differences in functional abilities and isometric muscle potential resulting from three types of recreational exercise: Tae Bo aerobics, step aerobics and cardio boxing. The obtained results partially showed significant differences in functional abilities (Harvard step test -  $p < 0.001$  and 2-Minute Step in Place Test -  $p < 0.003$ ). The differences in the mentioned two tests appeared as a consequence of the type of movement in the three recreational activities. On the other hand, the values of arterial blood pressure were at a very similar level in all three groups. In this paper, three aerobic recreational programmes were compared; therefore, there were no significant differences between the groups due to the fact that a positive effect on arterial blood pressure is expected in all aerobic activities.

This is confirmed by research showing that aerobic exercise is an effective way to reduce blood pressure as it reduces the risk of cardiovascular disease that is otherwise a consequence of high blood pressure (Swift et al., 2012, Hong, Lee, & Lee, 2018; Leal et al., 2019; Çetin et al., 2019). It is also considered that moderate-intensity exercise for 30 minutes reduces the possibility of cardiovascular disease in women because physical activity slows down the appearance of this type of disease not only with a positive effect in the struggle against obesity, but also on insulin sensitivity, type 2 diabetes, blood pressure, inflammatory processes, etc. (Bassuk & Manson, 2010).

The results of this study in the field of isometric muscle potential indicate the existence of a significant difference between recreational groups ( $p < 0.000$ ). The best results were achieved by female exercisers who practiced cardio boxing, and the worst were present in the group where step aerobics was practiced. However, further post hoc analysis shows a constant difference between the group that practiced step aerobics and the other two groups (Tae Bo and cardio boxing). On the other hand, there were differences between the Tae Bo group and cardio boxing in only one test (Trunk Extensor Endurance Test  $p < 0.037$ ). The similarity of the results for these two groups in the isometric muscle potential is reflected in the similar elements used during exercise - punches and kicks. Step aerobics also increases muscle endurance and strength (Hallage et al., 2010). However, the martial elements (punches and kicks) in cardio boxing and Tae Bo influenced the existence of a higher level of the two mentioned motor abilities, especially in the arm, shoulder and abdominal muscles, which contributed to better results in tests assessing isometric muscle potential, unlike the step aerobics group. A positive impact of recreational exercises with martial elements on muscle strength was also noted by Nikić and Milenković (2014) who found a significant increase in the strength of upper and lower limbs in women who practiced Tae Bo for 12 weeks. Besides, Mustedanagić, Jorgić and

Cicović (2014) indicate that Tae Bo training in women has achieved positive effects in terms of improving certain fitness abilities, primarily the endurance of the extensor muscles of the arms, legs and torso. It is certainly necessary to mention certain limitations of this research. The physical activities that the female exercisers have during the day while performing regular jobs, within leisure activities, and not at the time designated for organised physical exercise, which was researched in this paper, were not taken into account. Furthermore, in this type of research, the number of respondents can always be higher and give much more precise effects. The fact that this was a quasi-experimental study, because the groups were not formed by random selection, but the respondents were the target population, can also be considered a type of disadvantage.

The aim of this study was to determine the differences in functional abilities and isometric muscle potential of female exercisers in three recreational groups: aerobics with Tae Bo elements, cardio boxing and step aerobics. The initial assumption was that there would be a difference between the two research areas among the recreational groups of female exercisers. The obtained results showed statistically significant differences observing both areas in general (functional abilities  $p < 0.000$ ; isometric muscle potential  $p < 0.000$ ). However, individually, arterial blood pressure did not yield the differences expected by the initial hypothesis. It has already been mentioned that all three forms of recreational activities are of the aerobic type and that, as a consequence of exercise, a positive effect on arterial blood pressure is expected in all aerobic activities. In the isometric muscle potential, two recreational groups with martial elements showed better results compared to the step aerobics group.

Such and similar research can contribute to better understanding of the positive effects of regular recreational physical exercise. Regular and proper physical activity is important for improving the health of all social categories and combating a sedentary lifestyle.

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**NIVO FUNKCIONALNIH SPOSOBNOSTI I IZOMETRIJSKOG MIŠIĆNOG POTENCIJALA KOD ŽENA U ODNOSU NA VRSTU REKREATIVNOG VEŽBANJA**

Istraživanje je izvršeno sa ciljem utvrđivanja razlika u funkcionalnim sposobnostima i izometrijskom mišićnom potencijalu vježbačica tri rekreativne grupe (aerobik sa Tae Bo elementima, kardio boks i step aerobik). Uzorak se sastojao od 45 vježbačica (po 15 u svakoj grupi), starosti od 30 do 50 godina, koje su u procesu rekreativnog vježbanja najmanje godinu dana. Za procjenu funkcionalnih sposobnosti korišten je Harvardski step test, dvominutni test koračanja u mjestu i arterijski krvni pritisak. Izometrijski mišićni potencijal procijenjen je testovima izdržljivosti trupa: izdržljivost fleksora, ekstenzora i bočnih mišića trupa (lijeva i desna strana), kao i izdržaj na podlakticama. Osim deskriptivnih parametara (aritmetička sredina  $\pm$  standardna devijacija), za utvrđivanje razlika između rekreativnih grupa primijenjena je analiza varijanse za nezavisne uzorke i naknadna post hoc analiza. Rezultati su pokazali da je u funkcionalnim sposobnostima uočena statistički značajna razlika kod Harvardskog step testa ( $p = 0,001$ ) i dvominutnog koračanja u mjestu ( $p = 0,003$ ). Kod izometrijskog mišićnog potencijala može se uočiti statistička značajnost razlika kod svih testova (izdržljivost fleksora trupa 0,017; izdržljivost ekstenzora trupa 0,001; izdržljivost bočnih mišića trupa (lijeva strana 0,021; desna strana 0,011) i izdržaj na podlakticama 0,023).

**Ključne riječi:** aerobik sa Tae Bo elementima, kardio boks, step aerobik

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