Association between eating habits and low physical activity in adolescents

Povezanost između navika u ishrani i nedovoljne fizičke aktivnosti među adolescentima

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Abstract

Background/Aim. Insufficient levels of physical activity and poor nutrition, have led to an increase in the number of obese adolescents and cardiometabolic problems. The aim of this study was to analyze the association between eating habits and low physical activity levels among adolescents. **Methods.** The cross-sectional study, conducted in May 2017, included a total of 389 participants, aged 15–19 years. The study instrument was a questionnaire regarding demographic characteristics, physical activity (International Physical Activity Questionnaire-Short Form), as well as eating habits. The data were analyzed using univariate and multivariate logistic regression analysis. **Results.** A total of 131 participants (33.7%) had a low level of physical activity, and 258 (66.3%) had a moderate/high level of physical activity. Adolescents with moderate/high physical activity were significantly more likely to be male and medical school students. Moreover, they had breakfast significantly more often, consumed fish more than twice a week or at least twice a week, ate fruit once a day or more, and generally ate healthy, compared to the high school students with low physical activity. Among the factors associated with low physical activity were the following: the female gender, eating breakfast never/sometimes, consuming fish less than twice a week, fruit less than once a day, maintaining a healthy diet, and adolescents aged 18–19 years. **Conclusion.** This study identified several statistically significant independent factors associated with low physical activity in adolescents. Based on the obtained results, it is necessary to undertake certain interventions, promote physical activity, correct eating habits, and the overall lifestyle, with a special emphasis on the female population and teenagers aged 18–19 years. The education of both adolescents and their parents is essential.

Key words:
adolescent; attitude to health; exercise; feeding behavior; healthy lifestyle; serbia; sex factors; surveys and questionnaires.

Apstrakt

Uvod/Cilj. Nedovoljan nivo fizičke aktivnosti i loša ishrana doveli su do povećanja broja gojaznih adolescenata i kardiometaboličkih problema. Cilj rada bio je da se analizira povezanost između navika u ishrani i niskog nivoa fizičke aktivnosti kod adolescenata. **Metode**. Studijom preseka, sprovedenom tokom maja 2017. godine, obuhvaćeno je ukupno 389 ispitanika, uzrasta 15–19 godina. Instrument istraživanja bio je upitnik o demografskim karakteristikama, fizičkoj aktivnosti (*International Physical Activity Questionnaire-Short Form*), kao i navikama u ishrani. Podaci su analizirani korišćenjem univarijantne i multivarijantne logističke regresione analize. **Rezultati.** Ukupno 131 (33,7%) ispitanik imao je nizak nivo fizičke aktivnosti, a 258 (66,3%) umeren/visok nivo fizičke aktivnosti. Adolescenti sa umerenim/visokim nivoom fizičke aktivnosti su značajno češće bili muškarci i učenici medicinske škole. Takođe, oni su značajno češće doručkovali, jeli ribu češće ili bar dva puta nedeljno, jeli voće jednom ili više puta dnevno i generalno su se hranili zdravo, u poređenju sa srednjoškolcima sa niskim nivoom fizičke aktivnosti. Među faktorima povezanim sa niskim nivoom fizičke aktivnosti bili su: ženski pol, doručkovanje nikada/ponekad, konzumiranje ribe ređe od dva puta nedeljno, voća ređe nego jednom dnevno, održavanje zdrave ishrane i adolescentni uzrast 18–19 godina. **Zaključak.** Ovom studijom identifikovano je nekoliko statistički značajnih nezavisnih faktora, koji su povezani sa niskim nivoom fizičke aktivnosti kod adolescenata. Na osnovu dobijenih rezultata, neophodno je preduzeti određene korektivne mere, promovisati fizičku aktivnost, korigovati navike u ishrani i način života, posebno u ženskoj populaciji i kod adolescenata uzrasta 18–19 godina. Veoma je važna edukacija adolescenata i njihovih roditelja.

Ključne reči:
adolescent; stav prema zdravlju; vežbanje; ishrana, navike; zdravlje, način života; srbija; pol, faktor; ankete i upitnici.

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Introduction

A balanced diet and physical activity (PA) are essential for healthy growth and development of adolescents. Poor eating habits and insufficient PA are associated with cardiometabolic problems in this population [1]. Insufficient levels of PA and poor nutrition, according to the World Health Organization (WHO), have led to an increase in the number of obese and overweight children and adolescents, from 11 million to 124 million obese and 216 million overweight, from 1975–2016 [2]. Furthermore, the increase in type 2 diabetes mellitus in adolescents worldwide in the last 20 years is dramatic, where the prevalence is three times higher at the age of 15–18 compared to the age of 10–14, and girls have a 60% higher prevalence than boys [3].

Elevated blood pressure in childhood and adolescence can be manifested in adulthood through the development of hypertension and metabolic syndrome and can be associated with poor glucose metabolism and dyslipidemia [4].

PA helps develop and improve the musculoskeletal system and cardiorespiratory fitness, enables better control of energy balance and body weight, and reduces sedentary behaviors. Moreover, PA affects social interaction and has a positive impact on mental health through the reduction of anxiety and stress, better cognitive function, self-confidence, and achievement in school [5]. The recommendation for daily PA in adolescence is 60 min of moderate to vigorous PA [6, 7]. Exercises to strengthen the musculoskeletal system should be included at least three times a week. The WHO data show that in the category of adolescents, more than 80% of them do not meet the level of recommended PA [6]. The prevalence of insufficient PA worldwide in the period 2001–2016 was lower in boys by 2.5%, while in girls, it remained unchanged, with an increased gender gap of 7.1%. In Serbia in 2015, 65.5% of adolescents (aged 15–18) did not meet the level of recommended PA, where the girls were less active by 19% [8].

In order to make the strategic and necessary interventions to promote PA and prevent the negative trend of the development of chronic non-communicable diseases, it is very important to understand the eating habits that affect insufficient PA. A study conducted among adolescents in the United States of America shows a strong association between PA and nutritional behavior and that higher levels of PA are associated with higher intake of fruits and vegetables [9]. On the other hand, a lower intake of fruits and vegetables correlates with a lower PA level [10]. Some studies have shown that older adolescents are less physically active compared to the younger ones, that the male gender is associated with higher PA [10, 11], and that adolescents who skip breakfast have lower PA levels [12, 13]. In contrast, Sila et al. [14] have shown that breakfast consumption does not affect PA.

The aim of this study was to analyze the association between eating habits and low PA levels among adolescents in Valjevo, Serbia.

Methods

The cross-sectional study was conducted in May 2017; 389 adolescents aged 15–19 years were randomly selected for this study from all five Valjevo high schools (Medical School, Valjevo High School, Technical School, School of Economics, and School of Agriculture). Valjevo is a city and the administrative center of the Kolubara District in western Serbia. The coverage rate was 14.4%.

The sample size was calculated using Epi Info 7 (population 2,700, expected prevalence 81%, acceptable margin of error: 5%, design effect 1). The required sample size was 291. Due to potential losses, the number of participants included in the study was increased by 20%.

Information about the study and the study protocol were submitted to the School Board and then to the Parents' Council, after which the parents gave their consent for the children's participation in the study. The number of respondents who refused to participate in this study was 14.4%. The study was approved by the Ethics Committee of the Faculty of Medicine, University of Belgrade, Serbia (No. 29/XII-18, from December 28, 2015).

Data collection

All data were collected by a questionnaire. It contained questions related to the demographic characteristics of adolescents, their PA, and their eating habits.

Sociodemographic characteristics

Sociodemographic characteristics that were collected *via* a questionnaire were gender (male/female), age (15–17/18–19), type of school (Medical School, Valjevo High School, Technical School, School of Economics, and School of Agriculture), and residence (with parents, with one parent, tenant).

Physical activity level

The International Physical Activity Questionnaire-Short Form (IPAQ-SF) was used for assessing PA [15]. This questionnaire consists of seven questions related to the assessment of the level of PA for the last seven days. Obtained time in min is converted to metabolic equivalent (MET)-min *per* week:

MET/week = high-intensity PA (MET) + moderate-intensity PA (MET) + low-intensity PA (MET) [16]; 8.0 MET is used for high-intensity PA, 4.0 MET for medium-intensity PA, and 3.3 MET for low-intensity PA. Energy expenditure was calculated in the following way:

MET/week = number of days with PA x duration in min x k*; *k is intensity (8/4/3.3 MET)

All participants were classified into three groups according to the degree of their PA: insufficient/low level of PA (< 600 MET-min/week), sufficient/moderate level of PA (601–3,000 MET-min *per* week), and sufficient/high level of PA (> 3,000 MET-min *per* week) [16]. Since the aim of this study was to determine the factors that affect low PA, two categories of participants were made – those with low PA and those with moderate/high PA, based on the recommendation for minimal PA [7].

Anthropometric measurements

The height was measured on the altimeter SECA 213 (Seca GmbH & Co.KG.). Weight was measured with the InBody 230 (Biospace, Seoul, Korea). Body mass index (BMI) percentiles were calculated according to the WHO standards [17].

Body composition analysis

The percentage of body fat (% BF) of the participants was obtained by body composition analysis that was performed on the device InBody 230 (Biospace, Seoul, Korea). Measurements were made according to the manufacturer's instructions – in the morning, after at least 2 hrs of not consuming any food or fluids, and after emptying the bladder. Participants did not engage in any PA prior to performing the analysis. They were classified into four categories based on their % BF and age (underweight, with normal body weight, overweight, and obese) [18].

Eating habits

In our study, we used adapted items from the questionnaire applied in the Serbian National Health Survey 2013 [19]. Our questionnaire contained nine questions that related to breakfast (every day/sometimes/never), consumption of milk and dairy products (2 or more cups every day/one cup every day/sometimes, not every day/never), type of bread most often used (white/semi-white/integral/combined-all types/do not eat bread), type of fat most often used for food preparation (lard, butter/vegetable fat, margarine/oil/do not use fat), salting food (yes, almost always before tasting food/yes, when food is not salty enough/never), fish consumption (more than twice a week/twice a week/less than twice a week, never), fruit consumption (once and several times a day/4 to 6 times a week/1 to 3 times a week/less than once a week/never), vegetable consumption (once and several times a day/4 to 6 times a week/1 to 3 times a week/less than once a week/never), and thinking about health when choosing a diet (always/often/sometimes/never).

The variables were analyzed individually, but we also formed a cumulative variable "healthy diet", based on the Healthy Eating Index, as a measure of diet quality [20].

The cumulative variable was formed as the sum of the answers to eight questions related to nutrition. The total score of "healthy diet" had values from 0 to 8. The variable was divided into two categories (unhealthy diet < 4 and healthy diet 4+). Answers are marked with 1 in the following categories: breakfast (every day), consumption of milk and dairy products (2 or more cups/one cup every day), the type of bread most often used (integral/combined-all types), the type of fat most often used for food preparation (oil/do not use fat), salting food (never), fish consumption (more than twice a week/twice a week), fruit consumption (once and several times a day), and vegetable consumption (once and several times a day).

Data analysis

A total of 16 variables were analyzed: gender, age, school, housing, BMI, % BF, breakfast, consumption of milk and dairy products, type of bread most often used, type of fat most often used for food preparation, salting food, fish consumption, fruit consumption, vegetable consumption, thinking about health when choosing a diet, and a healthy diet.

Data analysis was performed using the statistical analysis software IBM SPSS Statistics 24.0 for Mac (Chicago, IL, USA). Methods of descriptive statistics (mean, standard deviation, and median) were used in statistical data analysis. Univariate logistic regression analysis (ULRA) and multivariate logistic regression analysis (MLRA) were used to examine significant independent factors for low PA. Variables with a *p*-value of < 0.1 according to ULRA were included in the MLRA model. The difference was marked as significant if $p < 0.05$.

Results

High school students (389 participants) had an average value of % BF 23.30 ± 8.30, average value of BMI 21.80 ±

Table 1

Distribution of moderate/high physical activity (PA) and low PA of high school students in relation to their demographic characteristics

Demographic characteristics	Moderate and high PA n = 258	Low PA n = 131	OR (95% CI)	*p*-value*
Gender				
male	116 (45.0)	24 (18.3)	3.64 (2.19–6.04)	< 0.001
female	142 (55.0)	107 (81.7)		
Age (years)				
15–17	206 (79.8)	87 (66.4)	2.00 (1.25–3.22)	0.004
18–19	52 (20.2)	44 (33.6)		
School				
medical	56 (21.7)	17 (13.0)	1.86 (1.03–3.35)	0.039
other**	202 (78.3)	114 (87.0)		
Residence				
with parents	218 (84.5)	104 (79.4)	1 (Ref.)	
with one parent	33 (12.8)	19 (14.5)	1.20 (0.65–2.21)	0.237
tenant	7 (2.7)	8 (6.1)	2.38 (0.84–6.75)	

Moderate and high PA – more than 600 metabolic equivalent (MET)-min *per* week; Low PA – less than 600 MET-min *per* week; OR – odds ratio; CI – confidence interval; Ref. – reference category; *p-value according to univariate logistic regression analysis. **other – Valjevo High School, Technical School, School of Economics, School of Agriculture.
Data are expressed as numbers (percentages).

3.17 kg/m^2, average total score of healthy diet 3.59 ± 1.49, and in MET-min 1,633.82 ± 1,302.31.

Of the 389 participants who participated in the study, 258 (66.3%) had moderate/high PA, and 131 (33.7%) had low PA. Students with moderate/high PA were significantly more likely to be male, 15–17 years old, and enrolled in medical school. There was no significant difference between the examined groups in terms of the place of residence during studies (Table 1).

No statistical differences among high school students were observed between BMI and % BF and PA levels (Table 2).

Students with moderate/high PA had breakfast significantly more often, consumed fish at least twice a week, ate fruit at least once a day, and generally ate healthy compared to high school students with low PA. There was no significant difference between the two groups concerning the frequency of consumption of vegetables and milk and/or dairy products, as well as the type of bread and fats consumed, or salting food (Table 3).

Table 2

Distribution of moderate/high physical activity (PA) and low PA
of high school students in relation to their anthropometric characteristics

Level of nutrition	Moderate and high PA n = 258	Low PA n = 131	OR (95% CI)	*p*-value*
Body mass index				
malnutrition/normal body weight	210 (81.4)	113 (86.3)	1 (Ref.)	
overweight	36 (14.0)	14 (10.7)	0.72 (0.37–1.39)	0.456
obesity	12 (4.7)	4 (3.1)	0.61 (0.19–1.95)	
Body fat percentage				
malnutrition/normal body weight	198 (76.7)	88 (67.2)	1 (Ref.)	
overweight	36 (14.0)	24 (18.3)	1.50 (0.84–2.66)	0.120
obesity	24 (9.3)	19 (14.5)	1.78 (0.92–3.42)	

Data are expressed as numbers (percentages). *p-value according to univariate logistic regression analysis.
For other abbreviations, see Table 1.

Table 3

Distribution of moderate/high physical activity (PA) and low PA
of high school students concerning eating habits

Eating habits	Moderate and high PA n = 258	Low PA n = 131	OR (95% CI)	*p*-value*
How many times during the week do you have breakfast?				
every day	235 (91.1)	103 (78.6)		0.001
sometimes/never	23 (8.9)	28 (21.4)	2.78 (1.53–5.05)	
How often do you drink milk and/or dairy products?				
2 or more cups every day	62 (24.0)	26 (19.8)	1 (Ref.)	
one cup every day	80 (31.0)	35 (26.7)	1.04 (0.56–1.91)	0.285
sometimes, not every day/never	116 (45.0)	70 (53.4)	1.44 (0.83–2.48)	
What type of bread do you use most often in your diet?				
integral	20 (7.8)	8 (6.1)	1 (Ref.)	
semi–white	11 (4.3)	8 (6.1)	1.82 (0.53–6.19)	
combined (all types)	78 (30.2)	39 (29.8)	1.25 (0.50–3.09)	0.768
white	122 (47.3)	66 (50.4)	1.35 (0.56–3.29)	
do not eat bread	27 (10.5)	10 (7.6)	0.93 (0.31–2.77)	
What type of fat is most often used for food preparation (cooking, baking, making a cake, etc.) in your household?				
oil/do not use fat	179 (69.4)	93 (71.0)	1 (Ref.)	
lard, butter	65 (25.2)	31 (23.7)	0.92 (0.55–1.51)	0.944
vegetable fat, margarine	14 (5.4)	7 (5.3)	0.96 (0.37–2.47)	
Do you add salt to the food you eat?				
never	71 (27.5)	36 (27.5)	1 (Ref.)	
yes, when the food is not salty enough	159 (61.6)	75 (57.3)	0.93 (0.57–1.51)	0.44
yes, almost always before I try food	28 (10.9)	20 (15.3)	1.41 (0.70–2.84)	
How often do you eat fish?				
more than twice a week	10 (3.9)	1 (0.8)	1 (Ref.)	
twice a week	53 (20.5)	4 (3.1)	0.75 (0.07–7.48)	< 0.001
less than twice a week/never	195 (75.6)	126 (96.2)	6.46 (0.81–51.10)	
How often do you eat fruit other than juice made from fruit concentrate?				
once and several times a day	106 (41.1)	28 (21.4)	2.56 (1.57–4.17)	< 0.001
less than once a day	152 (58.9)	103 (78.6)		
How often do you eat vegetables and salads, except potatoes and juice from vegetable concentrates?				
once and several times a day	93 (36.0)	36 (27.5)	1.49 (0.93–2.36)	0.091
less than once a day	165 (64.0)	95 (72.5)		
Healthy diet** 4+	140 (54.5)	45 (34.6)	0.44 (0.28–0.69)	< 0.001

Data are expressed as numbers (percentages). *p-value according to univariate logistic regression
analysis. **Healthy diet minimum value 0, maximum value 8. For other abbreviations, see Table 1.

Table 4

**Factors of low physical activity according to the results
of multivariate logistic regression analysis**

Parameter	B	OR (95% CI)	p-value
Model 1			
gender: female	1.42	4.12 (2.36–7.18)	< 0.001
age: 18–19 years	0.83	2.29 (1.33–3.92)	0.003
breakfast: never/sometimes	0.98	2.67 (1.36–5.22)	0.004
fish: less than twice a week	1.92	6.82 (2.54–18.27)	< 0.001
fruit: less than once a day	0.73	2.08 (1.22–3.55)	0.007
Model 2			
gender: female	1.59	4.90 (2.82–8.51)	< 0.001
age: 18–19 years	0.879	2.41 (1.42–4.07)	0.001
healthy diet 4+	-0.402	0.67 (0.56–0.79)	< 0.001

For abbreviations, see Tables 1 and 3.

The first MLRA model included the variables gender, age, school, breakfast, and consumption of fish, fruits, and vegetables, which were converted into variables with two categories each for the needs of MLRA. Significant independent factors of low PA were the female gender, age 18–19 years, breakfast never/sometimes, consuming fish less than twice a week, and fruit less than once a day (Table 4).

A healthy diet significantly positively correlates with all individual variables related to nutrition, which served to form the given variable.

The second MLRA model included gender, age, and healthy diet (overall assessment of healthy eating in high school students), and it was found that all three variables represent significant independent factors of low PA (Table 4). Female gender and age of 18–19 years were risk factors, while a healthy diet was a protective factor for low PA.

Discussion

The results of this study showed that two-thirds of adolescents had moderate/high PA, and one-third had low PA, in contrast to the data of WHO, which show that in the category of adolescents, more than 80% of them do not meet the level of recommended PA [6]. This study shows that adolescents in Valjevo are more physically active than adolescents in Belgrade (low PA 65.5%), the capital of Serbia, according to data from urban areas [8]. On the one hand, that is probably due to the availability and proximity to sports facilities in smaller communities and participation in sports and recreational activities, and on the other hand, it could be due to the use of IPAQ-SF as an indirect method of measuring PA.

According to MLRA results, significant independent factors of low PA among adolescents are female gender, breakfast never/sometimes, consuming fish less than twice a week, and fruit less than once a day. These factors are significantly independent even after age control, and being in the 18–19 age group represents a significant independent risk factor, but so does a healthy diet.

Despite the high prevalence of PA in Valjevo, we found that females have about four times higher likelihood to have low PA, as shown by some other studies [10, 11]. That indicates that women have lower levels of PA compared to men in all age groups, which directly impacts their health [21], while the

study of Miljanovic-Damjanovic et al. [22] shows that in this period of adolescence, there is a decrease in PA in both genders. In addition to the aforementioned benefits, PA is important for women from a psychological point of view due to the reduction of stress, anxiety, and depression. In addition, PA is vital because of self-esteem, social integration, and equality in society [23]. Furthermore, PA is essential for expectant mothers and a healthy pregnancy. During pregnancy, PA is primarily important in the prevention of preeclampsia and gestational diabetes mellitus, the most frequent metabolic disorder during pregnancy.

As shown by the results of other studies, adolescents who skip breakfast or have breakfast sometimes are about 2.5 times more likely to have low PA, i.e., those who eat breakfast more regularly (2–3 days/3 days, frequent breakfast consumption) are more physically active [24] when it comes to moderate/high PA [25]. Skipping breakfast is associated with female gender and low PA [12]. On the other hand, the study of Sila et al. [14] shows that skipping breakfast is not related to PA, and there is no consensus. In addition to the influence on PA, breakfast as the most important meal of the day is positively associated with academic achievement, mental performance, and quality of life and negatively associated with obesity [26]. Consuming fish less than twice a week and consuming fruit less than once a day fits into a poor diet and lifestyle in general. It increases the likelihood of low PA by almost 6.5 times when it comes to consuming fish and more than 2.5 times when it comes to consuming fruit. Manz et al. [11] found that adolescents with high PA levels were twice as likely to consume large amounts of fruit. When it comes to consuming vegetables, we did not find any significant association with PA, while some other studies did show that [11]. According to MLRA, older adolescents aged 18–19 have a 2.3 times higher likelihood of having low PA than the younger ones. This indicates that this is the period when high school students are approaching the period of going to college and that their obligations are increasing, which affects their PA. Moreover, the study of Farooq et al. [21] shows that PA decreases in late adolescence. In addition to the above, despite factors associated with low PA, our results show that a healthy diet is negatively associated with low PA, while some studies show that a healthy balanced diet is positively associated with PA [11]. This can be explained by the adoles-

cents' way of thinking that the impact on health is sufficient if they only take care of a healthy diet and that it is not necessary to practice any kind of PA. In addition, girls think more about their body shape, tend to control or lose weight, and have increased awareness about their diet.

It is known that insufficient levels of PA and poor nutrition are associated with overweight and obesity. Adolescents with obesity are at a high risk of being obese in adulthood and, thus, at a higher risk of developing cardiometabolic diseases. In Serbia, the number of obese children and adolescents in 2018 was 5.7%, and 18.2% were overweight [27]. In addition to medical comorbidities, social and psychological comorbidities are present, mostly associated with depression, negative moods, destructive behavior, and physical and verbal abuse, often as a result of peer stigmatization. These problems lead to a worse social life, poor school performance [28], and, as a result, poorer quality of life [29].

On the one hand, reduced PA and poor nutrition are elements for the development of obesity, and on the other hand, overweight and obesity affect reduced volume or absence of PA. However, it is interesting that in our study, there was no statistical difference between students of different PA levels and their BMI, but we got that low PA is associated with skipping breakfast, insufficient consumption of dairy products and whole grains, insufficient daily intake of vegetables, and salting of food, which on the other hand affects overweight and obesity.

Limitations of the study

The study has certain limitations, hence the recommendations for future research are as follows: this study included a random sample of adolescents aged 15–19 but did not in-clude the category of younger adolescents. Instead of IPAQ-SF, it would be better to use more accurate measuring instruments, for instance, an accelerometer, to obtain more reliable PA data and avoid bias. In addition, longitudinal dietary monitoring should be used in the following research on eating habits. The strength of the study is in identifying significant independent factors affecting low PA, and the use of IPAQ-SF makes our results comparable to numerous studies that use the same questionnaire.

Conclusion

This study identified several statistically significant independent factors that are associated with low PA in adolescents. They refer to the female gender, age 18–19, breakfast never/sometimes, consuming fish less than twice a week and fruit less than once a day, and an unhealthy diet. According to the obtained results, it is necessary to undertake certain interventions, such as education and promotion of PA, aimed at correcting current eating habits, as well as the overall lifestyle. The education of both adolescents and parents is essential. This would be of great importance for the health of adolescents and future generations, with a special emphasis on the female population. It is necessary to continuously promote PA and healthy eating habits in schools while introducing new programs aimed at increasing the number of physically active adolescents.

Conflict of interest

The authors declare no conflict of interest.

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