LEVELS OF PHYSICAL ACTIVITY AS PREDICTORS OF THE BODY COMPOSITION OF ADOLESCENTS AFTER THE SARS-CoV-2 VIRUS PANDEMIC

NIVOI FIZIČKE AKTIVNOSTI KAO PREDIKTORI TELESNE KOMPOZICIJE ADOLESCENATA NAKON PANDEMIJE SARS-CoV-2 VIRUSA

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ABSTRACT
The consequences of the SARS-CoV-2 virus pandemic, certain types of quarantine, and online teaching and reduced physical activity are assumed to be able to affect the levels of physical activity in adolescents. The aim of the research was to determine and compare groups of subjects in body composition, classified according to different levels of physical activity, obtained on the basis of the IPAQ questionnaire (International Physical Activity Questionnaire, Craig et al., 2003). The sample of respondents consisted of 140 high school students from Belgrade, with an average age of 16.95±1.03 years. Two anthropometric measurements were measured according to the International Biological Program (IBP), and body composition was assessed with three body composition measurements using InBody 230 (Biospace Co., Ltd, Seoul, Korea). The Body Mass Index (BMI) according to the Centers for Disease Control and Prevention (2000) was also calculated. The results of the research indicate that 3 clusters were obtained: low level of physical activity of 67 or 47.86%; medium level of physical activity, of which 36 respondents or 25.72% and high level of physical activity, 37 or 22.42% of respondents. Significant differences were further determined in the overall system of variables ($p < 0.03$), and by individual analysis significant differences were found in the variables: Body weight ($p < 0.00$), BMI ($p < 0.02$), Total amount of fat ($p < 0.00$), Total muscle mass ($p < 0.00$) and Visceral fat ($p < 0.00$). A series of Post Hoc tests according to Bonferroni found that better body composition was achieved by subjects with higher levels of physical activity, while the worst body composition with higher values of visceral and total fat was observed in subjects with low levels of physical activity. The authors believe that the quality of life and the level of physical activity can determine the physical composition of adolescents. Also, for future research, they recommend the IPAQ questionnaire as a cheaper and faster means of obtaining information, which could be used to model kinesiological treatments, as clear levels of pairs of groups are obtained that could be used to increase physical activity.

Keywords: adolescents, levels of physical activity, SARS-CoV-2 virus, body composition

APSTRAKT
Posledice pandemije SARS-CoV-2 virusa, određeni vidovi karantina, te on line nastava i smanjena fizička aktivnost predpostavlja se da bi se mogli odraziti na nivoe fizičke aktivnosti kod adolescenata. Cilj istraživanja bio je usmeren na utvrđivanju i poređenje grupa ispitanika u telesnoj kompoziciji, klasifikovanih prema različitom nivou fizičke aktivnosti, dobijenog na osnovu IPAQ upitnika (International Physical Activity Questionnaire, Craig et al., 2003). Uzorak

ispitanika bio je sačinjen od 140 učenika srednje škole iz Beograda, prosečne starosti 16.95±1.03 godina. Izmerene su dve antropometrijske mere prema (International Biological Program (IBP)), te je procenjena telesna kompozicija sa tri mere telesnog sastava uz pomoć InBody 230 (Biospace Co., Ltd, Seul, Korea). Takođe je izračunat Index telesne mase (eng. Body mass index (BMI)) prema Centers for Disease Control and Prevention (2000). Rezultati istraživanja ukazuju da su dobijena 3 klastera: nizak nivo fizičke aktivnosti njih 67 ili 47.86%; srednji nivo fizičke aktivnosti od toga 36 ispitanika ili 25.72% i visok nivo fizičke aktivnosti njih 37 ili 22.42% ispitanika. Dalje su utvrđene značajne razlike u celokupnom sistemu varijabli ($p < 0.03$), a pojedinačnom analizom značajne razlike su utvrđene u varijabalama: Telesna težina ($p < 0.00$), BMI ($p < 0.02$), Ukupna količina masti ($p < 0.00$), Ukupna mišićna masa ($p < 0.00$) i Visceralne masti ($p < 0.00$). Serijom Post Hoc testova po Bonferoniju, utvrđeno je da su bolji telesni sastav ostvarili ispitanici sa višim nivoima fizičke aktivnosti, dok su najlošiji telesni sastav sa većim vrednostima visceralne i ukupne količine masti bili primetni kod ispitanika sa niskim nivoom fizičke aktivnosti. Autori smatraju da kvalitet života i nivo fizičke aktivnosti defnitivno može odrediti telesnu komoziciju adolescenata. Takođe za buduća istraživanja preporučuju IPAQ upitnik kao jeftinije i brže sredstvo dobijanja informacija, koje bi mogle poslužiti za modelovanje kinezioloških tretmana, jer se dobijaju jasni nivoi parova grupa sa kojima bi se moglo raditi na povećanju fizičke aktivnosti.

Ključne reči: adolescenti, nivoi fizičke aktivnosti, SARS-CoV-2 virus, telesna kompozicija

INTRODUCTION

Regular physical activity is an aspect of a person's healthy habits, thus it greatly impacts his physical and mental health (Ruíz-Roso et al., 2020; Shahidi et al., 2020). During the Sars-CoV2 pandemic (Covid-19), public health recommendations in most countries were for people to keep their distance, reduce contact and introduce quarantine, which caused restrictions on movement among people, which resulted in changes in physical activity levels (Narici et al., 2021). Online lessons, work from home or hybrid model of classes in high schools have been introduced. The introduction of restrictions on contact and movement was aimed at reducing the rate of spreading the infection. But on the other hand, physical activity of children of younger, older and middle school age has inevitably decreased. This period of limited movement affected all citizens, social categories regardless of age, gender and ethnicity. Such actions forced even the youngest and most capable, most active people - children and youth to become suddenly inactive and adopt sedentary behavior.

The negative effects of the introduced measures were mostly reflected in participation in normal daily activities, teaching classes in schools (students attended lessons that were based on different teaching models), physical activity, travel and access to many forms of exercise (Castañeda-Babarro et al., 2020; Hossain, Sultana, & Purohit, 2020) which is closely positively correlated with a decrease in physical activity compared to earlier periods. Several countries have implemented a complete restriction of movement, in the form of curfew, which limits the time for participation in outdoor activities or completely eliminates outdoor activities, and the Republic of Serbia was among them. Insufficient physical activity, along with increased calorie intake, can reduce the body's immune response, reduces the ability to cope with infections and can cause numerous negative consequences for human health, especially in young people. The most common are obesity, sudden cardiovascular conditions, cardiorespiratory insufficiency, and decreased ability to work (Ruiz-Roso et al., 2020). Furthermore, such conditions can lead to cardiopulmonary complications with more severe outcomes (Bloch, Halle, & Steinacker, 2020; Steinacker et al., 2020). Such restrictions, potentially endangering physical activity, deteriorate health, and create new habits in children and adolescents (longer periods of sitting) have led to changes in diet during the pandemic (Ammar et al., 2020). This is important because good nutrition is important for health and well-being, especially when the immune system is compromised (WHO, 2020). In addition, limited access to fresh food negatively affects the overall physical and mental health of people. Anxiety and boredom, reduced ability to move, walking in the open, caused by quarantine are considered risk factors for consuming more food and food of poorer quality compared to standard living conditions (Ammar et al., 2020). For children and young people, physical activity is closely linked to school activities, active transport to school and participation in sports (Hoffmann et al., 2019; Dwyer et al., 2020). Since schools were closed during the COVID-19 pandemic (classes were held online, students followed the hybrid model), it can be assumed that such habits, in addition to such reduced physical activity in adolescents, further affected changes in body composition and physical activity levels. Reduced movement threatened and limited their participation in physical activities, thus increasing the risk of the consequences of long-term sedentary behaviour. Monitoring the state of nutrition, healthy habits of youth and children, is a very useful activity for school and parents. Such actions indicate the adequacy of the growth and development process. They can also help in understanding the current situation during the children's stay in high school. Therefore, much can be done to improve the quality of nutrition and physical activity of children (Moreno-Verjans-Janssen et al., 2018; Viljakainen et al., 2019). Therefore, the aim of this research would be to use a questionnaire (IPAQ) to check the level of physical activity, and based on the classification of subsamples according to the level of physical activity, determine the students' body composition and compare with the appropriate level of physical activity in adolescents from Belgrade.

METHOD

The research was of a transversal nature. Non-experimental design was used, more precisely, the ex post facto research design. One assessment using a questionnaire was performed, as well as one measurement at one time point on one group of study participants of the same age, who were not divided by gender into subsamples. In addition to the assessment with the questionnaire, two anthropometric, and three measures of body composition were measured, and based on two anthropometric measures, the body mass index was calculated (Body mass index (BMI)). According to the nature of scientific research, the empirical method was used, while according to the knowledge of the problem, the confirmatory method was used. In relation to the degree of control, the semi-laboratory method was applied. Assessment of the questionnaire, measurement of anthropometric measures, and measurement of body composition was done within the project of the Faculty of Teacher Education, University of Belgrade entitled "*The concept and strategy of providing quality basic education*", registered under number: 179020 and funded by the Ministry of Education, Science and technological development of the Republic of Serbia. Parents/guardians of the study participants gave their consent for the participation of children in the research, as well as the fact that the data will be used only for scientific purposes, which is in line with the World Medical Association Declaration of Helsinki (2013).

Research sample

Using the random sampling method, four high schools in the city of Belgrade were selected. The appropriate sample of study participants included 140 students (BH=179.18±7.31 cm; BW=74.61±13.12; BMI=23.26±3.69 kg/m2) with an average age of 16.95±1.03 years of both genders. At the time of the survey (October 2021), the study participants were healthy, without any reported health problems, and regularly attended the third grade of high school. For further analysis, based on the scores on the IPAQ questionnaire (*International Physical Activity Questionnaire*, IPAQ; Craig et al., 2003), study participants were divided into groups according to the level of physical activity, as follows: Group 1 defined as Low level of physical activity, which consisted of 67 study participants or 47.86%; Group 2 defined as Medium (moderate) level of physical activity, 36 or 25.72% of them and Group 3 as High level of physical activity, which consisted of 37 study participants or 22.42%).

Instruments

Basic anthropometric measures were selected as a sample of measuring instruments: 1. To assess the longitudinal dimensionality of the skeleton: 1) *Body height* (0.1 cm) was measured using the Martin anthropometer according to the International Biological Program (IBP: according to Lohman, Martorell, & Roche, 1988); 2. To estimate body volume and weight: 2) *Body weight* (0.1 kg) - was measured using InBody 230 (Biospace Co., Ltd, Seoul, Korea). Based on the measured dimensions of body weight and body height, the 3. Nutritional Status was calculated by dividing the body weight value by the squared body height: 3) *Body Mass Index* BMI (kg/m2) - calculated according to the Centers for Disease Control and Prevention, 2000). Body composition was assessed using three measures: 4. Body composition: 4) *Total muscle mass* (%); 5) *Total amount of fat* (%); 6) *Percentage of visceral fat* (%) - all three measures were measured using InBody 230 (Biospace Co., Ltd, Seul, Korea). In order to assess the level of physical activity, in the current research, a widely used short version of IPAQ was used (IPAQ-SF, Craig et al., 2003b). In the short version of the questionnaire, three different categories of physical activity were assessed, total physical activity and sedentary behaviour: 1) walking on a weekly basis (MET-minutes); 2) physical activity of moderate intensity (without walking) on a weekly basis (MET-minutes); 3) high-intensity physical activity on a weekly basis (MET-minutes) and 4) total physical activity on a weekly level (MET-minutes). An instrument called the *International Physical Activity Questionnaire* (IPAQ) has proven to be valid, according to the research (Bauman et al., 2009; van Poppel et al., 2010). The short version of IPAQ consisted of six items, which referred to the above-mentioned types of physical activity, while one additional item referred to sedentary behaviour. The study participants assessed how physically active they were during the previous seven days at school/during transport, and in their free time or while playing sports/recreation (Radosav, 2019). It was necessary for the study participant to firstly indicate how many days he was physically active in the past week (walking, moderate or intense activity), and then how many hours and minutes he was usually physically active on those days. Furthermore, for each category, the number of active days was multiplied by the number of minutes spent doing a given activity, and the total number of minutes that the study participants spent during the week doing a certain activity was obtained. This number was multiplied by the corresponding number of MET (metabolic equivalent) based on the estimate of energy consumption during the given activity. One MET represented the amount of energy required by the body to perform basic life functions at rest. The energy value of walking was estimated at 3.3 MET (i.e., 3.3 times more energy was consumed than at rest); moderate activity was worth 4 MET; and intense physical activity - 8 MET. In this way, for each study participant, scores for walking, moderate and intense physical activity were obtained, expressed in MET-minutes on a weekly basis. By adding these scores, a score was obtained for the total weekly physical activity (Radosav, 2019).

Data processing methods

During the statistical data analysis, the basic descriptive statistical analysis of variables was done, namely: mean (AS), standard deviation (S), for all three groups of study participants separately. The Kolmogorov-Smirnovlev and Shapiro Wilk coefficients were used to estimate the normality of the distribution. The existence of statistically significant differences between subsamples of different groups for all analyzed variables was tested using multivariate (MANOVA) and univariate (ANOVA) analysis of variances, and the comparison of pairs of groups was tested by a series of Bonferroni's LSD test at the level of statistical significance $p \leq 0.0167$. Due to the uneven number of study participants in the groups, the MANOVA test results were interpreted using the Pilar's Trace coefficient.

RESULTS

Based on the classification of study participants into groups, it was noticed that there is the largest number of study participants who are from the group classified as low physical activity (N = 67), while the other two groups - moderate (N = 36) and very physically active (N = 37) were approximately equal in number of participants. Analyzing the descriptive statistics of morphological variables and body composition variables in Table 1, it can be concluded that all three groups of study participants had approximately similar longitudinal skeleton dimensions, approximately normal nutritional volume, according to the National Institutes of Health, Lung, and Blood Institute (1998), and that study participants who have a high level of physical activity are on average the lightest and have the lowest BMI values compared to the other two groups of study participants. Of course, there were study participants who had a body mass index that is very high and corresponds to obesity, which was reflected in the average results in the study, as well as several participants who were malnourished. The lowest average values of the variable *Total amount of fat* were recorded in the group of study participants who are most active, with high level of physical activity, as well as the *Percentage of visceral fat*, while the highest values are in the group of study participants who have low level of physical activity. In contrast, the highest values of *Total muscle mass* were detected in study participants with a high level of physical activity, and the lowest in study participants with the lowest level of physical activity.

Furthermore, the values of Kolmogorov-Smirnov coefficient (KSp) and Shapiro-Wilk test (ŠVp) indicate the normality of distribution of the analyzed variables in all three subsamples.

Table 1. Analysis of differences in morphological characteristics and body composition
Tabela 1. Analiza razlika u morfološkim karakteristikama i građi tijela

Variable	Low level (N=67)		Moderate level (N=36)		High level (N=37)	
	AS±S	KSp	AS±S	ŠVp	AS±S	ŠVp
Body height (cm)	178.99±7.56	0.20	180.74±7.36	0.65	177.99±6.71	0.31
Body mass (kg)	76.61±14.91	0.08	76.83±11.03	0.07	68.83±9.59	0.06
BMI (kg/m^2)	23.91±4.25	0.14	23.52±3.36	0.11	21.80±2.33	0.10
Total body fat (%)	19.89±8.19	0.08	19.18±7.24	0.18	14.38±4.79	0.13
Total amount of muscle (%)	40.28±4.85	0.20	40.64±4.11	0.06	43.68±3.09	0.12
Percentage of visceral fat (%)	5.25±3.52	0.06	4.89±2.96	0.09	3.51±2.08	0.11

Note: AS - mean; S - standard deviation; KSp - level of statistical significance of Kolmogorov Smirnov coefficient, SVp - level of statistical significance of Shapiro-Wilk coefficient for small samples

Observing the obtained F values in Table 2, it is concluded that there are statistically significant differences P<0.04 between groups of study participants formed on the basis of physical activity in terms of their morphological characteristics and body composition, observing the whole system of applied variables. Due to the uneven number of participants in the study, the Pilar´s Trace coefficient was used. An individual analysis of each variable concluded that there were statistically significant differences in the variables: Body weight (p < 0.00), BMI (p < 0.02), Total fat (p < 0.02), Total muscle (p < 0.00) and Percentage of visceral fat (p < 0.00). Only in the variable for the assessment of longitudinal skeletal length, body height, no statistically significant differences between groups were observed (p < 0.27).

Table 2. Analysis of group differences
Tabela 2. Analiza grupnih razlika

Variable	Group	AS	f	p
Body height	NN	178.99	1.34	0.27
	UM	180.74		
	VN	177.99		
Body mass	NN	76.61	5.18	**0.00**
	UM	76.83		
	VN	68.83		
BMI	NN	23.91	4.21	**0.02**
	UM	23.52		
	VN	21.80		
Total body fat	NN	19.89	7.39	**0.00**
	UM	19.18		
	VN	14.38		
Total amount of muscle	NN	40.28	8.07	**0.00**
	UM	40.64		
	VN	43.68		

Percentage of visceral fat	NN	5.25	3.95	**0.00**
	UM	4.89		
	VN	3.51		
PT=1.87; **P=0.04**				

Note: NN - low level of physical activity, UN - moderate level of physical activity; VN - high level of physical activity; AS - mean; f - univariate f test; p - level of statistical significance f test; PT – sawdust trace coefficient; p - statistical significance of multivariate PT test

In order to determine between which groups there are statistically significant differences, Bonferroni's comparison with a level of statistical significance of $p \leq 0.0167$ was applied (Cohen, 1988).

Table 3. Differences between groups - Bonferroni's comparison
Tabela 3. Razlike među grupama - Bonferronijevo poređenje

Variable	**(I) Groups by level of physical activity**	**(J) Groups by level of physical activity**	**Difference AS (I-J)**	**p**
Body mass	NN	UN	-0.22	1.000
		VN	7.78*	**0.010**
	UN	VN	8.00*	**0.025**
BMI	NN	UN	0.39	1.000
		VN	2.11*	**0.015**
	UN	VN	1.71	0.133
Total body fat	NN	UN	0.70	1.000
		VN	5.51*	**0.001**
	UN	VN	4.80*	**0.015**
Total amount of muscle	NN	UN	-0.35	1.000
		VN	-3.39*	**0.000**
	UN	VN	-3.04*	**0.008**
Percentage of visceral fat	NN	UN	0.36	1.000
		VN	1.74*	**0.019**
	UN	VN	1.37	0.171

Note: p - level of statistical significance; * - statistically significant difference at the level of $p < 0.05$

The differences were defined between the following groups in the following variables (Table 3). Variable Body weight: between study participants with low level of physical activity and high level of physical activity ($p < 0.010$) in favor of better average values of study participants with higher level of physical activity, as well as study participants with moderate and high level of physical activity ($p < 0.025$) in favor of study participants with a high level of physical activity who were lighter. Variable BMI: between study participants with low levels of physical activity and study participants with high levels of physical activity ($p < 0.015$) in favor of study participants with high levels of physical activity who had lower BMI values. Variable Total amount of fat: between study participants with low and high levels of physical activity ($p < 0.001$) in favor of a more physically active group of study participants, then between study participants who were moderately and highly physically active ($p < 0.015$) in favor of study participants from a high level of physical activity activities. Variable Total muscle mass: between study participants in the group with low level of physical activity and high level of physical activity (p < 0.000) in favor of more physically active group of study participants and between group with moderate level of physical activity and high level of physical activity (p < 0.008) in favor of groups a high level of physical activity. Finally, the variable *Percentage of visceral fat*: only between the groups with low levels of physical activity and the group with high levels of physical activity (p < 0.019) in favor of the group with high levels of physical activity.

DISCUSSION

The research was conducted on 140 participants, adolescents from Belgrade, using a short version of the IPAQ questionnaire and assessment of body composition, in order to determine the consequences of the Covid 19 pandemic on the physical health of study participants, i.e., on the state of body composition after the quarantine period. The COVID-19 pandemic can be characterized as an unprecedented health crisis in the world, because the entire population (Narici et al., 2021) lived in isolation, and in some countries, curfews were introduced, and the population was found in the newly created conditions, which lasted from several weeks to months, which in itself posed a special physiological challenge with a significant health condition that carries certain risks.

The results of current research on the adolescent population have indicated that the level of physical activity may be a limiting factor in body constitution. The research indicated that the largest number of study participants were from the group that had a low level of physical activity. The findings also indicate that the largest number of study participants were from the group that was the least physically active, and this indicates that sedentary behavior was probably common during the current COVID-19 pandemic. When it was allowed to spend some time outside, a smaller number of adolescents used it for more intense physical activity, and we are all witnesses that the open fields were empty at that time. In the resulting COVID-19 pandemic, millions of people around the world had limited and low social activity and longer stays at home, as well as working from home, and children attended school online. This led to a higher number of study participants with lower levels of physical activity dominating this study. This means that almost every third individual, adolescent, had a significantly reduced level of daily physical activity. We have well-documented information on the importance of physical activity for maintaining health, and thus significantly reduced physical activity that resulted in less than the daily recommendation of 7500-10 000 steps per day (Boot et al., 2017) has certainly exacerbated health problems due to physical inactivity. Indeed, unfavorable indicators of body composition in a group that had a low level of physical activity may indicate the occurrence of cardiometabolic risk that occurs when there are less than 5,000 steps per day. Therefore, the need for multisectoral intervention in order to monitor and improve healthy nutrition and increase the level of physical activity of adolescent children is increasing, even today (Tavonga & Tonderayi, 2020). It was pointed out that the study participants with the highest level of physical activity had on average the lowest values of the total amount of fat, visceral fat and the highest percentage of the total amount of muscle. More ideal BMI ratio compared to study participants who were characterized as low and moderately physically active.

An explanation of this phenomenon and the results obtained can be found in data from various studies, including Mosole et all (2014) and Narici et all (2021). These groups of authors show that muscle loss occurs quickly after disappearance or reduced physical activity, because changes can already be detected within two days of inactivity. This loss of muscle mass is associated with denervation of muscle fibers, neuromuscular damage to joints at synapses, and increased regulation of protein breakdown. The occurrence of loss or reduction in the amount of muscle is mainly explained by the suppression and synthesis of muscle protein. Inactivity also affects glucose homeostasis, as just a few days of step reduction or rest without physical activity reduces insulin sensitivity, mainly in the muscles (Kilroe et al., 2020). The accumulation of subcutaneous fat increases, which is accompanied by a decrease in the percentage of muscle mass in the body. There is an increase in subcutaneous fat and the total amount of fat in the body. Accumulated sugars are transferred to fat depots, which accumulate in the body of inactive people in higher concentrations. Due to the reduced level of physical activity (sedentary bahaviour) within a few days, objective signs of muscle atrophy can be found. Indeed, significant atrophy of the thigh muscles *m. quadricepsa femorisa* was found after 5 days of rest (time without physical activity) (2%) (Mulder et al., 2015), combined with even greater loss of muscle strength (8-9%) as indicated by the findings of (de Bur et al., 2007; Demangel et al., 2017). Only for the example of physical inactivity and reduction of the total amount of muscles due to reduced movement, we should point out the example from practice that during the following days and weeks, *m. quadricepsa femorisa* atrophies at a relentless rate, 6% after 10 days (Narici et al., 2020), 10% after 29 days (Alkner & Tesch, 2004a), 13% after 60 days (Mulder et al., 2015), reaching a peak atrophy of 18% after 90 days (Alkner & Tesch, 2004b). This rate of muscle atrophy follows an exponential rate of time, predicting a loss of 10% of muscle mass in 30 days and 15% in 60 days, where the ratio of muscle mass and subcutaneous adipose tissue changes, and the total amount of fat in the body.

In addition, aerobic capacity is impaired at all levels of oxygen consumption, and energy balance increases and energy consumption decreases, thus increasing both BMI and total body fat percentage, due to reduced energy consumption. Due to inactivity, the activity of the cardiovascular system is reduced, which affects all functions, including peripheral circulation, and the oxidative function of skeletal muscles. Positive energy balance during physical inactivity is associated with fat deposition, associated with systemic inflammation and activation of the body's antioxidant defenses, worsening the loss of muscle mass. That reduced levels of physical activity are bad for the human body at all age levels from preschool to high school which has been proven in numerous studies (Pelemiš, Macura, & Branković, 2017; Mandić, Pelemiš, Džinović, Madić, & Kojić, 2019; Pelemiš, Prskalo, Badrić, & Madić, 2019; Pelemiš, Mandić, Momčilović, Momčilović, & Srdić, 2021; Kojić, Mandić, Pelemiš, & Đurić, 2021), but this research also indicated that there are significant differences in the body composition of people who had different levels of physical activity. It has been proven that a higher level of physical activity exists in adolescents who were with a lower percentage of visceral fat, total amount of fat, with a higher percentage of muscle and a more orderly body mass index. Physical inactivity and time spent sitting are the most common risk factors that endanger human health, increasing the percentage of body fat and reducing the percentage of total muscle mass (Matthevs et al., 2012; Wilmot et al., 2012; de Resende, Ray-Lopez, Macudo, & do Carmo Luiz, 2014) as was the case with this sample of adolescents from Belgrade. Higher levels of total physical activity, of any intensity, and

less time spent in sedentary activities are associated with better body composition, lower blood sugar levels and reduced percentages of total and visceral fat, which reduces mortality rate in physically active people (Ekelund et al., 2019). That is why it is vital to raise awareness about the level of physical activity and the connection with health risks, especially among young people who are just starting to adopt social habits.
In general, it can be concluded that the study participants with the highest level of physical activity had body composition that was characterized by the lowest percentage of body fat, visceral fat, ideal BMI, a higher percentage of muscle. This phenomenon can be characterized as a consequence of physical activity of this group of study participants. On average, worse results are noticeable in groups that are characterized as moderately and low in physical activity. Those study participants who were the least physically active also had the worst results in terms of body and visceral fats with the highest average BMI values. The authors point out that these harmful effects of physical inactivity can be reduced by regular physical exercise, and even by walking more intensely, all the way to a special type of programmed physical exercise (strength type with low to medium intensity resistance), which are available today in most sports centers. These types of interventions will have positive effects, especially if performed in combination with a 15-25% reduction in daily energy intake. This combined regimen is ideal for maintaining the neuromuscular, metabolic, and cardiovascular health of adolescents. The authors also believe that the quality of life and the level of physical activity can definitely affect the physical composition of adolescents. Moreover, in future studies, the IPAQ questionnaire is recommended as a cheaper and faster tool for obtaining information, which could be used to model kinesiological treatments, because more precise levels of pairs of groups are obtained that could be used to increase physical activity.

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