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GENDER DIFFERENCES IN QUALITY OF LIFE AND EXERCISE MOTIVATION OF ADOLESCENTS OF AVERAGE AND INCREASED BODY MASS[1]

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Abstract: The main aim of this transversal study was to examine the relevant differences between the constructs of quality of life and exercise motivation among male and female adolescents of average and increased body mass. The sample included high school students from Valjevo (N = 337). The average age of the participants was M = 16.53 years (SD = .38). Two measuring instruments were used: The Exercise Motivations Inventory-2 (EMI-2) and The Kidscreen Questionnaire -27 (TKQ). The results of the Cronbach's alpha suggested that the questionnaires used in the research have satisfactory level of reliability and internal consistency, and are valid for assessing adolescent population in Serbia.

The research has shown that there are internal and external motives for adolescents' exercise motivation, and that the male adolescents more favourably perceive the quality of life. Statistically significant gender differences were found, there was higher level of the evaluation of the TKQ construct among male adolescents than female adolescents which is the consequence of a more substantial view of physical well-being, pleasant feelings and moods, good family and social environment, as well as the ability to organize and arrange free time. It was also found that participants with average body mass prefer the perception of own physical activity and health more than their peers with increased body mass. Male adolescents do physical exercise for enjoyment, challenge, competition, strength and endurance, as well as for social reasons (factors such as belonging to a group, pressure, and acceptance), whereas female participants are more willing to exercise in order to control their body mass. The results of the Mann–Whitney U test revealed relevant gender differences: adolescents with average body mass are more likely to exercise because they enjoy the activity, while adolescents with increased body mass are more stimulated by the possibility of body mass regulation ($p \leq .01$).

This research discussed practical implications of the results on creating the motivation for exercise and quality of life among adolescents of both sexes with normal and increased body mass (BM).

Keywords: *motives, adolescence, body mass index, physical exercise, mood and emotions*

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INTRODUCTION

Gender differences in the quality of life and exercise motivation among adolescents of average and increased body mass have been the research subject of many authors (Bull et al., 2020; Cilar Budler et al., 2022; Guthold et al., 2020). Some of the authors (Lee et al., 2018) have noted that the quality of life is complex and includes various lifestyles and individual actions. In their study Poulain et al. (2019) view the quality of life as overall happiness which involves real factors, personal valorisation of physical, material, social and affective possibilities, where individual development and overall behaviour are dominant in one's personal system of values. According to a research conducted by Ihm (2018), determining the quality of life is influenced by various factors, starting from satisfying biological needs, to characteristic social, spiritual, cultural, and historical situations. Certain authors (Grant et al., 2018) claim that personal perception of satisfaction with life dominates this term, which is defined as the overlap between real life and what one expects. This research also identifies the quality of life as a link between adolescents and their competence to plan to achieve certain goals, while other authors (Twenge et al., 2018) isolate free time as a significant determinant in recognizing personal lifestyle. In the study of Fischer-Grote et al. (2019) family life and peer relationship are regarded as significant predictors of the quality of life, which is presented as a multidimensional experience caused by reality and a person's values.

Searching for the causes of the high level of personal happiness, authors examined various latent dimensions such as the level of nutritional status and physical activity in adolescence. The authors of another study (Van Sluijs et al., 2020) noted that physical activity involves any body movement that includes activating skeletal muscles and spending energy. Lowry et al. (2021) claim that physical activity is a necessary element for realizing the most advantageous functioning of the body, especially proper body growth and development, and improvement of psychophysical health. Physical exercise is a significant way of training aimed at preserving and improving body shape, as noted in another study (Marotta et al., 2022). The aforementioned authors believe that moderate daily exercise has positive influence on physical, mental and social well-being of an individual. Generally speaking, if professionally organized, physical exercise can motivate adolescents to create and adopt healthy habits (Palenzuela-Luis et al., 2022). According to another study (Arruda et al., 2022), regular training during adolescence correlates to the decrease of negative health conditions and illnesses, meaning that it minimizes the danger of negative changes in the skeletal system such as osteoporosis later in life. In addition, physical exercise is in relevant interaction with the decrease of body mass and risk of coronary disease, and the improvement of spiritual health, and consequently the increase of self-respect and self-confidence (Huffman et al., 2018). In their study, Asam et al. (2019) note that physical exercise represents a successful strategy for dealing with stress, especially depression and anxiety. The same authors claim that the effects of physical exercise lead to better social communication and acceptance of personal skills. The findings of other empirical studies that deal with these phenomena are not consistent, and the authors point out that they should be analysed by integrating all the factors of the process of socialization (Khamidovna & Khudayberganov, 2022). These authors also found that when compared to the physically non-active young population, athletes manifest more developed communication skills, social skills, and a tendency to be team players because physical exercise can affect their physical constitution and social position among peers. However, Romanova et al. (2022) claim that the contemporary phenomenon of hypokinesis is more and more dominant as a generator of health problems. These results indicate that the lack of physical exercise is linked to the growing dangers of increased body mass index (BMI) and peer violence, which has a particularly negative influence on psychosocial difficulties among adolescents. However, despite the well-known scientific effects that exercising has on psychophysical and social health, the fact remains that the intensity of exercise is visibly low in modern society, especially among female adolescents which is reflected in increased body mass (Ivanović & Ivanović, 2012; Ivanović & Ivanović, 2018; Ivanović, & Ivanović, 2021; Pope & Harvey, 2015).

Motivation is a mental process which encourages a person to engage in physical activity (PA), to determine the orientation and coordinate the intensity and length of the activity (Thomas & Azmitia, 2019). The aforementioned authors believe that if we are to motivate people to exercise, it would be important to identify the mental and physiological factors which encourage them to be physically active. Seeing how the increased body mass (BMI) is a growing occurrence, obesity has become a serious health condition which is particularly significant during the sensitive and formative period of adolescence where lack of physical activity and increased BMI are dangerous, and

therefore researching this subject matter has become a necessity (Ivanović et al., 2014; Ivanović & Ivanović, 2016). In addition, the lack of physical exercise and the increase in body mass lower the quality of life and can lead to premature death, so it is important to develop effective prevention programs and actions that can directly change the existing condition. Identifying the motivation and motives for exercising of an individual of a certain age, as well as their characteristics can influence more efficient planning. In order to understand better the needs and actions of adolescents and gain better insight into the way they experience happiness, it is necessary to identify the factors which define or influence it.

The main motive for the focus of our research on this complex problem is the fact that such studies so far have not been conducted on the Serbian adolescent population, so the main aim of this research was to examine the quality of life and exercise motivation, and the difference in assessing the aforementioned constructs among adolescents depending on gender and BMI. It is very significant to explore this phenomenon as it can have significant methodological and theoretical implications for both further research and practice.

In accordance with the results of earlier empirical studies, theoretical predictions and the aim of this research, and with the application of adequate statistical tools, the following hypotheses were formulated: H_1 – male participants are expected to score their quality of life, meaning the variables of physical well-being, mood, and feelings higher than female participants; H_2 – the assumption is that the variables of physical well-being and health have statistically significantly lower values in male participants with increased body mass than in their peers with average body mass; H_3 – adolescents with normal body mass and those with increased body mass generally evaluate the quality of life identically; H_4 – it is believed that internal (enjoyment, challenge, competition, strength, and endurance) and external motives (belonging to a group) stimulate male participant to exercise, while female participants are motivated more by the control of their body mass.

METHOD

Participants and procedure

This transversal research was conducted on a pertinent sample (N = 337) consisting of students from a secondary economy school and a technical vocational school in Valjevo, including: 222 male adolescents (51%) and 115 female adolescents (49%). The average age of the participants was 16.53 (SD = .38).

Before filling in the questionnaires, the students were given detailed instructions, and the aim of the research was explained to them, without explaining the purpose of each measuring instruments (in order to prevent desirable responding). The instructions were printed out on the test as well. The students were asked not to think too much about answers and in case of doubt choose an answer they favour more, and that there would be no consequences for quitting at any time. The research lasted for 45 minutes and was conducted by the authors of this study and the school psychologists. The research was anonymous and voluntary, and was conducted with the permission of school principals and students' parents.

The process of filling in the questionnaires and taking the anthropometric measurements (body mass and height) was organized in groups during the physical exercise classes. The anthropometric measurements were taken and that lasted approximately 30 minutes. Then, the participants were given the questionnaires: a) The Exercise Motivations Inventory-2, and b) The Kidscreen Questionnaire -27. That took approximately 30 minutes. The empirical research was conducted in October 2022.

The Exercise Motivations Inventory – EMI-2 (Vlašić et al., 2002)

The EMI-2 includes 54 items and it is created in a way that participants answer the question why an individual exercises or should exercise, and it includes 14 potential exercise motives: belonging to a group (for example, "To spend time with friends"), physical appearance (for example, "To have good figure"), challenge (for example, "So that I could develop skills"), competition (for example, "Because I like to compete"), enjoyment (for example, "Because I enjoy making effort"), disease prevention (for example, "In order to avoid getting sick"), agility (for example, "In order to get more agile"), health (for example, "Because I want to stay healthy"), refreshment (for example, "I find exercising refreshing"), social acceptance (for example, "In order to prove myself in front of others"), social pressure (for example, "Because others talk me into doing it"), strength/endurance (for example, "To increase

my strength/endurance"), stress management (for example, "Because exercising helps me cope with stress"), and control over body mass (for example, "In order to lose weight").

The total score shows the importance individual motives have in the decision to engage in physical activity and it is determined as a mean value of answers on specific subscales. The answers to the items are marked on a five point Likert-type scale (from 1 – *"very untrue for me"* to 5 – *"very true for me"*). The participants are offered multiple answers that belong to specific motives, and they have to answer how true a certain item is for them.

The reliability of internal consistency (Cronbach's Alpha) of the dimensions of the EMI-2 in this research is: belonging to a group (α = .79), physical appearance (α = .90), challenge (α = .92), competition (α = .90), enjoyment (α = .78), disease prevention (α = .79), agility (α = .86), health (α = .92), refreshment (α = .80), social acceptance (α = .85), social pressure (α = .91), strength and endurance (α = .79), stress management (α = .94), and body mass control (α = .77), which indicates that the metric characteristics of the questionnaire are satisfactory (Tabachnick & Fidell, 2013).

The Kidscreen Questionnaire -27 – TKQ (The Kidscreen Questionnaire -27; The Kidscreen Group Europe, 2006)

The TKQ examines the construct of the quality of life through the elements of physical, emotional, social, and behavioural well-being. The questionnaire contains 27 claims which measure six dimensions of the quality of life: fun and relationship with friends (for example, "Could you rely on your friends?"), school and learning (for example, "Were you doing well in school?"), physical activity and health (for example, "Were you physically active?"), mood and emotions (for example, "Were you feeling lonely?"), family and spare time (for example, "Were your parents fair to you?"), and financial resources (for example, "Did you have enough money for your own expenses?"). The participants needed to determine their level of agreement with a specific item on a five point Likert-type scale (1 – "*not at all*" to 5 – "*strongly agree*"). Negatively expressed items indicate that a higher score on a specific dimension means higher degree of the quality of life. The reliability of the coefficient of the internal consistency of each dimension of the questionnaire is satisfactory, and the value of Cronbach's alpha reliability coefficient for specific scales for our sample is: friends (α = .90), school and learning (α = .76), physical activity and health (α = .82), mood and emotions (α = 0,80), family and spare time (α = .78), and financial resources (α = .78).

Body Mass Index – BMI (Lohman et al., 1988)

The height-weight indicator of nutrition - BMI shows whether the body mass in relation to the body height of the subject is average, more or less below/above the average. It is calculated in accordance with the international classification for children and adolescents based on the measured morphological variables: body weight in kilograms and body height in meters (Weber et al., 2013). In that way the numerical value is compared to the values presented in the table classified by age and gender in order to obtain the converted value which is in accordance with the border values of our sample, so each participant is classified by the guidelines of Italian authors (Cacciari et al., 2006) into one of the four following categories: underweight (BMI ≥ 18.5 kg/m²), normal weight (BMI = 18.5–24,99 kg/m²), overweight (BMI ≥ 25 kg/m²), and obesity (BMI ≥ 30 kg/m²). Anthropometric measurements were conducted in accordance with the International Biological Programme.

Statistical analysis

The obtained data was first processed using the method of descriptive statistics, and then the Kolmogorov–Smirnov test was used for the examination of deviations from the obtained data distribution, and the Mann–Whitney U nonparametric test was used for testing the statistically significant differences between the two groups of data. The IBM SPSS 22.00 software (IBM Corporation, New York, USA) was used for processing the quantitative data.

RESULTS

The statistical parameters of the participants' assessments of the examined dimensions of The Kidscreen Questionnaire are presented in Table 1.

Table 1. *Result distribution for TKQ questionnaire variables*

Variables	*M*	*SD*	*C*	*Sk*	*Ku*	*K-S*
Friends	3.95	.82	4.08	5.52 (.18)	2.40 (.28)	1.39*
School and learning	3.47	.80	3.27	4.93(.15)	2.37(.26)	1.58*
Physical activity and health	3.66	.69	3.55	9.07(.16)	7.33(.31)	2.05**
Family and spare time	3.84	.76	3.78	7.38(.16)	2.94 (.31)	2.59**
Mood and emotions	3.89	.72	4.48	8.40 (.16)	4.53(.31)	2.44**
Financial resources	3.99	.88	4.60	10.30 (.16)	7-86 (.31)	3.29**

Legend. *M* = Arithmetic mean; *SD* = Standard deviation; *C* = median, measure of central tendency; *Sk* = skewness, with standard error for skewness; *Ku* = kurtosis, with standard error for kurtosis; *K-S* = Kolmogorov–Smirnov test; * $p \leq .05$, ** $p \leq .01$ ($N = 337$)

Having an insight into the matrix, one can see that participants perceive the quality of life on a generally high level. Maximum evaluations can be seen on the financial resources ($M = 3.99$, $SD = .88$), and friends ($M = 3.47$, $SD = .80$) variables. The values of the Kolmogorov–Smirnov test of normal distribution and standardized coefficients of skewness and kurtosis show that the applied variables do not have normal distribution, because the values ranged between -2 and +2 (Gravetter & Wallnau, 2014; Kim, 2013). Therefore, the nonparametric method of the inferential statistics of the Mann–Whitney U test was used to test the differences between the two independent samples.

Table 2 shows the descriptive parameters of the examined variables of the EMI-2 questionnaire.

Table 2. *Result distribution for EMI-2 questionnaire variables*

Variables	*M*	*SD*	*C*	*Sk*	*Ku*	*K-S*
Belonging to a group	3.05	1.28	3.00	7.16 (.15)	2.40 (.28)	2.46*
Physical appearance	3.79	1.17	3.92	5.943(.16)	4.55(.26)	2.58*
Challenge	3.65	1.30	3.82	9.07(.16)	7.33(.31)	2.05**
Competition	2.68	1.62	2.80	7.38(.16)	2.94 (.31)	2.59**
Enjoyment while exercising	3.35	1.25	3.18	8.40 (.18)	4.53(.31)	2.44**
Disease prevention	2.96	1.37	3.28	10.30 (.16)	7-86 (.31)	3.29**
Agility	3.63	1.30	3.71	3.35 (.27)	9.85(.31)	2.56**
Health	3,90	1.19	3.94	2.84 (.15)	3.78(.31)	2.67**
Refreshment	3.59	1.17	3.70	4.81(.16)	6.64(.31)	3.75**
Social acceptance	2.28	1.42	2.47	6.78(.15)	5.64(.31)	2.97**
Social pressure	1.03	1.27	.48	5.53(.16)	3.76(.31)	4.16**
Strength and endurance	3.93	1.09	4.30	3.68(.15)	8.95(.31)	2.65**
Stress management	3.23	1.40	3.30	2.84(.16)	7.68(.31)	2.95**
Body mass control	3.42	1.37	3.48	8.56(.16)	5.64(.31)	3.45**

Legend. *M* = Arithmetic mean; *SD* = Standard deviation; *C* = median, measure of central tendency; *Sk* = skewness, with standard error for skewness; *Ku* = kurtosis, with standard error for kurtosis; *K-S* = Kolmogorov–Smirnov test; * $p \leq .05$, ** $p \leq .01$ ($N = 337$)

The main descriptive parameters of the exercise motivation construct are in most cases distributed just above the mean value of the theoretical range, which means that the exercise motivation is average. The findings show that

adolescents consider social pressure, social acceptance, and competition to be the least important motives for exercising. They consider the most important motives to be health, strength and endurance, and physical appearance. The participants' answers reveal much about how they see the connection between physical exercise and improving and preserving their physical well-being. On the other hand, the distortion of the normality of answers on certain variables (the values of the Kolmogorov–Smirnov test of normal distribution and standardized skewness and kurtosis) allowed the use of nonparametric methods (LaMorte, 2017).

The findings obtained from the *Mann–Whitney U test*, with 1% risk, are shown in Table 3 and reveal the significant differences between the self-assessments of the quality of life construct based on gender, where compared to female adolescents, male adolescents have higher values on the numerical variables, the dimensions school and learning, physical activity and health, family and spare time, and mood and emotions.

Table 3. *Differences between male and female participants on TKQ questionnaire dimensions*

	Male adolescents (H = 222)			Female adolescents (N = 115)					
Variables	*M*	*SD*	*C*	*M*	*SD*	*C*	*U*	*Z*	*p*
Friends	4.09	.68	4.23	4.09	.66	4.23	42742.46	-.70	.45
School and learning	3.52	.80	70	3,26	.77	3.50	3962.60	-4.25	.01**
Physical activity and health	3.76	.70	3.70	3.62	.65	3.50	4961.30	-5.56	01**
Family and spare time	3,87	.93	3.92	3,59	.91	3.63	5675.00	-4.28	01**
Mood and emotions	3.99	.59	4,25	3,76	0,74	.66	4.859.30	-8.05	01**
Financial resources	4.18	.89	4.56	4.14	.87	4.20	6592.03	2.92	.98

Legend. *M* = Arithmetic mean; *SD* = Standard deviation; *C* = median; *U* – value of Mann–Whitney U test for independent samples; *z* – Standard value of u; **p* – Probability of statistically significant difference (***p* ≤ .01)

The Mann–Whitney U test for nonparametric data and z – standard values were used to calculate the statistically significant differences in the perceived construct of the quality of life depending on the body mass index (Table 4).

Table 4. *Descriptive parameters of difference between male and female participants on BMI variable*

	ABM			EBM					
Variables	*M*	*SD*	*C*	*M*	*SD*	*C*	*U*	*Z*	*p*
Friends	3.96	.68	4.19	3.95	.90	4.19	5811.00	-.105	.88
School and learning	3.29	0.80	3.35	3.28	.70	3.35	4729.20	-3.352	.67
Physical activity and health	3.59	0.67	3.55	3.40	.72	3.47	2591.44	-8.906	01**
Family and spare time	3.80	.77	3.78	3,76	.80	3.78	3670.03	-4.473	.45
Mood and emotions	3.99	.68	4,00	3.99	.57	3.99	7516.45	-6.128	.34
Financial resources	4.20	.80	4.49	4.26	,79	4.49	7282.00	-1.155	.43

Legend. ABM – average body mass; EBM – extra body mass; *M* – Arithmetic mean; *SD* – Standard deviation; *C* – median; *U* – value of Mann–Whitney U test for independent samples; *z* – Standard value (deviation of some results from the arithmetic mean presented as standard deviation); ** *p* – Probability of statistically significant difference (*p* ≤ .01)

Having an insight into the matrix, one can see that when compared to the participants of average BMI, the participants with increased BMI manifest significantly lower level of satisfaction on the variables physical activity and health.

The *Mann–Whitney U* nonparametric test was used to compare the results between male and female adolescents on the EMI-2 questionnaire variables (Table 5).

Table 5. *Descriptive parameters of differences between male and female adolescents on EMI-2 questionnaire subscales*

	Average body mass			Excessive body mass					
Variables	*M*	*SD*	*C*	*M*	*SD*	*C*	*U*	*z*	*p*
Belonging to a group	2.95	1.28	3.18	2.80	1.29	2.95	4874.25	-2.962	.01**
Physical appearance	3,68	1.27	3.96	4.05	1.07	4.30	5895.03	-1.837	.43
Challenge	3.68	1.30	4.01	3.39	1.18	3.44	7641.05	-2.860	01**
Competition	3.22	1.53	3.48	2.25	1.50	1.96	6085.40	-7.829	01**
Enjoyment while exercising	3.38	1.27	3,80	1.33	1.30	3.35	6784.06	-3.014	01**
Disease prevention	2.97	1.50	2.96	3.08	1.29	3.28	7942.00	-.655	.72
Agility	3.49	1.28	3.70	3.59	1.18	3.70	5692.03	-.254	.68
Health	4.00	1.21	4.28	3.99	1.19	4.30	4824.08	-.742	.57
Refreshment	3.59	1.19	3.70	3.60	1.21	3.68	8027.90	-.436	.46
Social acceptance	2.68	1.38	2.70	2.57	1.40	2.69	6078.12	-.560	01**
Social pressure	1.12	1.14	.78	1.05	1.20	.80	7902.94	-.382	01**
Strength and endurance	4.19	1.10	4.80	4.09	1.08	4.78	6092.44	-.620	01**
Stress management	3.19	1.40	3.19	3.15	1.38	3.20	5028.06	-.708	.77
Body mass control	2.98	1.38	3.18	3.05	1.42	3.20	4053.24	-.298	01**

Legend. *M* = Arithmetic mean; *SD* = Standard deviation; *C* = median; *U* – the value of the Mann–Whitney U test for testing the difference in the results of two independent groups of data; *z* – standard value (deviation of some result from the arithmetic mean presented as standard deviation); **p* – Probability of statistically significant difference (***p* ≤ .01)

The findings obtained using the *Mann–Whitney U* nonparametric and z – standard values show, with a 1% error, statistically significant differences on the EMI-2 questionnaire between male and female adolescents, in case of the following variables: belonging to a group, challenge, competition, enjoyment, social acceptance, social pressure, strength and endurance, and control over body mass. The variables belonging to a group, social acceptance, and social pressure are more important exercise motives to male than to female adolescents. In addition, male participants exercise more for the reason of enjoyment than female participants do. Males are also more motivated by the subscales challenge, competition, strength and endurance while engaging in physical activity. So, all the aforementioned motives are more important to male than female adolescents, except the body mass control variable, which is a bigger factor of motivation for female adolescents.

Table 6 shows the EMI-2 questionnaire results of the difference between the adolescents of both sexes depending on the body mass index.

Table 6. *Descriptive parameters of differences between adolescents on EMI-2 questionnaire subscales depending on BMI*

	Average body mass			Excessive body mass					
Variables	*M*	*SD*	*C*	*M*	*SD*	*C*	*U*	*z*	*p*
Belonging to a group	3.10	1.29	3.22	2.79	1.08	4.19	4803.25	-2.958	.45**
Physical appearance	3.70	1.30	3.98	3.77	1.07	4.30	5903.12	-1.765	.25
Challenge	3.70	1.28	3.99	3.60	1.20	3.48	5691.23	-2.900	.74
Competition	3.23	1.50	3.48	3.18	1.53	2.01	5643. 09	-8.263	.58
Enjoyment while exercising	3.40	1.28	3.78	3.36	1.30	3.35	6904.17	-5.836	01**
Disease prevention	3.00	1.47	2.98	3.10	1.30	3.30	7075.26	-.698	.65
Agility	3.56	1.30	3.68	3.60	1.23	3.69	6541.93	-.364	.46

Health	4.01	1.20	4.28	4.00	1.12	4.29	5162.00	-.560	.34
Refreshment	3.59	1.19	3.70	3.60	1.20	3.98	4732.84	-.452	.56
Social acceptance	2.68	1.38	2.80	2.59	1.40	4.00	7096.42	-.290	.86
Social pressure	1.13	1.14	.79	1.98	1.20	2.00	3641.08	-.905	.70
Strength and endurance	4.19	1.99	4.80	3.95	2.03	1.98	6852.06	-.628	.29
Stress management	3.19	1.40	3.19	3.15	1.38	3.20	5294.05	-.785	.65
Body mass control	2.98	1.39	3.18	3.10	1.42	3.20	5093.76	-.543	01**

Legend. *M* = Arithmetic mean; *SD* = Standard deviation; *C* = median; *U* – the value of the Mann–Whitney U test for testing the difference in the results of two independent groups of data; *z* – Standard value (deviation of some results from the arithmetic mean presented as standard deviation); **p* – Probability of statistically significant difference (***p* ≤ .01)

The obtained findings indicate that there are statistically significant differences on the EMI-2 depending on BMI, on the variables enjoyment and body mass control. The values of the descriptive parameters indicate that participants with average body mass are more motivated by the internal motive of enjoyment then the participants with increased body mass, while the participants with increased body mass are more motivated by the external motive of body mass control than the participants with average body mass.

DISCUSSION

Seeing how the research so far conducted on the western cultures gave inconsistent results, the aim of this empirical cross-sectional study was to examine the quality of life and exercise motivation, as well as the differences in the assessment of these constructs among male and female adolescents depending on the body mass index. The obtained results show that there are statistically significant differences between the self-assessment of the quality of life depending on gender, where male participants showed higher scores on the variables school and learning, physical activity and health, family and spare time, and emotions and mood than female participants, which is in accordance with empirical studies (Nilles et al., 2022; Villafaina et al., 2021). In addition, empirical research by various authors (Bucur, 2017; Gomez-Baya et al., 2019) showed that male adolescents are more satisfied with life than female adolescents. The studies (Årdal et al., 2018; Villafaina et al., 2021) determined that during the period of youth the differences in the way male and female persons perceive the quality of life are quite striking, with females having a more negative view on their quality of life. This can be explained by the radical physical transformations girls go through at that period of life. During that period female adolescents are more exposed to contradictory social expectations while gender equality is still present within a social group. The findings of our research have shown that adolescents with increased body mass manifest significantly lower level of satisfaction with the physical activity and health variables than their peers with average BMI. If we take the starting hypothesis that participants with average BMI engage in physical activity more than their peers with increased body mass, then this result is in accordance with the expectations and findings of previous empirical studies (Cole & Lobstein, 2012; Boiché et al., 2014; Jalali-Farahani et al., 2014; Lizandra & Gregori-Font, 2021; Magiera et al., 2017; Weber et al., 2013) which established that male adolescents who are athletes have significantly better perception of their physical well-being than their female peers who do not practice any sport. In addition, other research results (Lizandra & Gregori-Font, 2021) show that a higher level of physical activity is beneficial for emotions and health. The results obtained using the nonparametric U test revealed relevant differences in exercise motivation with participants of both sexes in terms of the following variables: belonging to a group, challenge, competition, enjoyment, social acceptance, social pressure, strength and endurance, and body mass control. At the same time, three variables: belonging to a group, social acceptance, and social pressure are more significant exercise motives for male than for female participants. The findings are in accordance with various studies' results (Ivanović & Ivanović, 2018; Galan-Lopez & Ries, 2019; Sicilia et al., 2014), which show that gender differences regarding exercise motivation start from the early period of adolescence. In addition, the same authors found that the most important motives depend on gender: male participants are more incited by intrinsic motives such as strength, competition and challenge, while female participants are more incited by body mass control and physical appearance. Our sample provided identical results characterized by the expression of intrinsic and extrinsic motives. Comparing the findings on the EMI-2 questionnaire depending

on gender, gender difference in motivation can be linked to the differences in their real actions. That is confirmed by the results of several studies (Dominguez-Alonso et al., 2018; Guddal et al., 2019; Kueh et al., 2017; Ivanović & Ivanović, 2018; Roychowdhury, 2018; Sicilia et al., 2014) which found that due to the consequences of the aforementioned motivational mechanism, female adolescents engage in physical activity less than male adolescents. It is important to keep that in mind while creating preventive procedures and mediations that are aimed at improving well-being of adolescents who expose themselves to danger.

The calculated values of the descriptive parameters on our sample show significant differences in exercise motivation depending on BMI. The values of the measures of central tendency point out that adolescents of average body mass are more motivated to exercise by the intrinsic motive of enjoyment than their peers with increased body mass, while adolescents with increased body mass are more incited to exercise by the body mass control motive than their peers with average body mass. Finally, these results are significant because, according to different studies (Ahmed & Shekahawat, 2021; Fives et al., 2022), external motives lead to short-term physical exercise.

The results obtained in this research completely confirmed all of the four starting hypotheses: the first hypothesis that, based on the assessment of the physical well-being, health, mental happiness, emotions and mood variables, male participants perceive the quality of life on a higher level than female participants (H_1); the second hypothesis where it was expected that physical well-being and health are on a statistically lower level in adolescents with increased body mass than in those with average body mass (H_2); the third hypothesis where it is believed that adolescents with average body mass and those with increased body mass generally identically evaluate the quality of life (H_3); the fourth hypothesis which suggested that male participants are more incited to exercise by intrinsic motives (enjoyment, challenge, competition, strength and endurance) and extrinsic motives (belonging to a group), while female participants are predominantly motivated by an extrinsic motive - body mass control (H_4).

This empirical research has certain methodological limitations that should be taken into account while interpreting the obtained results, which can potentially limit the generalization of the results on the entire adolescent population. The limitations are: a) the pertinent sample is not sufficiently representative due to the geographical area; b) methodological variance and the self-assessment method due to which the possibility of giving dishonest or socially desirable answers cannot be excluded; and c) transversal design of the research which tests the participants within a given timeframe, thus preventing identification of the cause-effect link between the examined variables.

Still, even with the aforementioned limitations, this research contributed in determining the motives and understandings of the motivation of adolescents, and acquiring the basic knowledge for encouraging and preserving daily physical activity of adolescents and thus improving the quality of their lives. The findings indicate that adolescents need adequate programs which can motivate them to accept and keep an active lifestyle. Recognizing the motivational factors among young people with average body mass can be a model for creating preventive programs aimed at engaging adolescents in physical activity in school gyms and sports fields. Future research should examine the relations between the examined variables and adolescents' physical exercise, which would provide a more comprehensive insight into the examined phenomena among high school population.

We recommend the questionnaires tested in this study as reliable psychological tools for measuring exercise motivation and the quality of life among Serbian male and female adolescents. Despite the methodological limitations, the theoretical and empirical results of this study can be used as a basis for future research, but can also serve as a valid indicator for predicting adolescents' increased exercise motivation and the quality of life. With that in mind, we can say that further empirical research is needed, covering various cultures and geographical regions, and that it should include: a) various conceptualizations and operationalization of the EMI-2 and TKQ concepts in adolescence, and b) differently designed studies, meaning longitudinal studies.

CONCLUSIONS

The results of this study point to the importance of further research regarding the perception of the differences of the quality of life and exercise motivation during adolescence. The values of the *Cronbach* α coefficient revealed satisfactory reliability of internal consistency type for the EMI-2 and TKQ questionnaires, which implies that they can be regarded as valid instruments for examining adolescent population in Serbia. The findings revealed higher quality of life among male than female adolescents, which is manifested through the significant differences on most variables of the examined construct. In addition, the results have shown that adolescents with average body mass and those with increased body mass have almost identical perception of the quality of life. Young people with

average body mass also enjoy higher level of physical well-being than their peers with increased body mass. Summing up the obtained results of this empirical research, one can conclude that motivational factors among male high school students are significantly different from the motivational factors among female high school students. There are significantly more intrinsic and extrinsic factors that motivate male students, while female students are motivated to exercise mostly because of body mass control.

To conclude, the obtained findings of this transversal research can be an encouragement for future (longitudinal) research which can lead to a better understanding of gender differences in exercise motivation and the quality of life among male and female adolescents with average and increased body mass. Additionally, these results can inspire exercise motivation and improve of the quality of life among the high school population.

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EUROPEAN FOOTBALL CHAMPIONSHIP 2020/2021: ANALYSIS OF GOALS SCORED AND EVALUATION OF STATISTICALLY PARAMETERS IN MATCHES[1]

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Abstract: The aim of the study was to analyse the characteristics of goals scored in the tournament in terms of a specific way of evaluation. Based on a sample of 51 matches and the participation of 24 national teams, this study is based on the personal observation of the researcher, that is, the analysis was based on watching the matches live via domestic cable channels, as well as on the UEFA official YouTube channel. A two-way analysis of variance between groups was used to process one part of the data. A total of 142 goals were scored. The fixed factor showed the highest prevalence of goals scored in the period of 45-60 minutes (30), while the fixed factors included the types of attacks and the number of goals scored: (80) continuous attacks (mean value = 53.7 minutes), (13) fast attacks (59.5 minutes), (14) counter-attacks (55.7 minutes) and (35) set plays or interruptions (51.8 minutes). One final touch was evaluated (80 or 65.6%), as well as two touches (17 or 13.9%). The highest number of hits (37) was achieved with the inside of the foot (mean value = 53.5 minutes) compared to (27) when hitting the ball with the header (54.4 minutes) and (21) when kicking the ball with the middle part of the foot ridge (49.5 minutes). Most goals were scored with the right foot (66 or 46.5 %), i.e. (90) goals were scored within sixteen meters (outside the box) (54.1 minutes). The first goal provided value (33 or 64.7 %) of the final victory in the match. The obtained results point out to the coaches that they should focus on quick attacks and counter-attacks that consequently lead to scoring goals. Attention must also be paid to more ball strikes with the outside of the foot and the outside part of the foot ridge.

Keywords: *football performance indicators, technical elements, tactical elements, goal, video analysis*

1. INTRODUCTION

Scoring a goal in football is the most important determinant of offensive action success, although it only represents 1 % of ball possessions in professional competitions (Tenga et al., 2010). Among numerous technical and tactical aspects of players' behaviour, goals are studied the most. It is true that a goal is the key of success for teams (Cachay & Thiel, 2000) and therefore its analysis in all matches in a big soccer tournament (European Championship, World cup) allows for multiple assessments.

Alberti et al. (2013) indicate that a significantly higher frequency of goals scored was recorded in the second half, with the highest rate in the final 15-minute periods of the game during major European football championships.

Feedback is one of the most important factors in improving the performance of football players. Coaches used to give feedback based on their subjective observations. Coaches' subjective observations may or may not be accurate, i.e. they are quite unreliable. This was supported by a study (Hughes & Franks, 2004) where it was found

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that the percentage of coaches who were correct in their assessment after the game was less than 45 percent during the 45 minutes of a soccer match. This is because human memory has limitations according to which we cannot remember the entire event during the match.

Football technique is the skill or ability of a player to perform simple and rational, free and easy, fast, safe and efficient movements with the ball in various, purposeful movements and in the most complex conditions (Aleksić & Janković, 2006). In short, technique should be understood as the effectiveness of the soccer player's actions on the pitch.

Tactical knowledge not only facilitates the processing of information, but enables targeted and expedient adaptation of the players' potential reactions in the surrounding and immediate conditions of the game (Ali, 2011).

Attack is the backbone of the football game. The basic goal of the football game is victory, and it is achieved with the maximum use of attack. In the modern practice of the football game, the means by which attack actions are carried out include: quick attack, counter-attack and combined attack (Savić, 2011).

The aim of this study was to analyze the characteristics of goals scored at the last European Football Championship 2020/2021, and also to evaluate the selected statistical parameters during the matches of the competition. In particular, the mean time of scored goals was examined depending on different observed fixed factors. The general hypothesis of the study is that more goals were scored in the second half than in the first and overtime periods. The special hypotheses of the study are that the most represented type of attack actions were continuous and quick attacks, then that there were most right-footed shooters, as well as that the space within 16 meters was the most represented when scoring goals. Likewise, it is assumed that during the set interactions between different variables and game periods, scored goals come approximately in the middle of minute divisions. And the last hypothesis would be that the winning teams have the best statistical parameters in the matches.

2. METHOD

2.1. Subjects

Fifty-one (51) matches were studied with the participation of 24 national teams (group phase and elimination phase of the competition). The reason for choosing the 2020/2021 European Football Championship was the participation of elite national teams (Italy, Switzerland, Turkey, Wales, Denmark, Finland, Belgium, Russia, Austria, North Macedonia, Holland, Ukraine, England, Croatia, Scotland, Czech Republic, Poland, Slovakia, Spain, Sweden, Hungary, Portugal, France and Germany).

2.2. Design and Procedures

The European Football Championship 2020/2021 is the sixteenth championship in a row (June 11 - July 11, 2021), which was held in European stadiums across eleven countries and eleven cities. Football matches at the championship were broadcast by Nova S and Sport Klub with the possibility of re-watching and re-analysing the TV footage. The research was based on the personal observation of the researcher who recorded the characteristics of the scored goals, which is partly defined in Table 1. Some of the statistical data, immediately after the matches, were downloaded from the EURO European Championship 2021 page through the options: overview, chronology, line-ups, statistics... The option to replay the scored goals on UEFA's official YouTube channel (UEFA Euro 2020), provided an accurate assessment of the set variables.

Table 1. *Definitions of analysed variables*

Continuous attacks	A slower attack with a larger number of participants, when the opponent's defence is numerically overwhelming; the attack usually s tarts from the attacker's half of the pitch; it can also mean a slower individual penetration towards the goal.
Quick attacks	A quickly executed attack in the opponent's half of the pitch, immediately after the ball has been taken; it is carried out against a formed last line of defence and unformed front line of defence.
Counter-attacks	The fastest possible attack from the attacker's half of the pitch, executed immediately after the ball has been taken away from the opponent; it is carried out against an unformed front line and last line of defence.

Set plays	It includes all types of set plays, i.e., scoring goals after corner kicks, after a direct free kick, after an indirect free kick, after penalties, after saved penalties, and after a side line throw-in.
Middle part of the foot ridge	A kick at shorter, medium or longer distances: a goal scored from close range by means of a "kick from the knee", but also from a distance of over 20 meters.
Inside of the foot	This kick is performed with a relatively wide and flat hitting surface at shorter distances of 2 to 15 meters.
Outside of the foot	Short sudden kicks to the side up to 10 meters.
Inside part of the foot ridge	The ball is sent through the air in an arching path when scoring goals or kicking with a "spin" with the inner part of the foot on the outer surface of the ball.
Outside part of the foot ridge	A straightforward run-up of 3-4 steps towards the ball and a kick with the outside part of the foot on the inner surface of the ball.
Header	A hit from a standing position: when the ball comes at the height of the player's head; a hitting movement: the ball moves a little further from the player, so it is necessary to run up towards it; a hit by jumping using both legs: it is not possible to run up towards the ball and there are opposing players in immediate vicinity of the player who scored the goal; a hit by jumping using one leg: when a player is able to make a slightly longer run up towards the ball when scoring a goal; a hit with the lateral part of the head: the player is turned sideways towards the opponent's goal due to the close proximity of the opponent, he is unable to face the goal. It can also be performed in a fall; a header performed by the top of the head: when a player has his back turned towards the goal or his teammates who stayed behind him, so he passes behind a high ball that came to him from the front.
Special kicks	Volley: kicking the ball in the air with the inside of the foot, and the middle ridge of the foot; "Dropkick": the shot is made after the ball touches the ground, in a similar way to the volley; Point kicks: the ball is reached at the last moment when taking a shot at the goal from close range; Sole kicks; Lower leg kicks.
Own goal	Scoring an own goal.
Penalty	A direct shot.
Penalty area	It implies a bordered area within 16 m.
Goal area	It implies a bordered goalkeeping area within 5 meters.
Outside penalty area	It includes the bordered area of the football pitch outside 16 meters.

The descriptive observation helped in obtaining the parameters of the type of attack, final contacts when scoring goals, asymmetry, the influence of the first goal on the final result, and relevant indicators in the matches. Also, the analysis method helped in observing the relationship between three variables (two categorical independent variables and one continuous dependent variable).

Dependent variable:

- time of scored goals during each match.

Fixed factor:

- division by game duration: from 1 to 15 minutes, from 16 to 30 minutes, from 31 to half-time, from 45 to 60 minutes, from 61 to 75 minutes, from 76 to the end of the game and extra time.

Fixed factors:

- types of attacks with which goals were scored during the tournament: continuous attacks, quick attacks, counter-attacks and breaks (set plays),
- the way a goal is scored: middle part of the foot ridge, inside of the foot, outside of the foot, inside part of the foot ridge, outside part of the foot ridge, header, special kicks, own goal and penalty, i.e.
- the area from which the goal was scored: the 16-meter area, the goalkeeper's area and the area outside the 16-meter perimeter.

Observation of football matches and transmission of indicators will enable improvement in the performance of national teams and extract the latest information and innovations at the most important European football tournament.

2.3. Statistical Analysis

Initially, a descriptive observation of all variables was carried out, in the form of absolute and relative frequency. Apart from the simultaneous examination of the effect of each independent variable on the dependent vari-

able, while also identifying the possible effect of their interaction, a two-way between-groups analysis of variance was also used. Significance level: 0.05. Relevance intervals: 95.0 %. When significant effects were observed, one-way ANOVA indicated differences between the mean values of the dependent variable in the groups. In significant interactions, Bonferroni's post-hoc test was used. The processing of all data was performed in the IBM SPSS Statistics (IBM Corp., Version 26, Armonk, NY, USA).

3. RESULTS

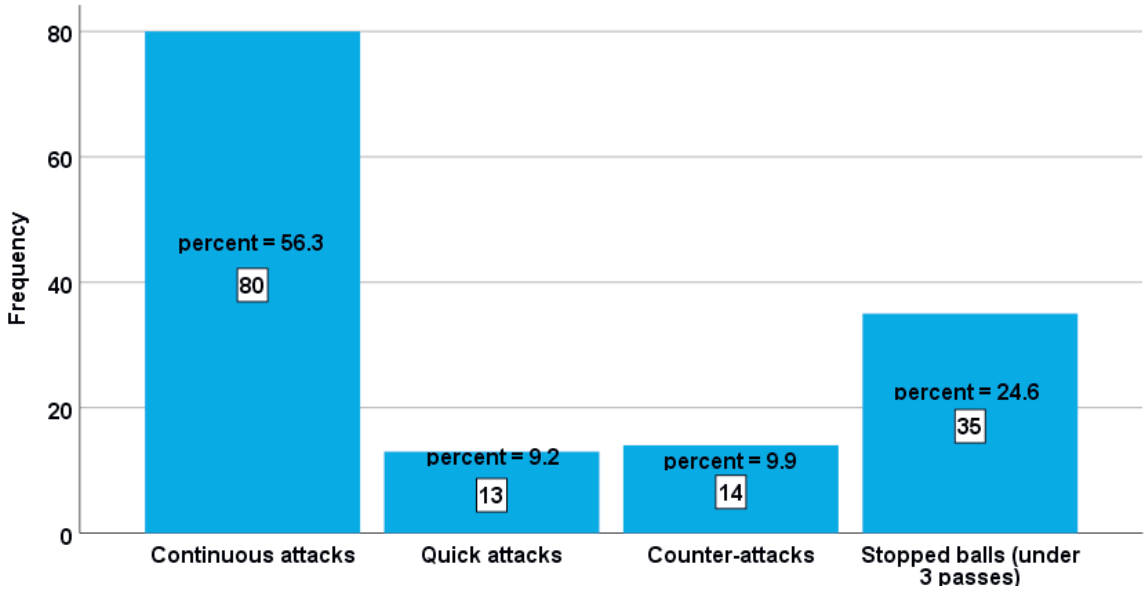
During the tournament, 142 goals were scored (2.79 per match). The analysis of the goals (Table 2) shows mostly similar numerical values or closer similar numerical values, with the exception from 1 to 15 i.e., 16 to 30 minute period as well as extra time periods. The absolute frequency was (N = 13) in the 1-15 minute period of the game, (N = 16) in the 16-30 minute period, (N = 23) in the 31-45+ minute period, (N = 30) in the 45-60 minute, (N = 24) in the 61-75 minute period, (N = 29) in the 76-90+ minute period, and (N = 7) in extra-time periods.

Table 2. *Descriptive parameters of goals scored*

Time of goals scored (in minutes)	*Number*	*%*	*Mean*	*Std. Deviation*	*Median*	*Min*	*Max*
0-15 minutes	13	9.2	7.9 (8')	4.8	8.0	2	15
16-30 minutes	16	11.3	24.1 (24')	4.5	25.5	17	30
31-45 minutes	23	16.2	40.4 (40')	5.1	42.0	31	48
45 second half-60 minutes	30	21.1	53.9 (54')	4.8	54.5	46	60
61-75 minutes	24	16.9	68.3 (68')	4.2	68.0	61	75
76-90 minutes	29	20.4	84.7 (85')	5.6	84.0	77	95
90 extra time-120 minutes	7	4.9	106.0 (106')	8.8	104.0	95	121
Total	142	100	(55')				

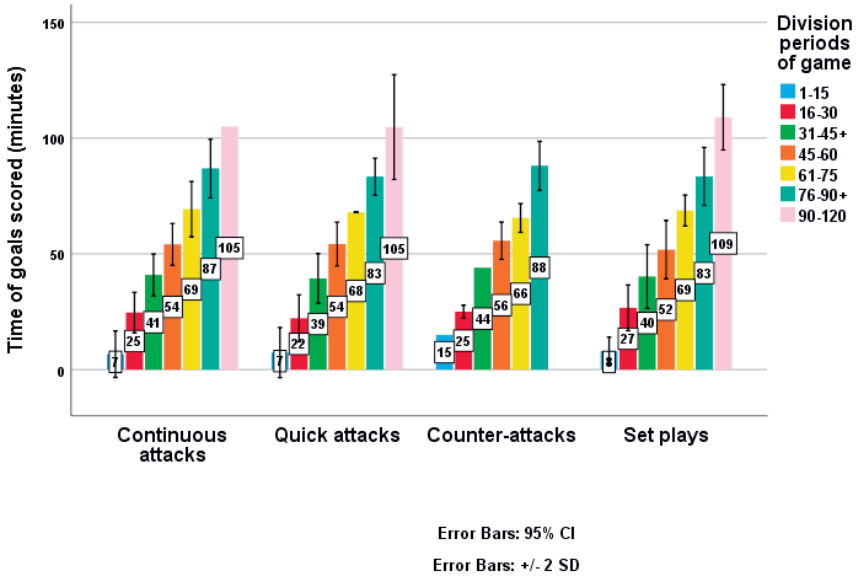
The frequency of the applicability of the types of attacks when scoring goals is presented in Figure 1. The observed results indicate that 80 (56.3%) goals were scored after continuous attacks, 13 (9.2%) after quick attacks, 14 (9.9%) after counter-attacks, and the remaining 35 (24.6%) goals were scored after stopped balls.

Figure 1. *Types of attacks when scoring goals*



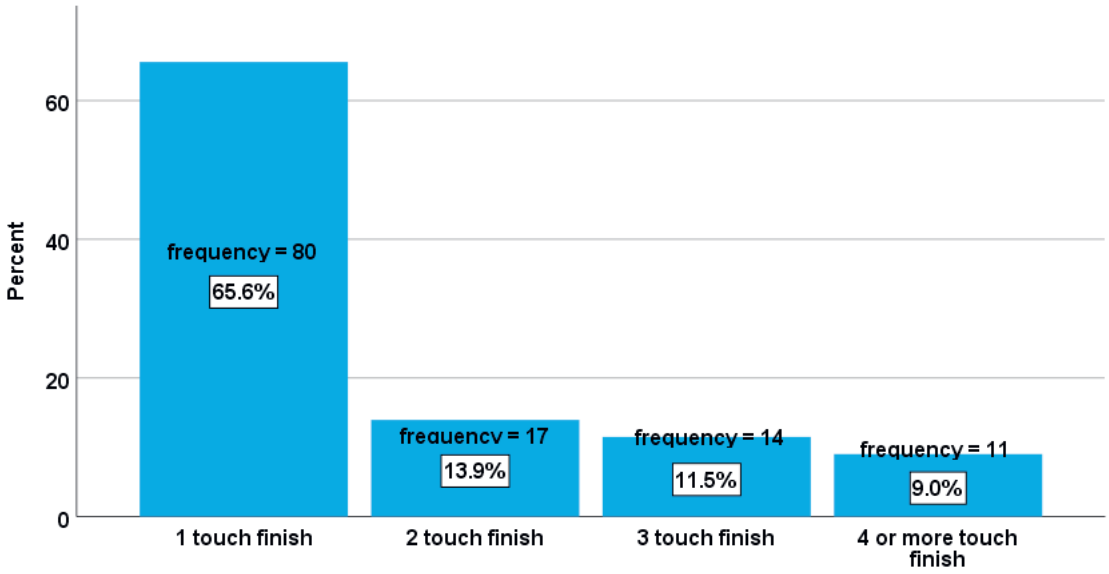
The interaction (Figure 2) effect between "division by periods of the game" and "types of attacks" when scoring goals was not statistically significant (F(16, 142) = 0.947, Sig. = 0.519). A statistically significant main effect of the "division by periods of the game" was found (F(6, 142) = 407.359, Sig. = 0.000). Subsequent comparisons using the one-way ANOVA (F(6, 141) = 614.743, Sig. = 0.000), and Bonferroni's post hoc test show the mean value of 1-15 minute-period (Mean = 7.9 or 8.3 minutes, Std. Deviation = 4.8) significantly different from 16-30 minute-period (Mean = 24.1, Std. Deviation = 4.5), then from the 31-45+ minute-period (Mean = 40.4, Std. Deviation = 5.1), from the 45-60 minute-period (Mean = 53.9 or 54.3 minutes, Std. Deviation = 4.8), from the 61-75 minute-period (Mean = 68.3, Std. Deviation = 4.2), from the 76-90+ minute-period (Mean = 84.7 or 85.1 minutes, Std. Deviation = 5.6) and from the 90-120 minute-period (Mean = 106.0, Std. Deviation = 8.8). The main effect of the "type of attacks" (F(3, 142) = 1.232, Sig. = 0.301) did not achieve statistical significance.

Figure 2. *Types of attacks, average time of goals scored, and division of game periods*



The Figure 3 shows in how many touches the goals were scored during the tournament: one touch finish was observed in 80 goals (65.6%), two touch finish in 17 (13.9%), three touch finish in 14 (11.5%), and four or more touch finish in 11 cases (9.0%).

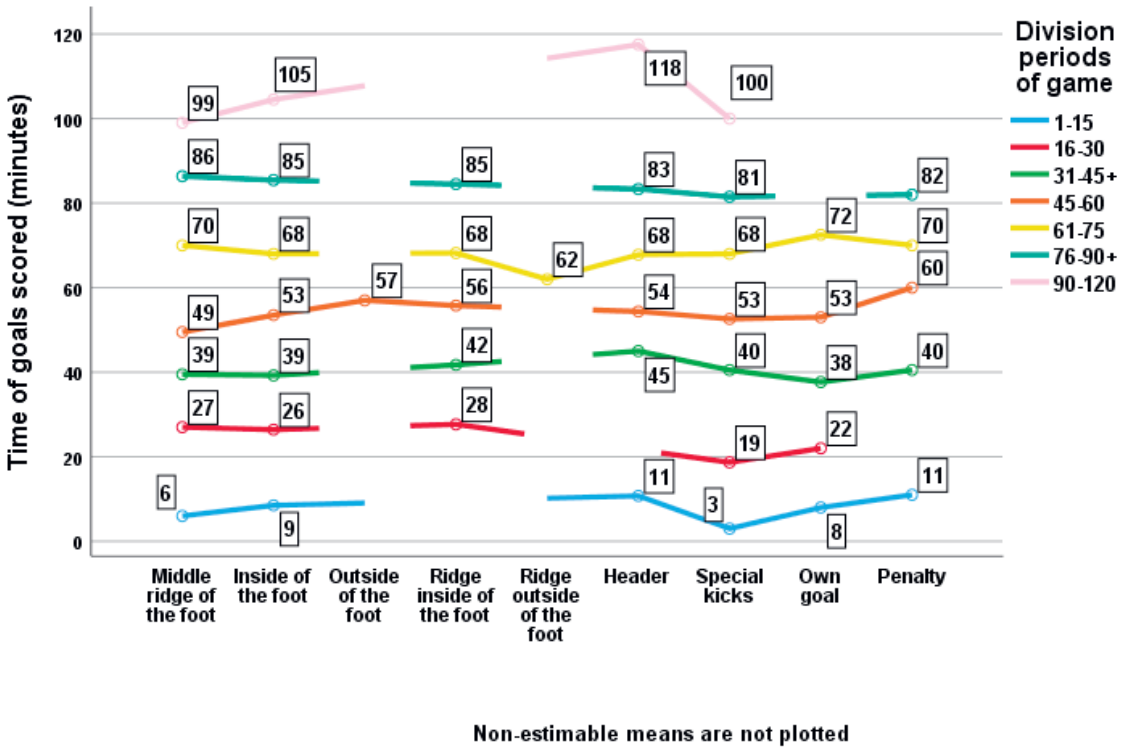
Figure 3. *Display of the number of final contacts of players with the ball when scoring goals*



The absolute frequency of goals scored were (N = 21) for the kicks with the middle ridge of the foot, (N = 37) for the kicks with the inside of the foot, (N = 1) for the kicks using the outside of the foot, (N = 18) for the kicks with the inside part of the foot ridge, (N = 1) for the kicks using the outside part of the foot ridge, (N = 27) for the headers, (N = 17) for the special kicks, (N = 11) for the own goals, and (N = 9) for the penalties.

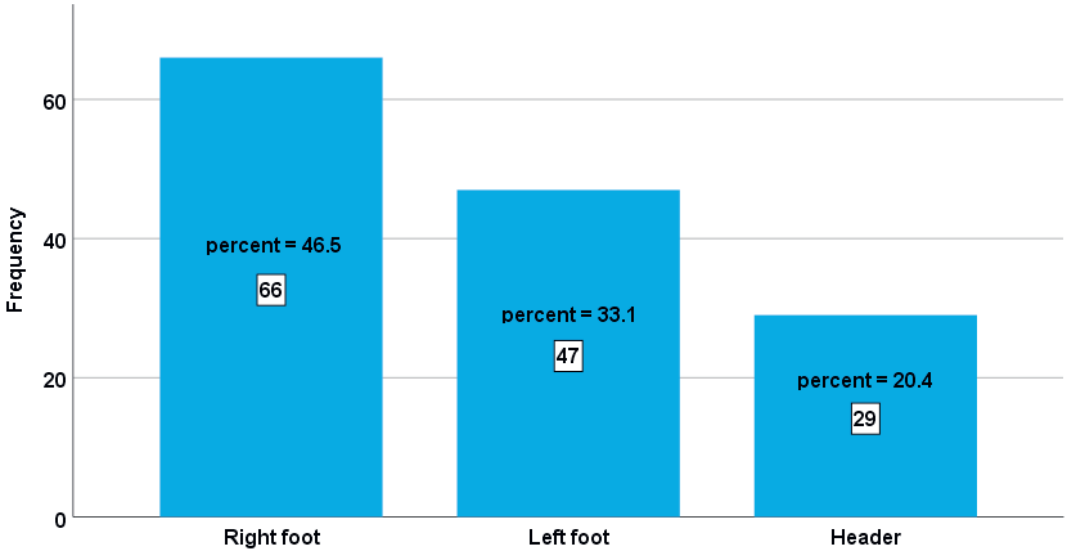
The interaction (Figure 4) effect between the "division by periods of the game" and the "ways of scoring goals" was not statistically significant (F(29, 142) = 1.015, Sig. = 0.459). A statistically significant main effect of the "division by periods of the game" was found (F(6, 142) = 451.452, Sig. = 0.000). Subsequent comparisons using one-way analysis of variance (F(6, 141) = 614.743, Sig. = 0.000), and Bonferroni's post hoc test, show the same statistically significant differences between the mean values of the results in the categorical independent variable the "division by periods of the game", as in the first observation (Figure 2). The main effect of the "ways of scoring goals" (F(8, 142) = 2.085, Sig. = 0.044) did reach statistical significance. However, subsequent comparisons using one-way ANOVA's (F(8, 141) = 1.197, Sig. = 0.306), and Bonferroni's post hoc test show that the mean value of the kicks using the middle ridge of the foot (Mean = 60.1, Std. Deviation = 32.3) had no significant difference from the kicks with the inside of the foot (Mean = 59.1, Std. Deviation = 25.8), and from the kicks with the outside of the foot (Mean = 57.0), the inside part of the foot ridge (Mean = 54.6, Std. Deviation = 18.7), the outside part of the foot ridge (Mean = 62.0), headers (Mean = 60.8, Std. Deviation = 28.5), special kicks (Mean = 47.4, Std. Deviation = 28.2), own goals (Mean = 37.0, Std. Deviation = 21.5), and penalties (Mean = 51.9, Std. Deviation = 24.1).

Figure 4. *Ways of scoring goals (technical elements - kicks per ball), average time of goals scored and division of game periods*



The Figure 5 shows the different ways with goals scored during the tournament: right foot were observed in values (66 or 46.5%), left foot (47 or 33.1%) and header kick (29 or 20.4%).

Figure 5. *Frequency of asymmetry of goals scored (right - left foot) as well as goals scored with different types of headers*



The absolute frequency of goals scored were (N = 90) in the penalty area, (N = 34) for the goal area, and (N = 18) for the outside penalty area.

The interaction (Figure 6) effect between the "division by periods of the game" and "area of materialization" was not statistically significant (F(11, 142) = 0.527, Sig. = 0.882). A statistically significant main effect of the "division by periods of the game" was found (F(6, 142) = 346.467, Sig. = 0.000). Subsequent comparisons using one-way analysis of variance (F(6, 141) = 614.743, Sig. = 0.000), and Bonferroni's post hoc test, show the same statistically significant differences between the mean values of the results in the categorical independent variable – the "division by periods the game", as in the first, and second observations (Figures 2 and 4). The main effect of the "area of materialization" (F(2, 142) = 1.146, Sig. = 0.321) did not reach statistical significance.

Figure 6. *Areas of materialization, average time of goals scored, and division of game periods*

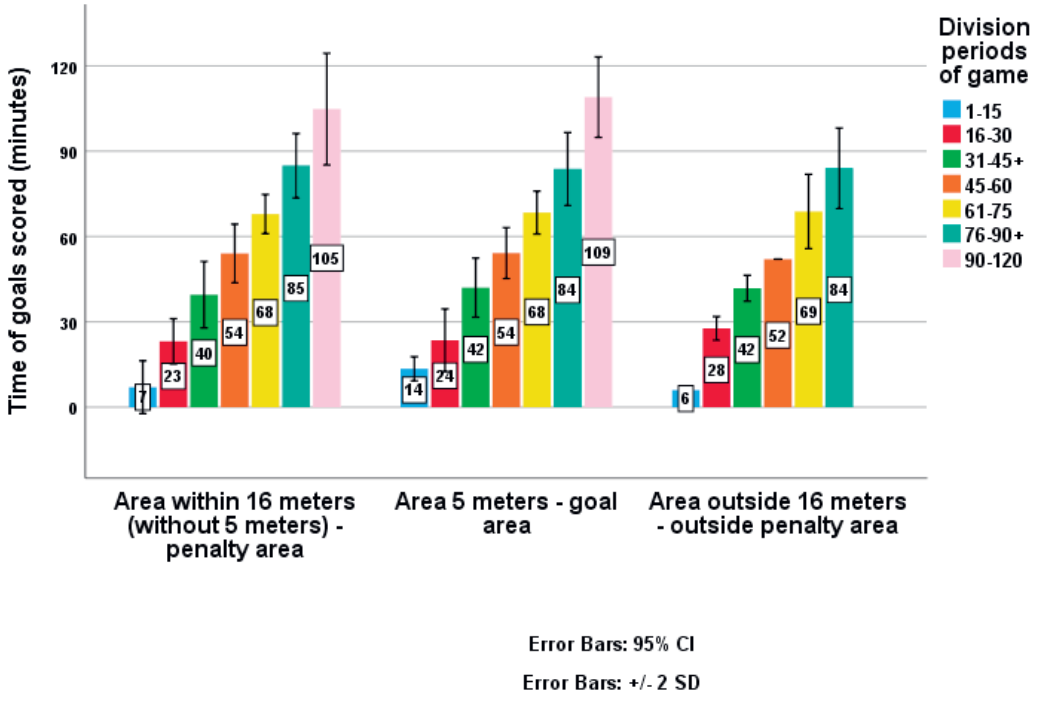
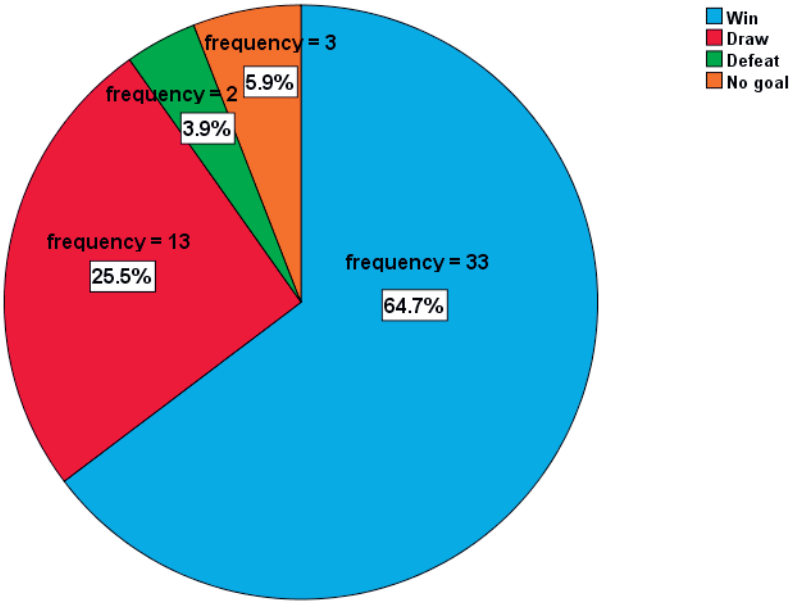


Figure 7 shows the impact of the first goal on the final outcome of the matches during the tournament: the team that scores first won in 33 (64.7%) games, finished with a draw in 13 (25.5%) games, and suffered a defeat in 2 (3.9%) games, whereas there was no goal in 3 (5.9%) games.

Figure 7. *Influence of first goal scored on final outcome of matches*



It is quite obvious that the winning teams were quite dominant in their matches (Table 3), taking into account: total shots (13.1), shots on goal (5.5), ball possession (53.6%), passes (517.0), accuracy of passes (82.5%), offsides (1.8), and corner kicks (5.0).

Table 3. *Differences between teams that won, drew and lost in tournament match statistics*

N = 36		*Winner*			*Drawer*			*Loser*	
Group stage	*Mean*	*Std. Deviation*	*Median*	*Mean*	*Std. Deviation*	*Median*	*Mean*	*Std. Deviation*	*Median*
Total shots	13.1	5.7	13.0	10.9	4.4	11.0	10.4	5.9	8.5
Shots on goal	5.4	2.6	6.0	3.3	1.8	3.5	2.5	2.0	2.0
Ball possession (%)	53.6	11.7	55.0	50.0	21.1	50.0	46.4	11.7	45.0
Passes	517.0	125.8	527.5	479.9	210.0	482.5	440.3	106.4	435.5
Accuracy of passes (%)	82.5	7.9	84.0	81.3	11.5	84.0	80.7	5.2	81.5
Fouls	11.3	2.9	11.5	11.6	3.8	11.5	10.8	3.6	10.0
Yellow cards	0.9	0.8	1.0	1.7	1.3	1.5	1.6	1.1	2.0
Red cards	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0
Offsides	1.8	1.5	2.0	1.3	1.1	1.0	1.5	1.2	1.0
Corner kicks	5.0	2.3	5.0	3.9	3.1	4.0	3.9	3.1	4.0
N = 7		*Winner*			*Drawer*			*Loser*	
Knockout phase 90'	*Mean*	*Std. Deviation*	*Median*	*Mean*	*Std. Deviation*	*Median*	*Mean*	*Std. Deviation*	*Median*
Total shots	10.6	4.0	11.0	/	/	/	11.7	5.9	10.0
Shots on goal	4.9	2.4	5.0	/	/	/	2.7	1.8	3.0
Ball possession (%)	48.3	4.8	48.0	/	/	/	51.7	4.8	52.0
Passes	464.7	85.5	445.0	/	/	/	488.4	83.1	451.0

Accuracy of passes (%)	82.3	6.4	83.0	/	/	/	82.1	5.8	83.0
Fouls	10.6	3.6	11.0	/	/	/	10.0	3.1	9.0
Yellow cards	1.1	1.2	1.0	/	/	/	2.0	1.3	2.0
Red cards	0.0	0.0	0.0	/	/	/	0.3	0.5	0.0
Offsides	1.3	0.8	1.0	/	/	/	1.9	1.6	2.0
Corner kicks	4.4	3.0	5.0	/	/	/	4.9	3.2	3.0
N = 8		*Winner*			*Drawer*			*Loser*	
Knockout phase 120'	*Mean*	*Std. Deviation*	*Median*	*Mean*	*Std. Deviation*	*Median*	*Mean*	*Std. Deviation*	*Median*
Total shots	21.3	5.1	21.5	15.3	8.5	14.0	11.8	4.2	12.5
Shots on goal	7.5	3.0	8.0	5.3	2.8	5.0	4.0	2.0	3.0
Ball possession (%)	58.5	7.0	57.0	50.0	18.9	50.0	41.5	7.0	43.0
Passes	761.0	90.6	746.5	629.5	240.9	578.5	555.3	97.0	577.5
Accuracy of passes (%)	87.0	1.4	86.5	82.1	8.1	86.0	81.0	1.4	80.5
Fouls	9.3	1.5	10.0	15.6	2.8	14.5	20.0	6.4	21.5
Yellow cards	1.3	1.0	1.5	2.4	1.5	2.0	2.0	0.8	2.0
Red cards	0.0	0.0	0.0	0.1	0.4	0.0	0.3	0.5	0.0
Offsides	2.5	1.7	3.0	2.9	2.6	1.5	2.8	2.2	2.0
Corner kicks	5.0	2.6	5.0	6.3	3.7	5.5	3.8	2.2	4.0

4. DISCUSSION

The study, which examined the goal scoring patterns in the Euro 2004 championship showed results (organized offense: 44.1 %, counter attacks: 20.3 %, and set plays: 35.6 %) (Yiannakos & Armatas, 2006). However, Piecniczk (1983) found that 27 % of the goals during the 1982 World Cup Tournament were scored after a quick offense and 28 % through organized offensive actions. Findings provide evidence for the importance of practicing set plays because of their potential productivity despite their relatively low occurrence in comparison to open play opportunities.

The observed applicability of different ball kicks when scoring goals is expected, given the available proportion of foot kick surfaces during final realizations. The analysed parameters of the available area in the football pitch (Figure 6) from which goals were scored can be explained by the fact that the advantage in the variable inside the penalty area is understandable, given that players in these situations have a complete perception the goal in front of them as well as a shorter ball flight length when hitting the target compared to the variable outside the penalty area. The 2010 World Cup tournament saw 82.07 % of the goals being scored from the penalty box. This is slightly lower than the 85.7 % for the 2002 World Cup (Njororai, 2004).

5. CONCLUSION

The proposed general hypothesis, as well as a number of special hypotheses, were confirmed by this paper, except for the hypothesis concerning interactions of variables, which was partially confirmed and likewise the hypothesis on match statistics, only in the group phase of the competition. In situational training, more attention should be paid to quick attacks, and counter-attacks in terms of crossovers, empty space in-depth run-ups, and the fastest possible realization of attacks. Exercising the different surfaces of the foot is considered crucial with extra attention given to kicks using the inside and the outside of the foot. However, the times of goals scored by different ways of kicking the ball do not have statistical significance, in contrast to the isolated observation of these technical elements, which is also indicated by the percentage of representation when scoring goals. A new current study (average time of scored goals) certainly provides pragmatic information about the contemporary repercussions of the most important tournament in European football.

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EFFECTS OF SELF-MASSAGE WITH FOAM ROLLER ON FLEXIBILITY AND OTHER MOTOR SKILLS – LATEST RESEARCH REVIEW[1]

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Abstract: During the past decade, self-massage of the muscular fascia using a foam roller (FR) has become an increasingly common way of supplementing traditional methods of soft tissue treatment, while both professional and recreational athletes use it as a tool for warm-up and/or post-training relaxation. Considering the relevance of this topic among researchers, coaches, and physiotherapists, the aim of this this paper is to present a narrative review with the systematization of the latest research on the effects of foam rolling on motor skills. Publication search was conducted using the following databases: Google Scholar, PubMed, and ScienceDirect. The following keywords were used in the search: foam rolling, self-myofascial release, fascia, and muscle soreness. The selection of papers was based on the following criteria: 1) publications written in English and published in the period 2019-2022, and 2) original scientific papers focused on examining the effects of soft tissue massage using FR on the range of motion (ROM), motor abilities (strength, power, speed, balance and others), acute muscle pain, and delayed muscle soreness. Recent research results confirm earlier findings that FR can have short-term, positive effects on flexibility and ROM, while findings regarding the effects on muscle strength, explosive power, and balance are equivocal. In addition, it has been noted that this type of treatment can delay the onset of fatigue, and alleviate the painful sensitivity of muscles after intensive work-out. Although foam rollers have been in use for a long time both in sports and in rehabilitation, due to the heterogeneity of methods applied in related studies, there is still no official recommendation on the optimal way of applying these tools (treatment duration, pressure and cadence, i.e. the frequency of vibration if such a roller is used).

Keywords: *foam rolling, vibration, flexibility, range of motion, myofascial relaxation*

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INTRODUCTION

The fascia system, with its diverse components, builds a three-dimensional continuum of soft, loose, and dense fibrous connective tissue that permeates the body and allows all body systems to function in an integrated manner (Gatt et al., 2018). Fascia can be generally classified as superficial, deep, visceral or parietal, and further classified according to the anatomical location. In the context of this review, we are primarily interested in the superficial fascia that is located directly beneath the skin and superficial layers of fat.

When healthy, fascia is a loose and wavy connective tissue but it can lose its flexibility when damaged by local trauma or inflammation. With acute inflammation, fascia tightens and loses flexibility. Long-term bad postural positioning that partially or completely prevents fascia from sliding and some other short-term processes can lead to its shortening. When this happens, the stretching of fascia can cause pain in distant sensitive areas such as nerves and blood vessels, muscles, which in turn leads to the limitation of the usual range of motion, etc. (Gatt et al., 2018).

Relaxing the fascia through manual therapy or other techniques reduces pressure on those areas and blood circulation returns to normal (Findley et al., 2012). In the last decade, self-myofascial release (SMR) using a foam roller (FR) has become an increasingly common way of supplementing traditional soft tissue treatment methods. The first use of a foam roller was recorded in the work of practitioners of the Feldenkrais method in the 1980s. After a series of positive experiences, foam rollers were very quickly introduced into the training processes of both recreational and professional athletes. Treatment with FR uses the pressure of the body weight on the roller, and therefore on the soft tissue during movement (Adamczyk et al., 2020). Changing body position makes it possible to isolate certain parts of the body and treat soft tissue restrictions (Healey et al., 2014).

Previous research has shown that massage with FR has short-term positive effects on flexibility, range of motion (ROM), pain sensitivity ("inflammation") of muscles, and also reduces the sensitivity of so-called myofascial pain points (also known as trigger points) (Macdonald et al., 2014; Miller & Rockey, 2006; Mohr et al., 2014). Mechanical compression applied on soft tissues increases blood flow (vasodilation) through muscles which can help quickly relieve fatigue symptoms after exercise. Research indicates that the application of FR can increase the hydration and elasticity of fascia (Adamczyk et al., 2020). Studies in the field of SMR indicate the effectiveness of this technique in relieving pain due to many physiological responses. Some of them are increased blood flow, reduced arterial stiffness, improved vascular endothelial function, and increased nitric oxide concentration (Adamczyk et al., 2020). However, the physiological mechanisms of the reported effects remain unclear, although initial evidence suggests an increase in arterial perfusion, enhanced fascial layer sliding, and modified corticospinal excitability after treatment (Zügel et al., 2018).

Recent studies on the impact of FR massage on motor skills suggest an improvement in the range of motion after a single or several repeated treatments, with the assumption that it enables more efficient movement patterns and results in reduced risk of musculoskeletal injuries (Chang et al., 2021; Folli et al., 2021; Fonta et al., 2021; Junker & Stöggl, 2019; Krause et al., 2017; Laffaye et al., 2019; Santana et al., 2021; Seever et al., 2022; Sulowska-Daszyk & Skiba, 2022; Yanaoka et al., 2021). Research findings on the impact of FR massage on other motor abilities (strength, power, speed, etc.) are not definite, so it is stated that this treatment does not inhibit, nor improve the characteristics of muscle function.

Considering the relevance of this topic in sports training and rehabilitation, the aim of this paper is to systematize the latest research on the effects of foam roller application on motor abilities, primarily through the impact on flexibility and range of motion.

METHOD

The publication search was conducted using the following databases: Google Scholar, PubMed, and ScienceDirect. The search was conducted using the following keywords: foam rolling, self-myofascial release, fascia, flexibility, ROM, motor ability, muscle soreness, muscle performance. The selection of papers was based on the following criteria: 1) publications written in English and published in the period 2019-2022; 2) original scientific papers focused on examining the effects of soft tissue massage using FR on joint mobility, motor skills (strength, power, speed, balance, etc.), acute muscle pain, and delayed muscle soreness.

RESULTS

After conducting the selection by the set criteria, 14 original scientific papers that investigated the application of standard FR (smooth, GRID, and wave roller; Table 1), as well as 8 studies (Table 2) that compared the effects of standard FR and vibrating foam-roller (VFR) were included in this review.

The short-term (acute) effects of foam-rolling (i.e., the effects that can be observed immediately after the applied procedure) were examined in 15 studies, while findings on possible delayed effects of FR massage (5 min to 48 h after treatment) were presented in five papers. Only two studies (Laffaye et al., 2019; Santana et al., 2021) examined the effects of the long-term use of FR (treatment range 2 to 8 weeks).

Study samples mostly comprised young people, up to 30 years of age. Most of the studies were conducted on physically active men (recreational or athletes), while women participated only in four studies on the effects of FR, as well as in 5 studies on VFR. It is important to note that some studies failed to include demographic data and information on the participants' level of physical activity.

The most numerous (19) are the studies that examined the impact of FR or VFR massage on flexibility (ROM in different joints of the lower extremities). In just over a half of all studies (13), foam roller was used for treatment of the hamstrings muscles (unilaterally or bilaterally). Only a few of the total number of papersresearc included in this review examined the effect of antagonist muscle group massage on hamstring flexibility and hip flexion ROM (de Benito et al., 2019; Ruggieri et al., 2021). Interestingly, the interventions listed in this review differ from each other in terms of treatment duration (FR and VFR), or vibration amplitude and frequency (VFR). Tables 1 and 2 depict key information about the research design, the applied treatment (including region/muscle group, duration, frequency, etc.) as well as the most important findings.

Table 1. *Overview of research on the effects of foam-rolling on flexibility and other motor abilities*

Research	Methods	Treatment	Results
Santana et al., 2021	20 males; Four sessions 48 hours between session; Assessment of the total number of repetitions, fatigue resistance index, and muscle soreness. 3 sets of 10-RM knee extensions performed in each session; FR treatments between the sets of knee extensions: 1- agonist; 2- antagonists; 3- agonists and antagonists; 4- passive rest.	Treatment applied between the sets of exercise, separately for each leg: 1- quadriceps femoris, 60s 2- hamstrings, 60s each; 3- front and back thighs, 30s each muscle group, total 120s for both legs.	In comparison to passive rest, significantly higher total training volume, fatigue resistance index, and total number of repetitions, and lower muscle soreness were observed after FR treatments.
Laffaye et al., 2019	20 males; Half squat jump (SJ), countermovment jump (CMJ), active and passive hip, knee, and ankle ROM and muscle pain sensitivity were assessed immediately after training (8 sets of squats: 20s squats/10s rest), then 24 and 48 h later.	Foam-rolling of iliotibial band and the front tight (sartorius and rectus femoris) was applied unilaterally, the other leg served as control. Two sets of 60s FR for each region.	Foam-rolling had no influence on thr jump height, leg muscle stiffness, and strength. The treated leg had 50% less muscle soreness sensitivity and greater hip ROM than the control leg.
Behara and Jacobson, 2017	14 males; Pretest – assessment of max and average power, speed, and torque of knee flexors and extensors, and hip ROM. Three groups: 1- dynamic stretching (8 min); 2- foam-rolling (8 min); 3- control group. Posttest immediately after, and 7 days after the intervention.	The treatment was applied bilaterally for 60 s per region: quadriceps femoris, gluteal region, hamstrings, and gastrocnemius.	The applied procedures did not lead to significant changes in the power, torque and speed of the tested muscles.
Krause et al., 2017	16 participants; Three sessions: 1) foam-rolling; 2) passive static stretching; 3) no intervention. Assessment of connective tissue stiffness and gliding, angle of first stretch sensation, and active and passive knee flexion ROM, before and immediately after the intervention.	Unilateral treatment of quadriceps femoris: 1. FR 2×60 s, break 30 s. Rolling duration 2s. 2. Passive static stretching 2×60 s	A significant increase in knee flexion ROM was observed after the FR treatment.
Cheatham, & Stull, 2019	36 participants (14 women); Three groups depending on the FR type: 1- smooth surface; 2- multi-level surface; 3- GRID surface. Knee ROM and pain threshold of m. quadriceps femoris assessed before and after the treatment.	Unilateral treatment of hip flexors and m. quadriceps femoris lasting 2 minutes.	ROM increased by 3° for the smooth, 5° for the multilevel, and 6° for the GRID FR group. Pain threshold increased by 14 kPa for the first, 179 kPa for the second, and 182 kPa for the third group.

Junker & Stöggl, 2019	40 participants; 8-week treatment, three groups: 1- upper leg foam-rolling, 5 exercises, 2×week; 2- core-stability, 5 exercises, 2×week; 3-CG. Bourbon test for trunk muscle strength, standing long jump, triple jump, balance test, and sit-and-reach tests (SAR) were applied.	Bilateral treatment of five regions: calf muscles, quadriceps femoris, hamstrings, iliotibial band, and gluteus. For each region, 3 sets of 30-50 seconds of FR with 60s break.	Foam-rolling may be an effective technique to increase SAR ROM without concomitant decrease in muscle endurance and power, and balance ability.
Nakamura et al., 2021	45 participants; Three groups depending on the FR treatment duration. ROM of dorsiflexion, stiffness of Mm. gastrocnemii and muscle strength were measured before, 2, and 30 minutes after foam-rolling.,	Unilateral foam-rolling of calf-muscles: A group 1 × 30s; B group 3 × 30s; B group 3 × 30s; C group 10 × 30s.	2 min after the treatment significant increase in dorsiflexion ROM observed for groups B and C. ROM was restored to its initial values 30 min after FR.
Folli et al., 2021	23 participants (6 women). On three separate days, MVC and SAR were assessed before and immediately after the foam-rolling, static stretching, or placebo intervention.	Bilateral treatment over the hamstrings, 60 s per leg.	All three interventions increased SAR ROM, but none significantly affected MVC.
Lopez-Samanes et al., 2021	11 professional tennis players; Two types of warm-ups in two sessions: 1. dynamic stretching; 2. foam-rolling. Before and after the treatment, squat jump, 505 agility test, 10 m sprint, straight leg raise, and Thomas test.	Unilateral 8 min. treatment: 1. 3 sets of increasing intensity dynamic mobility exercises, break 15s. 2. FR of quadriceps, hamstrings, gluteus, and gastrocnemius for 60s per region	Dynamic stretching improved time in the 505 test. Both protocols had minimal effect on squat jump, 10m sprint, and ROM. Dynamic stretching could be a better type of warm-up for changes of direction and sprinting.
Seever et al., 2022	42 participants, two groups: FR and CG. Two-week intervention, acute effects were measured during and immediately after the treatment. Chronic and residual effects on dorsiflexion ROM and dynamic balance (Y-Balance test) of both legs were measured 24h and 7 days after the intervention.	Bilateral foam-rolling of calf muscles, 3×60s per leg, 6×per week.	Significantly higher dorsiflexion ROM was recorded as a result of individual treatment, after the intervention, as well as 7 days later. FR did not affect Y-balance test performance.
Sulowska-Daszyk & Skiba, 2022	62 participants (recreational, long-distance runners) were divided into two groups: FR and CG without any intervention. Flexibility was assessed before and 15min after the treatment.	Bilateral FR, ~2min (10 movements) per muscle group: hamstrings, gluteus maximus, hip adductors, quadriceps, iliotibial band and gastrocnemius.	Flexibility and ROM were greater in the FR than in the CG group. In CG, a significant improvement was observed only in the hip flexors.
Chang et al., 2021	50 healthy, untrained, and non-sedentary participants randomly divided into FR and CG. Stiffness of gastrocnemius and ankle dorsiflexion ROM were measured before and after the intervention.	The FR group - unilateral treatment of the dominant leg, 3×1 min with a 30s rest between sets. CG - 5-minute passive rest (sitting).	Significantly lower stiffness and greater dorsiflexion ROM after application of FR than after sitting.

Yanaoka et al., 2021	10 active males participated in two tests lasting three days each. Before and after thr treatment with FR, hip joint ROM, muscle stiffness, and muscle pain sensitivity were assessed using the Loughborough Intermittent Shuttle Test (LIST) at 0, 20, and 60 min, and 24 and 48 h after the intervention.	At the end of the 90-minute LIST, a 2-minute massage of the right hamstrings was applied. Medium and hard-density FR was used. The left leg served as the control leg.	Compared to the left leg, larger hip ROM of the right leg was observed immediately after, as well as 20 min, 60 min, 24, and 48 hours after the FR intervention.
Fonta et al., 2021	25 healthy active subjects (11 women). Two interventions were applied (static stretching and foam-rolling) with a 7-day break. Before and after the interventions, trunk and hip flexion ROM, trunk lateroflexion and rotation ROM, as well as isometric MVC and trunk extensors endurance were measured.	1) 3min FR dorsal side and lateral part of the thoracic spine 2) 3min FR on the dorsal side and the lateral part of the lumbar spine 3) 1 min in a standing position against the wall while using FR on the paravertebral muscles of the trunk	Both interventions significantly increased ROM of all observed segments. MVC and trunk extensor endurance were significantly increased after FR but decreased after static stretching.

EG – experimental group; CG – control group; FR- foam roller; ROM- Range of Motion; MVC – maximal voluntary contraction

Table 2. *Overview of studies comparing the effects of a standard foam roller (FR) versus a vibration roller (VFR)*

Research	Methods	Treatment	Results
Ruggieri et al., 2021	15 women, experienced in resistance training, participated in 5 sessions (familiarization, no treatment, FR, VFR, vibration only). During all of the sessions (except for familiarization) before and after intervention, PT, HQ ratio, and the level of activation of the quadriceps and hamstrings, and hip flexion ROM were assessed.	Unilateral treatment of dominant leg hamstrings. Individual muscle heads of hamstrings were treated 3×10s (30s in total). A break between sets lasted 10s. VFR frequency 68Hz.	FR and VRF led to significant increase in ROM for both limbs. The vibration only treatment had an effect only on the treated leg. All three interventions led to a bilateral decrease in the hamstrings PT, and thus to lower HQ ratios.
Tsai & Chen, 2021	16 NCAA Division I volleyball players participated in three sessions: FR; VFR; passive rest. Explosive leg power was assessed using the drop jump test (DJ) performed before, and 2 and 5 min after the intervention.	Bilateral treatment to quadriceps (knees bent and then extended), gluteus, biceps femoris, tibialis anterior, iliotibial band, gastrocnemius, and plantar fascia. 15 minutes (1 min per region, 40 movements/min). VFR frequency 45Hz.	FR increased DJ height and mean power generation at the hip, only 2 minutes, but not 5 minutes after the massage when the values were similar to the pre-test. VFR did not affect the DJ height, but it did contribute to a significant drop in average power.
de Benito et al., 2019	24 recreational athletes (7 women) participated in 3 sessions: FR; VFR; and no treatment. Subjects were fatigued, and the SAR, Y-balance test, and sense of joint stability were evaluated before fatiguing and after the appropriate intervention.	Bilateral treatment to quadriceps femoris and hamstrings. 2×60s (30 movements/min), 30s rest. VFR frequency 30Hz.	The tested abilities were significantly improved after FR and VFR compared to the no-treatment session. There were no significant differences between FR and VFR.
Lim et al, 2019	16 males randomly assigned to FR or VFR group. Isometric EMG activity of rectus femoris (RF), vastus lateralis (VL) and vastus medialis (VM) of the dominant leg, and SAR were assessed before and after the interventions.	Unilateral treatment of the hamstrings of the dominant leg. 5 min (40 movements/min; 30s rest every minute). VFR frequency 32Hz.	Both FR and VFR lead to similar, significant increase in thr SAR ROM. After VFR, a significantly higher activation of RF, VL, and VM was recorded. The activation of RF and VL was significantly higher after VFR than after FR.
Lim & Park, 2019	20 subjects (3 women) randomly assigned to FR or VFR group. Active hip flexion and sitting knee extension ROM, and vertical jump height were measured before and after the intervention.	Unilateral treatment of the hamstrings 5×60s, (total duration 10 min) VFR frequency 32Hz.	Both interventions significantly increased hip and knee ROM. VFR had a greater effect on ROM than FR. Neither VFR nor FR significantly affected jump height.

Romero-Moraleda et al., 2019	38 participants (6 women) randomly assigned to FR or VFR group. Foam-rolling was administered 48h after a single exercise session (10×10 eccentric flywheel squats). VAS, pain threshold, O2 saturation, ROM, and jump height were assessed before and immediately after administerng FR and VFR.	Bilateral treatment of quadriceps femoris 5×60s, 30s rest between sets. VFR frequency 18Hz.	VAS and ROM improved in both groups, but the changes were significantly greater after VFR than FR. In both groups, there were similar, significant improvements in pain threshold, O2 saturation, and jump height.
García-Gutiérrez et al., 2018	38 students (19 women) participated in 3 sessions (FR, VFR, no treatment). Dorsiflexion ROM and isometric MVC of the plantar and dorsiflexors were measured before and after the intervention.	Unilateral treatment of triceps surae of dominant thr leg: 3×20s with a 10s rest between sets. VFR frequency 49Hz	Both treatments contributed to a similar, significant bilateral increase in ROM. No significant changes in MVC were recorded.
Ridha et al., 2021	14 healthy males with limited knee flexion ROM were randomly assigned to FR or VFR group. MVC and the EMG activity of biceps femoris (BF) and semitendinosus (ST) at 30° and 90° knee flexion were measured before and after the intervention.	The authors did not describe the details of the treatment.	After VFR, higher EMG activity of BF30, BF90, and ST90 was observed. After the FR groups, a decrease in EMG amplitude was observed at BF90

PT – Peak Torque; HQ – hamstrings to quadriceps ratio; MVC – maximal voluntary contraction

DISCUSSION

The aim of this paper was to review and analyse the latest research on the effects of the application of foam roller (FR) and a vibration foam roller (VFR) as a method of self-myofascial release on motor abilities, primarily on muscle flexibility and joint range of motion (ROM). The review included a total of 22 original research papers: 14 studies examined the effect of the standard foam roller (FR), and 8 studies that compared the effects of both FR and VFR.

Although the objectives of the studies covered by this review were very similar, there are obvious methodological differences among them including how the effects of the applied interventions were evaluated, the duration of the intervention, the structure/surface of the roller, as well as whether the treatment was applied unilaterally or bilaterally. Thus, in some studies the treatment was conducted before any other activity (Behara & Jacobson, 2017; Cheatham & Stull, 2019; Couture et al., 2015; Junker & Stöggl, 2019; Krause et al., 2017; Miller & Rockey, 2006; Mohr et al., 2014; Murray et al., 2016; Nakamura et al., 2021), while in others it was applied after exercise (Bushell et al., 2015; Laffaye et al., 2019; Macdonald et al. al., 2014; Pearcey et al., 2015), or between sets of physical activity (Santana et al., 2021).

Following the search criteria, the main effect of self-myofascial release using a foam roller is observed through the improvement in flexibility i.e., increased range of motion (Behara & Jacobson, 2017; Behm et al., 2020; Bushell et al., 2015; Cheatham et al., 2015; Cheatham & Stull, 2019; Junker & Stöggl, 2019; Krause et al., 2017; Nakamura et al., 2021; Wiewelhove et al., 2019). Although we did not use statistical techniques to compare the effects among the studies, the summary of the results indicates that after treating soft tissues, a short-term increase in ROM can be expected (range 2-6°, relative change 2-10%), regardless of the foam roller type. However, it is interesting to note that in some cases VFRs have shown to be more effective than standard FRs. Namely, both types of foam rollers lead to improved ROM, with Lim et al. (2019) and Romero-Moraleda et al. (2019) stating that the treatment using VFR had a greater effect compared to regular FR. Unfortunately, those few studies that examined the delayed effects of the intervention do not support the hypothesis about the residual effect of the applied treatment. Also, despite many studies supporting this view, there are conclusions on the lack of connection between foam-rolling and increased range of motion (Miller & Rockey, 2006).

In addition to the effect on ROM, some of the studies included in this review, investigated the effects of FR on other motor abilities, primarily on muscle strength and power. Only a few studies have evaluated changes in balance. Findings on the effect of foam-rolling on strength and power are ambiguous, although the most recent study supports the opinion that treatment with FR does not lead to significant changes in those muscular capacities (Behara & Jacobson, 2017; Behm et al., 2020; Couture et al., 2015; Folli et al., 2021; Laffaye et al., 2019; Wiewelhove et al., 2019). Studies where significant improvements were observed reported better characteristics of neuromuscular function (Santana et al., 2021), such as greater muscle activation (Lim et al., 2019; Ridha et al., 2021), greater maximal voluntary contraction force (MVC) and better force endurance (Fonta et al., 2021), and greater power (Moraleda et al., 2019; Tsai & Chen, 2021). Interestingly, positive effects on muscle activation were noted mainly after VFR, but not after FR, most likely due to the influence of vibration (Lim et al., 2019; Ridha et al., 2021). Explosive power generation in terms of vertical jump performance has also been a topic of research and just as with muscle strength, the findings are ambiguous: while some say they observed an increase in jump height after foam-rolling (Romero-Moraleda et al., 2019; Tsai & Chen, 2021), others suggest that such treatment does not lead to significant changes in jump performance (Junker & Stöggl, 2019; Lin & Park, 2019; Lopez-Samanes et al., 2021).

Ambiguous findings were also obtained in terms of balance: de Benito et al. (2021) suggest that foam-rolling promotes the recovery of the ability to maintain dynamic balance, while Seever et al. (2022) say that long-term application of FR (two-week intervention) does not lead to significant changes in Y-balance test results.

Muscle soreness and muscle tone are characteristics of neuromuscular function that can have influence on motor abilities, primarily through limited ROM and reduction of capacities for muscle force and power generation. Several studies reported a decrease in muscle soreness (Laffaye et al., 2019; Santana et al., 2021), increase in pain threshold (Cheatham & Stull, 2019), and resistance to fatigue (Santana et al., 2021), which may have contributed to better flexibility and ROM immediately after the foam-rolling treatment (Cheatham & Stull, 2019; Folli et al., 2021; Fonta et al., 2021; Krause et al., 2017; Laffaye et al., 2019; Seever et al., 2022; Sulowska-Daszyk & Skiba, 2022).

When discussing the results and findings of the reviewed studies, one must consider the diversity among the applied protocols, with different outcome measures and intervention parameters, whereby the physiological mechanisms responsible for the reported findings are not fully known or sufficiently investigated. We should not ignore

the fact that the outcome of the treatment may depend on the characteristics of the roller itself, and that the GRID rollers, multi-level, or vibrating rollers may have greater immediate post-intervention effects compared to smooth surface FRs (Cheatham & Stull, 2019). Although it has already been said, we would like to highlight the observed diversity in the research protocols, primarily in terms of the duration of the foam-rolling. In some studies, the treatment lasted only 15s, and in others up to 2 minutes (Cheatham & Stull, 2019), which obstructs the comparison of research results. Finally, despite gaps in knowledge and many contradictions regarding the effects of foam-rolling, there is a lack of studies that sought to determine the long-term effects of foam-rolling on physical abilities and neuromuscular function. Namely, one of the main disadvantages of longitudinal research is the impossibility of constant monitoring of participants (Miller & Rockey, 2006).

Although foam-rolling is often applied both in sports and rehabilitation, due to the heterogeneity of methods among the studies, there is currently no official recommendation on the optimal manner of use of FR (treatment time, pressure, and cadence). Nevertheless, current findings can be useful for future research that should further examine the underlying physiological mechanisms, with particular attention dedicated to possible contraindications and precautions when foam-rolling is used as a therapeutic tool or as an auxiliary tool in sports training. Although the basic physiological effects of FR and VFR are not fully understood and were not the subject of this paper, the potential of self-myofascial release using a foam roller certainly calls for additional research in this area.

CONCLUSION

The latest studies confirm earlier findings that foam-rolling can have a short-term positive effect on muscle flexibility and ROM in the joints, while the findings regarding the effect on the muscle function capacities (strength, explosive power, etc.) and balance are ambiguous. In comparison to static stretching, the favourable effects of foam-rolling on motor abilities or individual muscle's function (e.g. quadriceps femoris or hamstring muscles), or some motor tasks (e.g. jumps) have been confirmed when applied for longer than 60s, or if a VFR was used. Furthermore, some evidence suggests that FR may be a more appropriate alternative to static but not to dynamic stretching during warm-up. The research results certainly indicate that VFR massage could be an additional option for untrained adults as well as athletes to improve ROM. In addition, it has been noted that foam-rolling with FR or VFR can delay the onset of fatigue and relieve muscle soreness after intense exertion. Taking this into account, the findings suggest that the application of FR could have a positive effect on alleviating muscle hypertonicity, which is very important during warm-up, rehabilitation, or corrective exercise treatments for the prevention and correction of postural disorders.

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Scientific review **CC BY**

ORGANIC FOOD – PRO ET CONTRA[1]

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Abstract: Based on all available information, there has been a great expansion of organic food production and sale, both globally and in Serbia. It is estimated that this expansion results from buyers' belief that organic food is tastier and/or healthier, more nutritious, that it contains less pesticides, preservatives, additives, thaat it does not contain any genetically modified components, etc. However, which of these beliefs are facts, and which are misconceptions? In the absence of studies dealing with the issue of organic food in Serbia, we rely on the results of studies conducted in the world, primarily in countries where the production and sale of organic food has a decades-long tradition. Most studies covered by this review refer to the presence of pesticides in organic food and they all unequivocally established that organic food contains significantly lower amounts of pesticides than conventionally produced food. In terms of other aspects of health safety, it was found that organic food has significantly lower values or absence of antibiotics, growth hormones and factors, genetically modified components as well as artificial preservatives and additives. Some of the research that was conducted to confirm the claim that organic food is more nutritious than conventionally produced food, established that some foods have more vitamins, minerals and antioxidants. However, numerous studies did not confirm these conclusions, but rather found that there is no significant difference between the content of the mentioned ingredients in organic and conventional food. Which of the above is true will be confirmed by some future, fully objective studies.

Keywords: *organic food, conventional food, pesticides, additives*

INTRODUCTION

The term "organic food" first appeared in 1940, in the book "*Look to the Land*" written by Walter James and referred to the "farm that exists as an organism", an ecologically balanced, holistic system that stands in contrast to the "chemical farm" which cannot survive without human influence (Paull, 2006). The term "organic" as used in the biomedical sciences refers to molecules containing carbon and has nothing to do with organic food. An adequate, generally accepted term related to food obtained in the usual production processes is not "inorganic food" (because the food is not inorganic in the bio-medical sense), but "conventional food".

Organic food is produced in accordance with standards prescribed by relevant, authorised bodies or organizations. The USA (the National Organic Program), Australia (the Australian Organic Standards and the NASAA Organic Standard), the EU (the EU-Eco-regulation), Japan (the JAS Standards), India (National Program for Organic

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Production) etc. have the longest tradition in the standardization of organic production and distribution, as well as the most developed system of certification. According to most standards for production and trade, organic food is produced with minimal use of artificial chemical substances, under clearly defined environmental conditions, and strictly specified storage and transport conditions. In addition, more and more countries are accepting the norm that nanotechnology should not be used in the production of organic food (Paull & Lyons, 2008). As a result of applying these standards, organic food does not contain (or contains very small amounts of) pesticides, artificial preservatives, additives, heavy metals, antibiotics, hormones, genetically modified organisms and other potentially harmful substances.

According to information from the market, the production and sale of organic food is on the rise, both globally and in Serbia. In April 2009, organic food accounted for 1-2% of total food sales in the world, while in 2021 its sales reached 5.7% (Danner et al., 2022). The total sales of organic food in the world in 2002 amounted to around EUR 23 billion, and in 2016 it exceeded EUR 106 billion. Today, organic production is practiced in 190 countries, on a total of 75 million hectares cultivated by about 3.3 million farmers (Willer et al., 2022).

The UK Soil Association, the biggest organization for organic standards in Great Britain, underlines that the rise in the production and sale of organic food is a consequence of buyers' increased concern regarding the use of pesticides and other artificial substances, but also the raised awareness of how and in which conditions the food is produced, as well as for how long and in which conditions it was transported to buyers. In this regard, there is a prejudice that organic food is tastier and/or healthier, more nutritious, that it was produced in more environmentally friendly conditions, that it did not travel long from the place of production, that it does not contain artificial additives, preservatives, pesticides, genetically modified components, etc...

What of all this is fact and what is misconception?

Organic food and pesticides

First of all, not only natural substances are used in the production of organic food, but it is also allowed to use some artificially obtained chemical substances. Moreover, sometimes it is wrong to insist on natural agents. For example, some producers use natural fertilizers in the supplementation process that contain E. coli, which can cause health problems and can only be destroyed by prolonged exposure to high temperatures. There are plant-based pesticides, natural substances that protect plants from pest attacks. However, even those pesticides (Bacillus thuringiensis, pyrethrum, rotenone and similar substances) can be dangerous to human health, so in the USA they are completely prohibited in the production of organic food (Uddin & Bari, 2019).

On the other hand, synthetic pesticides are substances that without any doubt cause health problems in humans, either in workers on the farms where the pesticides are applied, or as substances whose residues we ingest in small quantities with food and water, or as substances that remain in the soil , contaminating food and water. Hundreds of studies have shown that exposure to pesticides can cause numerous health ailments and problems, such as abdominal pain, dizziness, migraine headaches, nausea and vomiting, as well as skin and eye problems (Ali et al., 2021; Ecobichon, 1991; Rani et al., 2021; Yura et al., 2021). However, pesticides can also cause more severe health problems, such as respiratory problems (Hughes, 2022; McCauley et al., 2006), cancer (Alavanja et al., 2004; De Graaf et al., 2022; Matich et al., 2021; Panis et al., 2022; Sandoval-Insausti et al., 2021; Van Maele-Fabry & Willems, 2003), depression (Kamel et al., 2003; Wu et al., n.d.), neurological problems (Arab & Mostafalou, 2021; Keifer & Firestone, 2007; Richardson et al., 2019), miscarriage and congenital anomalies (Engel et al., 2000; Fucic et al., 2021; Li et al., 2022; Schwartz et al., 1986) etc.

A US Department of Agriculture 2020 study which conducted testing of fresh and processed fruits and vegetables from organic and conventional production for the presence of about 400 different pesticides, showed that 30% of the samples had no detectable pesticides, while only 0.49% contained pesticides in an amount higher than prescribed. Out of a total of 9600 samples, 706 of them were from organic production. In the organic sample, around 30% of food did not contain detectable pesticides, and none of the samples contained pesticides in an amount higher than prescribed. For example, out of 19 examined kinds and products of fruits and vegetables, potato contained the highest values of pesticides, but organic potato contained virtually no pesticides (USDA, 2020). In addition to this one, many other studies confirm that there are no pesticides or their products in 25-30% of organic food (Crinnion, 2010; Schleiffer & Speiser, 2022).

Conventionally produced apples, unlike organically produced ones, are treated up to 16 times during the season with about 35 pesticides (Reganold, 2006). However, it must be underlined that conventional food, which

contains many times greater amounts of pesticides, still does not contain toxic amounts, which is taken into account during regular and extraordinary physical, chemical and health controls.

Additives and genetically modified organisms in organic food

Organic food must not contain additives such as saturated fats, artificial sweeteners and colouring, many of which are connected to the risk from developing asthma (Woessner et al., 1999), migraine headaches (Kelman, 2007), growth and development disorder and children hyperactivity (Kraemer et al., 2022). Organic food does not contain genetically modified organisms, nor are they used in the production process.

Nutritional value of organic food

One of the largest review studies was published in 1998, comparing the nutritional characteristics of organic and conventional foods. A comparative review of data from 34 previously published studies found that organic foods contain higher amounts of vitamin C, as well as most minerals (Worthington, 1998). In another well-known review study by the same authors (Worthington study), which analyzed data collected from as many as 41 studies, nutrient values of fruits, vegetables and grains were compared. This study showed significantly higher values of vitamin C (27%), iron (21.1%), magnesium (29.3%) and phosphorus (13.6%), compared to conventionally produced food. In addition, this study concluded that organic vegetables (spinach, carrots, potatoes, cabbage, lettuce) contain significantly higher amounts of vitamin C, compared to conventional vegetables. In addition, nitrate content was 15.1% lower (Worthington, 2001). Similar results were reported by Xiaofan et al. in a recently published large study conducted in China: organic fruits and vegetables had significantly more vitamin C, anthocyanins, isoflavonoids, carotenoids, phosphorus, iron, magnesium, zinc, copper and chromium, while foods of animal origin contained significantly more polyunsaturated fatty acids. Organic products had significantly lower amounts of nitrates and heavy metals, and no pesticides were registered (Yu et al., 2018). Very similar findings come from a study published by Brandt et al. (Brandt et al., 2011). In addition to this, it is interesting to mention that a team of Swedish scientists found that plants exposed to insect attacks produce polyphenols, which are among the strongest antioxidants, as a defensive measure. If they are protected from insects by pesticides, they have no need to create these beneficial substances. Untreated organic food thus has a double quality: lower levels of pesticides and higher levels of polyphenol antioxidants (Olsson et al., 2006). Organic vegetable soups have up to six times higher salicylate values, which are extremely important in the prevention and treatment of cardiovascular diseases, arteriosclerosis and colon cancer (Baxter et al., 2001).

However, not all studies confirm higher nutritional value of organic food and its beneficial effect on human health. One review of the literature concluded that "there is no strong evidence that consumption of organic foods contributes to health through its nutritional properties" (Dangour et al., 2009). Also, many other studies found no evidence that organic food is more nutritious, but they did establish that such food is safer to eat because it contains lower amounts of harmful substances (Ditlevsen et al., 2019; Forman et al., 2012; Williams, 2002). Interestingly, organic food can contain more natural biotoxins, such as solanine in potatoes (which is supposed to protect the plant from insects and other pests in the absence of pesticides and insecticides), which can be potentially dangerous to humans (Friedman et al., 2017).

We believe that it is almost impossible to observe in isolation the impact of the nutritional composition of organic food on a person, because health is affected by other factors, such as lifestyle (alcohol use, exposure to cigarette smoke, amount of food and its caloric value, amount of physical activity, etc.), environmental factors (air, water quality), genetic factors, etc. Therefore, this very important question should be analyzed in a strictly controlled study in which the influence of the mentioned factors would be minimized.

Why does organic food cost more?

Organic dairy products, wheat, grains, meat and other products cost more primarily because they are not produced in large quantities. These are small productions, on small farms and plots, so production costs are higher per unit of food produced. Organic producers strictly adhere to regulations that require that in food production they do not use antibiotics, hormones, pesticides, preservatives and additives to increase, preserve and maintain products, so part of the product perishes during the production, storage or transportation process. In the case of dairy products, eggs and meat, the price is also affected by the prescribed number of animals per unit of land area. For

these reasons, organic products in the US cost anywhere from a few to as much as 240% more than conventional products (USDA, n.d.).

CONCLUSION

The production and sale of organic food is on the rise. There is every chance that, as in any other big business, opinions are expressed regarding this matter that are either excessively favourable or extremely unfavourable, depending on whether they are written by supporters or opponents. Contradictions reported by large scientific studies dealing with exactly the same subject of investigation speak in favor of this. This is also the reason to conduct authentic, objective research as soon as possible in Serbia, which should confirm to us that organic food has positive nutritional and health characteristics. In the diversity of information available to us, we tend to believe that the magic of organic food exists, after all.

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BURNOUT SYNDROME IN ATHLETES[1]

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Abstract: Burnout syndrome is a consequence of accumulated stress, caused by excessive engagement, both in the physical and mental (psychological) domains. It is characteristic of many professions, especially professions that involve direct work with people (healthcare, education, army, etc.), and in sports it is almost inevitable. The two most common reasons that cause burnout syndrome are: setting hard-to-achieve goals or unrealistic deadlines and trying to meet other people's (imposed) expectations. In both cases, endurance limits are pushed, which leads to burnout and has consequences for the entire human body and psychophysical health. We live in a harsh age where it is not enough to be successful, the demand is to be the best. This ultimatum is particularly prominent in sports. Athletes are distinguished from others by discipline, perseverance, persistence, focus on the goal (victory), sacrifice and responsibility. Top fitness and top results are always expected from them. The question arises: Is it even possible to achieve top results and avoid the burnout syndrome? In addition to the analysis of causes, symptoms and consequences, the paper seeks an answer to this question.

Keywords: *affirmation, burnout syndrome, expectations, suppression, stress*

INTRODUCTION

Burnout syndrome has become a relevant issue in the past few decades and people who deal with psychology, sociology, interdisciplinary and medical sciences discuss and write about it, because the problem is interdisciplinary and can be viewed from several angles, in order to answer the question of how this syndrome arises, how to recognize it, treat it and, above all, prevent it.

The term burnout syndrome, which is used in most of the world, including here, was introduced by Freudenberg in 1974. "The name comes from the title of Graham Greene's novel *A Burn-Out Case*, published in 1961, in which a disillusioned architect quits his job and goes to an African jungle" (Dedić, 2005, p. 851).

There are different opinions as to what causes burning out. Erić (2021, p. 132) states: "The concept of suppression as a defence also opened a new perspective on the most important mechanisms of the onset of psychological disorders, observing them through the psychological mechanisms of defence that people use to overcome their life problems, which can be unconstructive and impoverishing and to bring a person into a sick state".

"People suffer (and not only suffer, but also get sick) because of untold stories, because of their own unfulfilled desires, because of (repressed or separated) sense", says Dimitrijević (2005, p. 215).

Adler (2020) believes that it is the feeling of inferiority that triggers all our mechanisms (especially organs) to engage with increased effort.

Bačanac and Radovanović (2005) point out that the cause lies in the desire for affirmation.

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Galić (2006) believes that the cause should be sought in the demands of the environment, integration into micro and macro collectives.

Richard H. Cox (2005) analyses the personality of athletes and claims that the response to stress primarily depends on the complex structure of the personality.

Karaleić (2019) believes that inadequately regulated stress in sports leads to burnout syndrome.

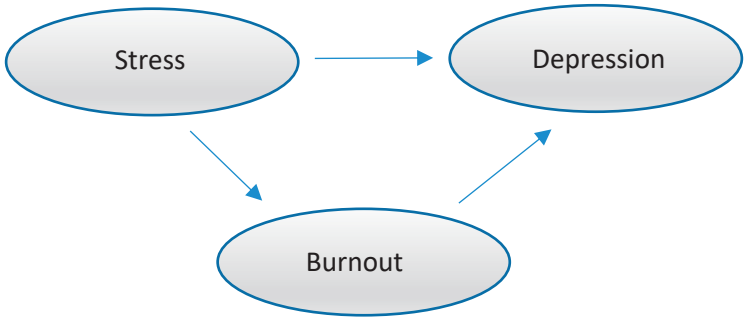
Čabarkapa (2020) points to the complexity of this syndrome and the necessary cooperation of doctors and psychologists in diagnosing it.

Freud (2013) emphasizes that we cannot explain any psychological phenomenon or illness with symptoms, as they only serve to recognize the condition, especially in situations of suppressed stress.

Dedić (2005) believes that emotional exhaustion, depersonalization and low personal achievement are the cause of burnout at work.

Cristina De Francisco et al. (2016) conducted a study in 2016 on a sample of 453 athletes from Spain on the topic: *Causes and Consequences of Burnout in Athletes: Perceived Stress and Depression*, and reached the following conclusion: "In short, studies on the origins of burnout in sports enabled the determination of burnout as a consequence of the chronic stress process. Empirically, it was also possible to establish positive relationships between depression and burnout. However, there is no literature in which these constructs are analysed together in order to establish clear relationships between them. Furthermore, there is no evidence of the form and degree of association between these variables. In this study, we hypothesize that: 1) stress has a positive effect on burnout in the context of sports, 2) burnout also has a direct effect on depression in the context of sports, and 3) stress has two types of effects on depression, one direct and the other indirect through burnout. (Figure 1 reflects the structure of the relationship between the three psychological constructs)" (p. 241).

Figure 1. *Hypothetical model*
Source: Cristina De Francisco et al. (2016, p. 241)



The relationship between stress and burnout in athletes will be further discussed in the the paper, with the aim of determining the possible conditioning, the connection between these two states of the organism that would be specific for athletes in seeking answers to what could be the most common cause of burnout and whether it can be alleviated or avoided.

METHOD

The paper used the method of induction, the descriptive method and the method of analytical reasoning.

NEED FOR AFFIRMATION

The desire for affirmation, the need to be acknowledged, accepted, praised, is something that develops from early childhood and manifests itself in different forms and dimensions. It begins with drawing the attention of the environment to us, and ends with imposing one's goals, attitudes, and aspirations.

One of the most common causes of frustration is when we fail to assert ourselves in our field of work. In sports, it is mostly related to results, winning titles, trophies, medals, etc. It often happens that burnout syndrome occurs during the preparation stage, disappointment emerges due to the absence of results, which then causes depression, demotivation and illness; the statements of the athletes, who talked about the reasons for their giving up and retiring at the peak of their careers, lead to the conclusion that stress and pressure are equally present when maintaining the achieved results.

According to Plunkett (2016), Anthony Erwin, an American swimmer, member of the US Olympic team, left the competition at the age of 35 due to burnout and became a swimming instructor. Four years later, when he saw the children he coached in the pool, he declared, "I just wanted to recapture that playfulness of being in the water. Why am I doing this? I enjoy work in itself".

Plunkett goes on to refer to Jax Mariash Koudele, who at age of 36 was on track to become the first woman to finish the gruelling Grand Slam Plus running event. Koudele said she was struggling with motivation amid her quest to win the series, stating at the time: "Someone asked me what was the hardest thing about the Grand Slam Plus Series, and I really think it's one of the hardest challenges - especially when you're trying to win everything - stay at that level of training, mentally and maintain that level of fitness for the whole year."

ENVIRONMENT DEMANDS

Galić (2006) explains the need for personality affirmation, which is closely related to integration into the micro and macro environment: "Everyday life and work of people in micro and macro teams is the only condition for the true affirmation of an integral personality, for the real manifestation of the creative qualities of most people, and full development of each social community as a whole. The very concept of integral personality gets its true meaning only in life as part of a team, where the collective and personal, joint and individual, communal and private face each other. Life in a certain collective is today the only way of life" (p. 216).

All our affirmations, but also frustrations, arise in interaction with others. In the course of one's life, a person strives to find and keep their place in both smaller and wider community. Immature personalities experience surprise and a sense of injustice when others fail to see all those things they think about themselves. Mature personalities strive to be better, to overcome the set limits, to renounce conformity for the sake of achieving results that would realistically make them stand out from others. Athletes certainly belong to the latter. Persistence, self-discipline, sacrifices are a sure path to success, but also a path to burnout.

Athletes are frequently forced to justify their investments, to return the investment by achieving certain results, which represents an additional burden and then sport ceases to be a path to self-realization and becomes a business, it comes down to the economic balance. As a rule, this leads to double burnout - on the one hand, physical effort, on the other hand, mental stress, which leads to a complete replacement of theses: sport is no longer a desired activity, but a compulsive one.

DIAGNOSIS, DIFFERENTIAL DIAGNOSIS AND THERAPY

It is interesting to emphasize that most doctors and psychotherapists claim that physical activity is crucial for health in general and that it an effective stress-management tool.

So how is physical activity a predictor of burnout syndrome in athletes?

The answer lies in excessiveness, exhaustion, constant pushing of endurance limits, which in a way is expected of athletes, especially prior to a competition. When symptoms of impaired health appear such as: increased anxiety, loss of focus, hormonal imbalance, loss of appetite, loss of sleep, increased blood pressure, palpitations, headache, nausea, depression/aggression, depersonalization, alienation from family and friends, regression of thinking (paraphrenia) etc., it is very difficult to make a precise diagnosis at first, because one or more of these symptoms can be the result of different diseases, and they can also indicate the frequency of stress that leads to burnout.

As pointed out by Čabarkapa (2020): "Given the fact that the burnout problem is characterized by mostly non-specific symptoms, a comprehensive and differentiated approach is necessary when we talk about establishing a diagnosis of burnout syndrome. For the diagnostic process, medical expertise is as important as interdisciplinary

cooperation and communication between all people involved in the diagnostic process (patient, general practitioner, specialist, psychologist, etc.)".

On the medical side, diagnosing burnout syndrome is very complex, because people with this problem usually see a doctor when any type of pain becomes chronic and cannot be treated with available drugs.

Pain is at the same time a reaction of our organism and an alarm that something is wrong. In case of physical pain, neurotransmitters accurately send feedback about the location of the pain. It is different with psychological pain. The whole organism sends signals that something is wrong and then it is the cause, not the location that needs to be looked into. The well-known proverb "A healthy mind in a healthy body" is often quoted by psychologists with the addition "and vice versa".

Adler (2020, p. 71) explains that "the mental mechanism of striving for compensation, which the mental organ uses to respond to the feeling of inferiority in order to alleviate this painful, tormenting feeling, has an analogy in organic life. It is a proven fact that vital organs, when they show weakness and impotence, if they are viable to any extent, begin to respond by an extraordinary increase in their efforts".

RELATIONSHIP BETWEEN PERSONALITY AND BURNOUT SYNDROME IN ATHLETES

Richard H. Cox studied personality levels in athletes and observed that burnout occurs due to membrane permeability between these levels. "Personality can be divided into three separate but interconnected levels. These are: (1) Mental cores, (2) Typical reactions (3) Role-related behaviors. The mental core of the individual preserves the idea of the personality as it is in reality. It includes self-concept. Mental core is the central part of one's personality, it includes basic attitudes, values, it is the "real self". Typical reactions are the usual way we react to situations in our environment. Role-related behaviours are the aspect of our personality closest to the surface. We engage in role-related behaviour in such a way that we adapt it to the perception of our environment" (Cox, 2005, p. 31).

Cox states that to understand the personality of athletes, we cannot rely on behaviour related to roles, but rather on typical reactions, because we find them more basic. But, reaching mental core is mostly blocked in situations of increased or frequent stress, because our organism defends itself by suppression, which Freud writes about in detail in his works. Suppression, again, accumulates stressful conditions in the deeper layers and deposits them, until the pressure on the permeable membrane, which Cox speaks of, occurs. This is the burning point and it is dangerous because the organism is no longer able to provide an adequate response.

IMPACT OF STRESS ON BURNOUT PROCESS IN SPORT

"Stress that is not adequately regulated in sports can be linked to increased anxiety and the occurrence of burnout syndrome, increased aggressiveness and violent behavior, a decrease in self-esteem and enjoyment in sports," defines Karaleić (2019, p. 122).

It is difficult to specify with certainty whether a mental state of exhaustion leads to a physical one or vice versa, but one thing is certain: a person is a unity of both and one symptom always triggers the other.

Although stress is one of the most common causes of burnout syndrome, there is a difference between stress and burnout syndrome. Stress in itself is not always unnatural, nor necessarily a harmful condition, but it even contributes in some situations to the mobilization of all our defence mechanisms.

Theresa Chyi et al. (2018) conducted a study in 2018 on the topic *Predicting Life Stress on Burnout in Athletes: Dual Role of Perceived Stress*, on a sample of 195 athletes (138 men and 57 women), recruited from two sports colleges and four universities in Taiwan: "This study demonstrated the intertwined relationships of life stressors, perceived stress, and burnout among student athletes. The negative component of perceived stress was a mediator in the relationship between stress and burnout in general and life and sport and life. On the other hand, the positive component of perceived stress played a moderating role between generations of life stress-burnout, but not in the condition of sport-specific life stress".

The authors of this study suggest that in order to promote health and reduce stress, life-management programmes for young athletes should be created and promoted.

DISCUSSION

Analysing various authors who researched the causes, symptoms and consequences of this relatively new (burnout) syndrome, we observe important aspects that indicate the complexity and connection (conditionality) of various factors that lead to burnout syndrome.

Affirmation is always related to integration into a smaller or wider community and environment, so Galić (2006) emphasizes that the very concept of integrality of personality is always related to the demands of the environment, which often lacks understanding for the individual and their needs. Athletes are role models for many, especially young people, so the expectation to maintain the unrealistic image of heroes, successful people, champions creates additional pressure.

According to Bogunović (2022), one of the possible consequences of unfulfilled expectations can further develop in the direction of thought regression (paraphrenia), and even further, such as paranoia and sensory hallucinations. This is the kind of an expression of the mental nature that was observed in unfulfilled athletes, as concluded by interactive psychoanalysts at the Institute for Philosophy and Interdisciplinary Studies in Novi Sad.

Accumulated, suppressed, delayed phenomena of frustration, dissatisfaction, depression, alienation, that emerge due to the highly demanding concept of discipline, renunciation, strenuous exercise (especially in the period of maturation of young people who have opted for professional rather than recreational sports), frequently lead to burnout.

The World Health Organization (WHO) has only recently included burnout syndrome in its *Disease Classification Manual*, so that from now on, healthcare professionals will be able to diagnose this disorder as a medical/health condition (Zavod za medicinu rada i sporta R. Srpske, 2021).

As Dedić (2004, p. 851) noted: "A condition similar to the phenomenon described in the professional literature was previously known as 'reaction to exhaustion'. In psychiatry, according to the *Classification of Mental and Behavioural Disorders* (ICD-10), this disorder is included in the diagnosis Adjustment disorders (F 43.2), which are characterized by disorders in social, work-related or academic functioning".

When stress in sports is not regulated properly and on time, Karaleić (2019) claims that, anxiety and burnout inevitably occur; that is why sport is a profession with a shorter lifespan than other professions.

CONCLUSION

Engaging in sports is certainly a way to a healthier life, especially nowadays, when a significant number of professions are increasingly linked to modern technologies that force people to work in a sedentary position in front of a computer, which affects their physical, social and mental state and health.

But sport as a profession is one of the most demanding professions that requires a lot of sacrifice, discipline, endurance, persistence, focusing on the goal, maintaining the achieved results, pushing the limits of success, but also endurance.

Most of the authors mentioned in the text are trying to find an answer to the question: What causes burnout in athletes?

Stress appears to be the most frequently mentioned reason. No matter how individual the responses to stress are, what they have in common is that stress is the "trigger" of many diseases, including burnout syndrome. Indicators of stress in athletes, such as: own ambitions, demands of the environment, self-denial, persistent and hard training, increasing competition, etc., depend on many factors and it is difficult to classify them as a general rule.

Success is the measure and result of all the efforts of an athlete. But success is a matter of the moment, while the path to success consists of renunciation, adaptation, self-discipline, persistence, etc. It should be kept in mind that any achieved result, if the cost is burnout (impairment of health), is not a success but a Pyrrhic victory.

How to act preventively to alleviate or avoid the burnout syndrome?

- Follow the signs of the organism. We notice and focus our attention on the environment and others much more easily and more often than on ourselves. Migraines, insomnia, nausea are symptoms more often caused by an internal disorder than by external factors.
- Raise awareness of suppressed defence mechanisms. For this, we usually need others (a friend, a family member, a coach, a pedagogue, a psychoanalyst).

- Conscious repressed content can also cause intense stress if we dwell on it. It is necessary to rationally analyse one's conditions and reactions, to give them the right name and significance, and to notice (find out) the causes that led to it.
- Work to eliminate the causes, not just the consequences.

In addition to coaches, sports clubs should have to have a psychologist who would monitor the mental state of each athlete and, in cooperation with the coach, adapt the requirements of professional sports to the complex personality structure of each athlete.

This kind of prevention requires the awareness of the individual, but also of the entire environment and society.

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SPORT – SCIENCE AND PRACTICE

INSTRUCTIONS FOR THE AUTHORS

The scientific journal SPORTS – SCIENCE AND PRACTICE is an official publication of the College of Sports and Health from Belgrade. It was established in 2009, and it publishes original scientific, review and professional papers from areas analogous with sports and health (http://sportnaukaipraksa.vss.edu.rs/snp-en.asp).

The journal is published online twice a year, in June and December, in Serbian and English. On the list of the Ministry of Education, Science and Technological Development of the Republic of Serbia, it is in the category of **National journals - M53** (https://mpn.gov.rs/nauka/nauka-i-istrazivanje-u-srbiji/kategorizacija-naucnih-casopisa/).

The journal is indexed by the Serbian Citation Index (SCIndeks), in the **B2 category – Journal of transnational / regional importance in Social sciences research area** (https://scindeks.ceon.rs/journaldetails.aspx?issn=1821-2077&lang=en).

When writing and publishing papers, the authors are obliged to respect scientific and ethical principles, in accordance with international and academic standards. The journal's publication policy is described in detail at the link https://scindeks.ceon.rs/PublicationPolicy.aspx?issn=1821-2077&lang=en.

All manuscripts are to be submitted electronically, via a system for online editing and publishing of journals - ASEESTANT (https://aseestant.ceon.rs/index.php/snp/). In exceptional cases, a manuscript can be submitted to the following email address: redakcija@vss.edu.rs.

The manuscripts must be previously unpublished (the exceptions are abstracts from scientific conferences, lectures and academic theses), and not undergoing editing in another journal. When the manuscript is accepted for publication, it must not be published in another journal in Serbian, English or any other language. **All manuscripts are screened for plagiarism immediately after submission**.

A cover letter is sent with the manuscript, its aim being to present the authors and point to the essence, significance and original scientific and professional contribution of the paper. The letter is to include the first and last names of the authors, date of birth, the affiliation, academic title and position, email address (business email, if possible) and a phone number. **A paper can have a maximum of three co-authors**, and in case of original scientific papers that involve collective research on field, five co-authors are allowed.

After reading the manuscript, the editor makes a decision regarding further proceedings. The manuscript is sent to the reviewers or back to the author with appropriate comments, or rejected. A paper is not accepted for publication if it does not comply with the standards of the journal, if the topic of the paper is not relevant, or if a paper with a similar topic has already been published in the journal.

All manuscripts undergo editing. The identity of the reviewer and author is anonymous (*double-blind review*). There are two reviewers for each manuscript, from the relevant scientific area. After the review, the manuscripts are accepted for publication or refused, or returned to the authors for changes according to reviewers' suggestions. **The manuscript needs both reviews to be positive to be accepted for publication**. In cases of completely opposing views of the reviewers, a third reviewer may be hired.

After receiving a positive review and formatting the final version of the paper in Serbian, the authors are obliged to submit the English version, which must be true to the original. Therefore, it is necessary to submit **quality and professionally translated papers**; otherwise, the translation will be returned for revision.

The papers are sent in *MS Word*, using the *Times New Roman 12pt* font. The papers should not exceed 15 A4 pages, including all tables, diagrams, charts, graphs and references. The texts are usually monospaced, and all four margins (upper, lower, left and right) are 2.54 cm.

THE STYLE AND STRUCTURE OF THE TEXTS

The following format is used for writing original scientific papers: INTRODUCTION, METHOD, RESULTS, DISCUSSION, CONCLUSIONS, REFERENCES.

The bibliographical-speculative method is used and deviations from the suggested structure for original research papers are allowed, while the author will adapt the structure to the contents of the prepared material, taking into account the proper marking of chapters and subsections. The numbering is the same as with the original papers (1. XXXX, 2. YYYY, 2.1. Yyyy, 2.2. Yyyy, etc.). Every claim, new classification, or synthesis of knowledge, should be based on the results of previous researches.

THE TITLE OF THE PAPER

The title should contain the following information:
- a precise and informative title which does not contain abbreviations
- in the case of empirical scientific papers, it is necessary to specify the variables and the nature of their links with the title
- the first and last names of all authors, without their titles
- the institution where the author works, as well as the city and state, should be noted underneath the name of every author
- a footnote notes the email address of the author for possible correspondence

ABSTRACT AND KEYWORDS

The abstract should include a general review of the topic. It must contain a defined aim and objective of the paper, a short description of the applied research proceedings, the most relevant results and conclusion. The abstract should be from 150-250 words.

Up to 5 keywords are given below the abstract.

INTRODUCTION

The introduction should contain a short review of the relevant research. **All the used bibliographical sources are to be mentioned in the references at the end of the article**, as well as in the text, noting the last names of the author and the year of publishing in parentheses. For example: (Lazarević and Havelka, 1981). Bibliographical sources SHOULD NOT be mentioned in the text in a footnote.

The topic and aim of research should be precisely defined, as well as the scientific validity and professional relevance of the researched topic.

In order for the paper to be more understandable to less informed readers, the editorial staff recommends that a short explanation of the basic concepts is given in this segment of the paper.

METHOD

This part should give a detailed description of the methodological procedure which would enable other researchers to repeat the testing.

It should contain the following subtitles: Samples, Variables, Techniques for data collecting, Testing procedures, Statistical analysis.

Every instrument used (survey, interview, scale, test etc.) must be shown in its integral form or illustrated in a shortened version.

RESULTS

In this part, it is necessary to concisely show the most important results, with short and clear instructions. It is possible to separate several parts, depending on the nature and complexity of the data. If shorter parts are used, it is necessary to label them precisely.

The results need to be presented and statistically processed (avoiding raw data). In the aim of a better assessment of results, it is optimal to use tables, graphs and images, and not repeat the data analyzed in the text. **Each table, graph, or image must be clearly numbered and mentioned in the text**. For example: Image 1, Graph 1, Table 1, Table 2, etc.

Tables, diagrams and images are always numbered precisely and consistently. They are an integral part of the text, and not an addendum. The numbering and labeling of the tables, diagrams and images (the name explains the contents), are given **above the diagrams**.

DISCUSSION

The discussion should comment on the results of the research in regards to the initial expectations and hypotheses set in the paper. It should also be professional and based on data obtained in the research.

CONCLUSION

The conclusion contains a short description of the research and a concise revealing of the main results, as well as the possible further line of research and the potential of a practical application of the obtained results.

REFERENCES

A reference list of the used bibliographical units mentioned in the text is given at the end of the paper, according to the APA referencing model: https://apastyle.apa.org/style-grammar-guidelines/references/examples

- The bibliographical sources are quoted according to alphabetical order, using the last name of the author.
- Every bibliographical source is numbered.
- Bibliographic sources that are not mentioned anywhere in the paper cannot be included in the list of references.

Examples of papers in periodical publications (journals, bulletins, etc.)

Author, A.A., Author, B.B., & Author, C.C. (year). Title of paper. *Title of journal*, volume(number), pages.

Amanović, Đ., Milošević, M., Dopsaj, M., & Peric, D. (2006). Modeling variability of the assigned level of force during isometric contractions of the arms extensor muscles in untrained males. *Facta universitatis – Series: Physical education and sport*, 4(1), 35-48.

Examples of non-periodical publications (textbooks, monographs, scripts, books, etc.)

Author, A.A., Author, B.B., & Author, C.C. (year). *Title of research paper*. Edited by: Editor.

Cohen, M., & Nagel, E. (1982). *An Introduction to Logic and Scientific Method*. Beograd: Zavod za udžbenike i nastavna sredstva.

Examples of chapters in non-periodical publications (textbooks, monographs, etc.)

Author, A.A., Author, B.B., & Author, C.C. (year). Title of chapter. U: A. Editor, B. Editor, C. Editor, *Book title*. Edited by: Editor (pp. xxx-yyy).

Puczkó, L., & Rátz, T. (2007). Trailing Goethe, Humbert, and Ulysses – Cultural Routes in Tourism. In: G. Richards, *Cultural Tourism – Global and Local Perspectives*. New York: The Haworth press, Binghamton (pp. 131-148).

Examples of references published in proceedings books from congresses and symposia

Author, A.A., Author, B.B., & Author, C.C. (year). Title of chapter. In: A. Editor, B. Editor, C. Editor (Eds.), *Name of conference, congress or symposium* (pp. xxx-yyy). Published by: Editor.

Perić, D. (2003). Factorial structure of modern basketball. In: A. Naumovski (Ed.), *International conference of sport and physical education* (pp. 256-260). Skopje: Faculty of physical culture.

Example of quoting sources from the Internet

Vujičić, I. (2020, July 21). *Kako pokreti ruku utiču na efikasnost trčanja?* Trčanje.rs. https://www.trcanje.rs/trening/uticaj-kretanja-ruku-na-trcanje/

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Designing and marking tables

- The tables must be simple and easy to understand.
- The data analyzed in the text should not be repeated in the tables.
- Refer the data mentioned in the tables to the text in the paper.
- Number the tables (for example: Table 1, Table 2).
- While marking the tables, after their numbering, make a mention of the data in the tables.
- The number and title of table are written above it.
- The tables are always marked and numbered in the same way.
- The tables are an integral part of the text.

Designing and marking diagrams

- It is desirable to include diagrams, charts, graphs, etc. in the paper.
- The data analyzed in the text should not be repeated in the diagrams.
- Refer the data in the diagrams to the text in the paper.
- Diagrams are to be listed by number (e.g.: Diagram 1, Graph 1).
- After their listing, mention the data they contain.
- The numbering and titles are noted under the diagram, chart, graph, etc.
- Diagrams are always numbered and marked in the same way.
- Diagrams are an integral part of the text.

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THE REVIEW OF THE BOOK

The journal can also publish a review of the relevant professional literature from the area corresponding to sports and health recently published. The review in a clear and fundamental way points to the significance and current validity of the book, as well as a review of the most important parts and contents. The title of the review must contain information references according to APA standards, these being the last name and initials of the author, the year of publication, the title (*italics*), the publisher, place of issue. Also included are the page number, the ISBN and COBISS number. The author of the book review signs it, along with a mandatory mentioning of the affiliation.

Example of the title of a book review:

Book review
Havelka N. and Lazarević Lj. (2011). *Psychology of sports management.*
Publisher: College of Sports and Health, Belgrade, Serbia; 384 pages;
ISBN 978-83687-14-5; COBISS.SR-ID 184385036