RISK FACTORS ASSOCIATED WITH OVERWEIGHT AMONG ADOLESCENTS IN SERBIA

DEJAVNIKI TVEGANJA, POVEZANI S PREKOMERNO TELESNO TEŽO PRI MLADOSTNIKIH V SRBIJI

Katarina BORIČIĆ[1, *], Snežana SIMIĆ[2], Nađa VASILJEVIĆ[3], Jelena MARINKOVIĆ[4]

[1] Institute of Public Health of Serbia "Dr Milan Jovanovic Batut", Department for Health Promotion for Special Groups, Dr Subotic Street 5, 11000 Belgrade, Serbia
[2] Institute of Social Medicine, Faculty of Medicine, University of Belgrade, 11000 Belgrade, Serbia
[3] Dietetic Unit, Institute of Hygiene and Medical Ecology, Faculty of Medicine, University of Belgrade, 11000 Belgrade, Serbia
[4] Institute of Medical Statistics and Informatics, Faculty of Medicine, University of Belgrade, 11000 Belgrade, Serbia

ABSTRACT

Keywords:
Overweight, risk factors, adolescents

Introduction. The pandemic of obesity in adolescents is one of the challenges of public health.

Aim. The aim of this study was to examine the association of overweight with demographic, socioeconomic and lifestyle factors among Serbian adolescents.

Method. A cross-sectional study of 2139 adolescents aged 10 to 19 years was carried out. Data used in this study were from the 2006 Health Survey. In accordance with the international sex- and age-specific Body Mass Index cut-off points, all participants were classified as being normal weight or overweight, including obese. The association between the risk factors and overweight were examined using a multivariate logistic regression model.

Results. The study showed that 28.9% of boys and 17.0% of girls were overweight, while 14.5% of boys and 8.1% of girls were obese. Boys were more likely to be overweight/obese, compared with girls. Being younger (p< 0.01 for 14 to 15 years) and (p< 0.01, for 16 to 19 years), engaging in physical activities that last less than 7 hours a week, in such a manner that they breathe quickly and become sweaty, (p< 0.01) and skipping breakfast (p< 0.05) were risk factors significantly associated with overweight among adolescents. No significant association was found with wealth index.

Conclusion. These findings should be an integral part of further preventive interventions, especially oriented towards younger adolescents, who are physically inactive, have a habit of skipping breakfast and are boys.

IZVLEČEK

Ključne besede:
prekomerna telesna teža, dejavniki tveganja, mladostniki

Namen. Pandemija debelosti pri mladostnikih predstavlja enega večjih izzivov za javno zdravje.

Cilj. Cilj te raziskave je bil preveriti povezanost prekomerne telesne teže med srbskimi mladostniki z demografskimi in s socialno-ekonomskimi dejavniki ter z dejavniki, ki so povezani z načinom življenja.

Metoda. Narejena je bila presečna študija z 2.139 mladostniki, ki so bili stari od 10 do 19 let. Za podatke v tej študiji so bile uporabljene vrednosti iz Health Survey 2006. Glede na mednarodno sprejete vrednosti indeksa telesne mase, povezane z odgovarjajočim spolom in starostjo, so bili vsi udeleženci uvrščeni v skupine z normalno težo, s prekomerno telesno težo in z debelostjo. Za ugotavljanje povezave med dejavniki tveganja in prekomerno telesno težo je bila uporabljena statistična metoda multivariantne logistične regresije.

Rezultati. Raziskava je pokazala, da je imelo 28,9% fantov in 17,0% deklet zvišano telesno težo, in sicer je bilo 14,5% fantov in 8,1% deklet debelih. V primerjavi z dekleti so bili fantje debelejši ali so imeli zvišano telesno težo. Za naslednje dejavnike tveganja smo ugotovili statistično pomembno povezavo s prekomerno telesno težo med mladostniki (starost 14-15 let (p<0,01) in 16-19 let (p<0,01)), ukvarjanje s telovadbo, ki povzroča hitro dihanje in potenje manj kot 7 ur dnevno(p< 0,01), ter vsakodnevno izogibanje zajtrku (p< 0,05). Na drugi strani ni statistično pomembne povezave med zvišano telesno težo/debelostjo in indeksom družinskega bogastva.

Zaključek. Ugotovitve naše študije bi lahko imele vpliv na preventivne ukrepe, ki bi bili posebej usmerjeni v mladostnike moškega spola, ki ne zajtrkujejo in se ne ukvarjajo z redno telesno aktivnostjo.

*Corresponding author: Tel: +381 69 502 3732; E-mail: katarina.boricic@gmail.com

1 INTRODUCTION

The World Health Organization (WHO) defines adolescents as young people aged 10 to 19 years (1). Adolescents are usually viewed as a healthy population, since the routine health statistics data in the Republic of Serbia show the lowest rates of morbidity and mortality in this age group, so the health condition analysis is based on the health-oriented approach rather than the disease-oriented approach (2).

The risk factors referred to in the literature that are responsible for the occurrence of overweight and obesity in children and adolescents are hereditary and developmental factors, social and cultural environment factors, eating habits, the way of managing free time, physical activities and sports participation (3).

Overweight is caused by an imbalance between energy intake (calories originating from food) and energy expenditure (calories needed for basal metabolism and physical activities). In everyday practice, nutrition level is estimated on the basis of body weight and height and the calculation of the Body Mass Index (BMI). BMI is the most convenient way of measuring relative obesity; it can be easily calculated, relatively cheaply obtained, is highly acceptable by participants, which is particularly important for adolescents who may be reluctant during measuring, and it is correlated with percentage of body fat. BMI is more accurate when measurement is done by a trained person rather than self-reported. There is low observer error, low measurement error and good reliability and validity. However, BMI may not be a sensitive measure of body fat in people who have extreme muscular or disproportional body build or stunting growth. As a result of its advantages compared to other indirect methods, it is commonly used for population surveys (4).

BMI measure of overweight and obesity in children and adolescents is more complicated than for adults, because an ideal BMI for a child changes as they grow older and it differs between boys and girls. For children and adolescents, aged 2 to 20 years, value of BMI (index) is gender and age specific (4). Three international references are widely used to assess overweight and obesity in children and adolescents: the International Obesity Task Force (IOTF) criteria, the United States Centers for Disease Control and Prevention (CDC) growth charts and the World Health Organization (WHO) criteria (5).

The IOTF reference for children and adolescents 2–18 years old was developed in 2005 from a database of 192,727 children from birth to 25 years from six countries. Age and sex specific cut-off points that are extrapolated from the adult BMI cut-offs are 25 kg/m2 and 30 kg/m2 for overweight and obesity respectively. However, it has low sensitivity for diagnosing overweight and obesity compared with the other methods where body fat was taken as the gold standard and does not provide month-specific cut-off points (5).

The CDC growth reference for children 2-20 years old was issued in 2000 and developed using five national health examination surveys conducted between 1963 and 1994 in the United States of America. This growth reference defines children as at risk of overweight and obesity if their BMI exceeds the 85th and 95th percentiles in most routine assessments. Despite the fact that the CDC system is frequently used internationally, it was designed using only information from the United States with the objective of documenting obesity trends in that country (5).

The WHO Reference 2007 is a reconstruction of the 1977 National Center for Health Statistics (NCHS)/WHO reference. It uses the original NCHS data set supplemented with data from the WHO child growth standards sample for under-fives. The WHO classification is the only system designed using data from before the obesity epidemic, and it might be the most appropriate for countries where the prevalence of childhood obesity is still relatively low (5).

However, there is not a clear consensus on which classification system should be used to diagnose overweight and obesity (5).

The prevalence of overweight children and adolescents is growing around the world in both developed and developing countries. The increase in prevalence of obesity in children is particularly registered in the developed countries of North America and Europe, i.e. it has been 0.5% to 1% per year over the last two decades. Overweight and obesity are found in 20-30% of children and adolescents in the European Region of the WHO. The highest prevalence of overweight or obesity is registered in the countries of Southern Europe (6).

Given that overweight and obesity in adolescents are maintained into adulthood and associated with morbidity and increased risk of premature mortality from coronary heart disease, atherosclerosis and certain types of malignant disease, WHO indicates obesity as one of the most important public health problems (4).

The aims of this study were 1) to determine the prevalence of overweight and obesity and 2) to identify risk factors (demographic and socio-economic characteristics, eating habits, the way of managing free time and conducting physical activities) associated with the overweight in adolescents aged 10 to 19 years in the Republic of Serbia.

2 METHOD

2.1 The population included in the research

This research is a cross-sectional study on a sample of 2139 adolescents aged 10 to 19 years. In the research, the database from the «Health Survey of the citizens of the Republic of Serbia» study (without any data for Kosovo and Metohija) from 2006, conducted by the Ministry of Health of the Republic of Serbia, was used. A two-stage stratified sample was used. The main strata in the sample were six geographic regions: Vojvodina, Belgrade, Western Serbia, Central Serbia and Southeastern Serbia. In order to analyze further, each stratum was divided into urban and rural. In the first stage of sampling, 675 EAs (Enumeration Areas) from the Census of 2002 in Serbia were selected on the basis of Pro-

bability Proportional Sampling. After updating within each EA, a selection was made that included 10 households and 3 replacement households from the household list, using Simple Random Sampling without Replacement. In this way, 7673 selected households were made a sampling frame and observation units were all members of the selected households. Out of the 7673 households randomly selected for the sample, 6156 were interviewed. The household response rate was 86.5%. In selected households, 2139 adolescents aged 10 to 19 years were identified (7-16).

2.2 Instrument

Two types of questionnaires have been used for data collection: face-to-face questionnaire (a version for each child and adolescent aged 7 to 19 years, living in the household) and household questionnaire. Ten questions that were related to demographic characteristics, socio-economic status, physical activities and dietary habits of adolescents of the 81 questions from a face-to-face questionnaire were used. Socio-economic status was measured by calculating the demographic and health survey wealth index (wealth index) on the basis of answers to 9 questions from the household questionnaire that included 30 questions. The questionnaires correspond to the standard questionnaires used in this type of research (for example, World Health Organization 2002 Health Survey) (17). The surveys were conducted by trained interviewers. The process of data collection was standardized in order to ensure data quality. Considering that each household was carefully selected, the obligation of the interviewers was to interview all household members (17).

2.3 Measuring body height and weight

The trained health care workers, a nurse-technician or physician, measured body height and weight using an altimeter and medical metric scales with decimal numbers. The instructions for the measurement procedure are in accordance with the European Health Risk Monitoring (EHRM) Recommendation for indicators, international collaboration, protocol and manual of operations for chronic disease risk factors surveys. The calibration of the instruments occurred at the beginning and the end of each examining day. The scale was balanced with both sliding weights at zero and the balance bar aligned. The scale was checked using the standardized weights, and calibration was corrected if the error was greater than 0.2 kg. The height rule was checked with standardized rods and corrected if the error was greater than 2 mm (18). The percentages of adolescents who were not measured were 2.9% for weight and 1.9% for height (17). Based on these data, BMI was calculated by dividing the body weight (kg) by the body height squared (m^2).

CDC growth charts were used to calculate BMI-for-age and sex for the population of children and adolescents. The points of intersection for identifying children and adolescents in relation to nourishment level were recommended. The interval between the 15th and 85th percentiles identifies people with normal body weight, while those with a BMI

value higher or equal to the 85th percentile are overweight (between 85 and 95 have a high risk of obesity, and obese are those whose level is higher than or equal to 95) (19).

2.4 Demographic characteristics and socio-economic status of the respondents

The data on demographic characteristics and socio-economic status of the respondents have been separated from the database as independent variables: age, sex, type of settlement, household wealth index - Demographic and Health Survey Wealth Index (Wealth Index), family structure and success in school. The independent variables have been coded as follows: sex (1 - male, 2 - female), age (1 - from 10 to 13 years old, 2 - 14 to 15 years old, 3 - 16 to 19 years old), type of settlement (1 - rural, 2 - urban area), family income (1 - poorest, 2 - poorer, 3 – middle class, 4 - richer, 5 – richest), family structure (1-complete, 2-incomplete) and success in school (1 - not attending school, 2 - repeated a grade or sufficient, 3 - good, 4 - very good or excellent). The socio-economic status of adolescents was measured by calculating household wealth index, which was calculated on the basis of the answers to the questions referring to the ownership of various durable goods (the number of bedrooms per household; the materials the floor, roof and walls of the house were made of; the type of water supply and sanitation; the type of heating fuels; owning a color television, cell phone, refrigerator, washing machine, dishwasher, computer, air conditioner, central heating and car). Quintiles were used for a tabular Demographic and Health Survey analysis of wealth index, and the quintiles were based on the household population apportionment (five categories of 20%) (17).

2.5 Free time and physical activities of the respondents

The data referring to the manner in which adolescents spend free time and conduct physical activities were gathered based on the responses to the question of how much time daily or weekly they spend watching television, doing homework, sleeping and engaging in physical exercise so that they breathe quickly and become sweaty. The independent variables have been coded as follows: watching television (1 - less than 1 h/day, 2 - 1 h to 2 h, 3 - more than 3 h), doing homework (1 - less than 1 h/day, 2 - 1 h to 2 h, 3 - more than 3 h/day), the frequency of physical activities that cause them to breathe quickly or become sweaty during a week (1 - almost every day, 2 - 3 times a week, 3 - less than 3 times a week), engaging in physical activities that makes you breathe quickly or become sweaty (1 - more than 7 h/week, 2 - from 2 h to 6 h/week, 3 - less than 1 h/week) and sleeping at night on weekdays (1 - less than 4 h, 2 - from 5 h to 8 h, 3-more than 9 h/day).

2.6 Eating habits

The data concerning eating habits of adolescents were based on the responses to the question of how many times

a week they eat breakfast and how often, during the previous week, they consumed fresh vegetables, fruits, sweets, sweet beverages and snacks. The independent variables were coded as follows: eating breakfast (1 - every day, 2 - sometimes, 3 – never), consumption of vegetables and fruits (1 – 6 to 7 times/week, 2 – 3 to 5 times/week, 3 – 1 to 2 times/week, 4 – none) and consumption of candies or confectionery, sugar - sweetened beverages and snacks (1 - none, 2 - 1 to 2 times, 3 - 3 to 5 times, 4 - 6 to 7 times/week).

2.7 Statistical analysis

For assessing statistical significance of differences in the prevalence of overweight/obesity, a nonparametric test (x^2 test) was used. The multiple logistic regression model was used to determine the association of overweight/obesity with the selected variables (demographic characteristics and socio-economic status, physical activities, the way of managing free time and eating habits). The odds ratio (ORs) with a 95% confidence interval (CI) was adjusted by age and sex for each category.

The statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) ver.15.0 software package, with a minimum significance level of p<0.05.

3 RESULTS

Figure 1 shows the prevalence of overweight and obesity according to the age and sex categories. Nearly one fifth of the adolescents aged 10 to 19 years were overweight, of which 11.3% adolescents were obese. Specifically, 28.9% of boys and 17.0% of girls were overweight, while 14.5% of boys and 8.1% of girls were obese. The prevalence of overweight and obesity significantly decreased with the increase of the age category in males, while it significantly decreased in girls only between the first two age categories. Also, a statistically significant difference in the prevalence between the sexes within the age category of 10 to 13 years and 14 to 15 years was observed, with boys showing a higher prevalence of overweight and obesity than girls.

Table 1 shows the association between the selected demographic and socio-economic characteristics of the respondents with the occurrence of overweight and obesity in adolescents. Multivariate logistic regression models showed a significant association of prevalence of overweight (including obesity) with sex and age in adolescents. Adolescents who were younger (OR = 0.58 or OR = 0.55 for adolescents 14 to 15 years old and OR = 0.34 or OR = 0.30 for adolescents 16 to 19 years old) and boys (OR= .55 or OR =.51) had a significantly higher risk of being overweight
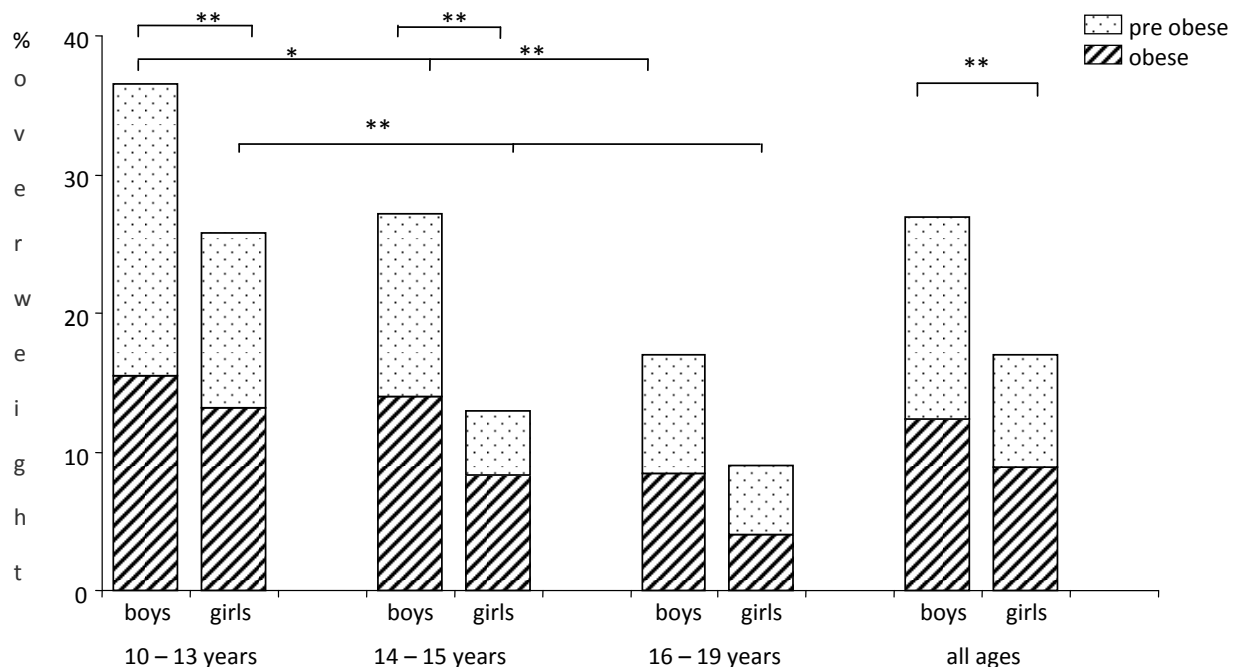
Significant difference* P < 0.05
Significant difference ** P < 0.01

Figure 1. The prevalence of overweight (including obesity) among adolescents aged 10 to 19 years, Serbia.

Table 1. Association between the demographic and socio-economic characteristics with the occurrence of overweight and obesity in Serbian adolescents aged 10-19 years.

	Number of participants (%)			Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)[†]
	Total n=2139	Normal weight n=1385	Overweight/obese n=470		
Sex					
Boys	1077	651(47.0 %)	290 (61.7 %)	1	1
Girls	1062	734 (53.0 %)	180 (38.3 %)	0.55(0.44-0.68)**	0.51 (0.40-0.65)**
Total	2139	1385	470		
Age					
10 – 13	873	503 (36.3 %)	270 (57.4 %)	1	1
14 – 15	468	308 (22.2 %)	96 (20.4 %)	0.58 (0.44-0.76)**	0.55 (0.41-0.73)**
16 – 19	798	574 (41.4 %)	104 (22.1 %)	0.34 (0.26-0.44)**	0.30 (0.22-0.41)**
Total	2139	1385	470		
Setllement					
Non-urban	1153	616 (44.5 %)	228 (48.5 %)	1	1
Urban	986	769 (55.5 %)	242 (51.5 %)	0.80 (0.62-1.02)	0.80 (0.62-1.04)
Total	2139	1385	470		
Wealth index					
Poorest	378	250 (18.1 %)	84 (17.9 %)	1	1
Poorer	460	298 (21.5 %)	86 (18.3 %)	0.88 (0.61-1.25)	1.01 (0.70-1.46)
Middle class	431	272 (19.6 %)	107 (22.8 %)	1.24 (0.87-1.75)	1.45 (1.01-2.08)
Richer	496	320 (23.1 %)	114 (24.3 %)	1.12 (0.78-1.60)	1.27 (0.87-1.84)
Richest	374	245 (17.7 %)	79 (16.8 %)	1.08 (0.72-1.63)	1.28 (0.84-1.96)
Total	2139	1385	470		
Family structure					
Complete	207	137 (10.2 %)	43 (9.3 %)	1	1
Incomplete	1873	1210 (89.8 %)	417 (90.7 %)	1.00 (0.70-1.45)	1.00 (0.68-1.46)
Total	2080	1347	460		
School success					
Not attending school	236	163 (12.4 %)	37 (8.1 %)	1	1
Repeated or sufficient	43	29 (2.2%)	7 (1.5 %)	1.15 (0.46-2.86)	0.75 (0.29-1.93)
Good	446	276 (21.0 %)	106 (23.2 %)	1.82 (1.17-2.85)	1.03 (0.63-1.67)
Very good or excellent	1310	844 (64.35 %)	306 (67.1 %)	1.70 (1.12-2.56)	0.91 (0.56-1.46)
Total	2035	1312	456		

†Adjusted for sex and age
*Significantly different from reference group *(P < 0.05)*
**Significantly different from reference group *(P < 0.01)*

than older adolescents and girls. No significant association with the wealth index was found.

When observing the association between the selected variables of the physical activities and the way of managing free time with the occurrence of overweight and obesity in adolescents, a statistically significant association of prevalence of overweight (including obesity) with variable of the physical activities lasting less than 7 hours a week, in such a way that you breathe quickly and become sweaty can be noticed. Specifically, the adolescents who spent physical activities less than 7 hours a week (OR = 25.04 or OR = 25.70 for physical activities 2 to 6 hours/a week; OR = 22.93 or OR = 21.35 for physical activities less than 1 hours/a week) were at risk in comparison with those who conducted physical activities more than 7 hours a week (Table 2).

Table 3 presents the association of the selected variables regarding specific eating habits with the occurrence of overweight and obesity. Specifically, we noted a statistically significant association for only one variable and only

after adjusting for age and sex. Namely, the adolescents who skipped breakfast had a significantly higher risk of becoming overweight/obesity compared with those who had breakfast every day.

4 DISCUSSION

The prevalence of overweight children and adolescents is growing around the world in both developed and developing countries. The results of our study, which showed that 22.0% of adolescents aged 10 to 19 years (26.9% boys and 17.0% girls) were overweight and that 11.3% of them (14.5% boys and 8.1% girls) were obese, indicated that Serbia is among the countries with high prevalence. Specifically, among European countries, the highest prevalence has been found in Southern European countries, particularly in Greece (44.4% boys and 37.7% girls aged 10 to 12 years), Malta (38.9% boys and 30.1% girls aged 10 to 11 years) and Cyprus (37.5% boys and 34.1% girls aged 10 to

Table 2. Association between the variables of the physical activities and the way of managing free time with the occurrence of overweight and obesity in Serbian adolescents aged 10-19 years.

	Number of participants (%)		Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)[†]
	Normal weight	Overweight/obese		
Television				
< 1 hr/day	215 (16.2 %)	66 (14.6 %)	1	1
1 – 2 hr/day	517 (39.0 %)	201 (44.4 %)	1.43 (.98-2.11)	1.42 (.96-2.10)
> 2 hr/day	593 (44.8 %)	186 (41.1 %)	1.27(.87-1.87)	1.27 (.86-1.88)
Homework				
< 1 hr/day	367 (29.7 %)	134 (31.0 %)	1	1
1 – 2 hr/day	491 (39.8 %)	194 (44.9 %)	1.13 (.84-1.52)	1.21 (.89-1.65)
> 2 hr/day	376 (30.5 %)	104 (24.1 %)	.73 (.52-1.03)	.86 (.60-1.23)
Physical activities				
almost every day	354 (26.2 %)	134 (28.9 %)	1	1
3 times a week	339 (25.1 %)	127 (27.4 %)	.80 (.58-1.10)	1.02 (.73-1.42)
less than 3 times a week	659 (48.7 %)	202 (43.6 %)	1.00 (.74-1.36)	1.14 (.83-1.56)
Physical activities				
> 7 hr/a week	63 (6.1 %)	28 (7.5 %)	1	1
2 – 6 hr/a week	444 (43.2 %)	169 (45.2 %)	**25.04 (3.43-182.92)****	**25.70 (3.50-188.71)****
< 1 hr/a week	521 (50.7 %)	177 (47.3 %)	**22.93 (3.14-167.50)****	**21.35 (2.91-156.65)****
Sleeping				
< 4 hr/day	12 (.9 %)	4 (.9 %)	1	1
5-8 hr/day	1049 (76.7 %)	336 (71.7 %)	.62 (.18-2.15)	.62 (.17-2.31)
> 9 hr/day	307 (22.4 %)	129 (27.5 %)	.99 (.28-3.52)	.85 (.23-3.17)

†Adjusted for sex and age
*Significantly different from reference group *(P < 0.05)*
**Significantly different from reference group *(P < 0.01)*

12 years). Also, Slovenia is among the European countries with high prevalence (31.7% boys and 22.5% girls aged 10 to 12 years) (20).This is confirmed by the data of a national study with a sample of 2474 adolescents aged 15 to 16 years (17.1% boys and 15.4% girls were overweight and 6.2% boys and 3.8% girls were obese) (21). Data from the survey examined excess weight and obesity in a population of Slovenian boys and girls aged seven to eighteen from 1991 to 2011 and revealed that obesity is growing at higher rates than excess weight, as it was almost three times higher among both sexes over just 20 years (overweight boys 13.3% in 1991 vs. 19.9% in 2011; overweight girls 12.0% vs. 17.2%; obese boys 2.7% vs. 7.5%; obese girls 2.1% vs. 5.5%) (22).

Our data have shown a statistically significant association between age and sex with the overweight. A declining trend in the prevalence of overweight with age is contrary to the survey data in developed countries, where either stable (23, 24) or positive trends (25) have been registered. In contrast, three Brazilian studies have shown the same trend as our study (26-28).

A greater prevalence of overweight in boys compared to girls is consistent with the research results (29-32), while some studies have found no statistically significant difference when it comes to sexes (33, 34).

There is a lot of literature that has demonstrated socio-economic inequalities in obesity among children in both high- and low-income countries – however, the direction of this association differs by economic context (35-43). Sobal

and Stunkard's review of the literature on the relationship between socioeconomic status and obesity included 144 studies published before 1989 with data on cross-sectional associations between SES and obesity in women, men and children from developed and developing countries. For girls and boys respectively, inverse associations were found in 40 studies, no associations in 35 and positive associations in 25 (42). Similarly, Shrewsbury and Wardle's review of 45 cross-sectional studies from 1990-2005 from developed and developing countries found that socioeconomic factors were inversely associated with adiposity in 19 studies, there was no association in 12 studies and in 14 studies there was a mixture of no associations and inverse associations across subgroups. Generally, in high-income countries, there is a strong inverse association between socioeconomic factors and obesity, whereas socioeconomic status and obesity are directly associated in low-income countries (43). A Slovenian national study showed a statistically significant association between high income families and the habit of consuming fresh fruits 1 or more times per day and engaging in physical activities 60 minutes per day, every day of the week (44). Health Behavior in School-aged Children study 2009/2010 in Slovenia showed that increased prevalence of overweight/obesity was significantly associated with low family affluence for girls and boys (45). The only study that associated socioeconomic factors with overweight/obesity in Serbia found a connection between high family income and female obesity (46). Our study did not find a statistically significant association between wealth index and the occurrence of overweight/obesity in adolescents.

Table 3. Association between the variables regarding eating habits with overweight and obesity in Serbian adolescents.

	Number of participants (%)		Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)[†]
	Normal weight	Overweight/obese		
Breakfast				
Every day	1201 (86.8 %)	406 (86.6 %)	1	1
Sometimes	168 (12.1 %)	60 (12.8 %)	.66 (.19-2.35)	.94(.26-3.44)
Never	14 (1.0 %)	3 (.6 %)	1.13 (.82-1.56)	**1.43 (1.02-2.01)***
Vegetables				
6 to 7 times/week	680 (49.3 %)	240 (51.5 %)	1	1
3 to 5 times/week	396 (28.7 %)	137 (29.4 %)	1.33 (.80-2.21)	1.30 (.77-2.20)
1 to 2 times/week	224 (16.3 %)	59 (12.7 %)	.81 (.56-1.17)	.71 (.49-1.04)
None	78 (5.7 %)	30 (6.4 %)	.99 (.75-1.30)	.88 (.66-1.17)
Fruits				
6 to 7 times/week	683 (49.7 %)	246 (52.6 %)	1	1
3 to 5 times/week	432 (31.4 %)	148 (31.6 %)	.72 (.38-1.35).	.67 (.35-1.28)
1 to 2 times/week	193 (14.0 %)	56 (12.0 %)	.85 (.58-1.25)	.94 (.64-1.40)
None	66 (4.8 %)	18 (3.8 %)	.95 (.73-1.24)	1.02 (.77-1.35)
Sweets				
None	112 (8.1 %)	34 (7.3 %)	1	1
1 to 2 times/week	409 (29.7 %)	145 (31.0 %)	1.46 (.76-2.82)	1.15 (.71-1.86)
3 to 5 times/week	537 (39.1 %)	197 (42.1 %)	1.45 (.76-2.77)	1.12 (.68-1.84)
6 to 7 times/week	317 (23.1 %)	92 (19.7 %)	1.38 (.71-2.66)	.84 (.49-1.45)
Sweet beverages				
None	61 (4.4 %)	14 (3.0 %)	1	1
1 to 2 times/week	282 (20.5 %)	100 (21.4 %)	1.46 (.76-2.82)	1.39 (.70-2.76)
3 to 5 times/week	537 (39.1 %)	190 (40.7 %)	1.44 (.76-2.77)	1.38 (.70-2.72)
6 to 7 times/week	495 (36.0 %)	163 (34.9 %)	1.38 (.71-2.66)	1.41 (.71-2.82)
Snacks				
None	159 (11.6 %)	59 (12.6 %)	1	1
1 to 2 times/week	466 (33.9 %)	159 (33.9 %)	.87 (.60-1.26)	.78 (.53-1.15)
3 to 5 times/week	540 (39.3 %)	184 (39.2 %)	.86 (.59-1.26)	.79 (.54-1.17)
6 to 7 times/week	210 (15.3 %)	67 (14.3 %)	.89 (.56-1.41)	.80 (.50-1.28)

[†]Adjusted for sex and age
*Significantly different from reference group *(P < 0.05)*
**Significantly different from reference group *(P < 0.01)*

Family functioning, which may also be linked to behavioral and psychological factors, has often been the interest of research (47, 48), while aspects of family structure (single parent families, number of siblings, birth order of child, age of mother at the birth of her child) have only rarely been examined and the results were inconsistent (49). In this study, the association of the variable referring to family structure with the occurrence of overweight and obesity wasn't found.

Researchers examined school performance as a variable associated with adolescents being overweight. In one review, which examined this association, it found that being or becoming overweight in adolescence was associated with poor school performance (50). The results of this study didn't find an association.

A large number of cross-sectional studies have investigated the association between eating habits and the occurrence of overweight/obesity. Namely, skipping breakfast is a powerful predictor for the occurrence of overweight/obesity in adolescents in both developed countries (28, 51, 52) and developing countries (53-55). Findings from the review of the prospective studies showed a negative association between breakfast consumption and BMI. In fact, breakfast consumption may be associated with decreased fat and snack intake later in the day, and it may a marker of health behavior of preparing food and eating at the table (56). Our research confirmed the results of the previously mentioned studies.

Among dietary factors linked with obesity, high-fat and sugar-containing foods have been the most studied. While overconsumption of these foods leads to excessive weight gain and obesity, consuming a diet high in fruits and vegetables protects against obesity.

The choice of beverage deserves special attention as a potential obesity risk factor in children and adolescents. Findings from recent systematic reviews ranged from no evidence to strong evidence for the independent role of the intake of sugar-sweetened beverages in the promotion of weight gain and obesity in children and adolescents (57, 58). Cross-sectional studies (59-61), as well as observational follow-up studies (62-64), showed positive associations between intake of sugar-sweetened beverages and overweight/obesity.

Although snack foods are generally high in both fat and calories and low in micronutrients or micronutrient density, prospective studies reported that they were not an important independent determinant of weight gain among children and adolescents (63, 65, 66).

Fruits and vegetables have high water and dietary fiber contents, making them low in energy density. However, a recent review of 23 longitudinal or experimental studies about fruit and vegetable intake and adiposity levels in children (67) showed an unclear relationship among children. Most studies in the review found no association, while only half of the child longitudinal studies found a significant inverse association. In a cross-sectional analysis, lifestyle pattern, including the consumption of vegetables, cooked meals and eating dinner, was negatively associated with obesity (68). Likewise, the findings of a review of 3 prospective, 10 cross sectional and 1 case control studies do not support a protective association between fruit or vegetable consumption and childhood obesity (69). Janssen I et al. showed, in a systematic review of a cross-sectional survey of 137,593 youth (10-16 years) from the 34 (primarily European) participating countries of the 2001-2002 Health Behavior in School-Aged Children Study, that overweight status was not associated with the intake of fruits, vegetables and soft drinks (70).

When considering an association of prevalence of overweight with the consumption of sweets, studies reported frequent consumption of sweets among other lifestyle factors significantly associated with obesity and overweight (27, 71-73). However, eating sweets was negatively associated with overweight/obesity in only two cross sectional studies (37, 74). Our data have shown no statistically significant association between the above-mentioned dietary factors and the overweight.

Lack of physical activity is a known determinant of obesity. Unfortunately, children become less and less active as they reach and progress through adolescence. Rauner A et al., in a review of twelve cross-sectional and two longitudinal studies, found that all studies reported inverse relations between physical fitness or physical activity and overweight. Only four studies analyzed the interaction among physical activity, fitness and overweight in adolescents and reported inconsistent results (75). One other systematic review of the cross-sectional studies examined the associations of physical activity and sedentary behavior to childhood and adolescent overweight and obesity and reported mixed results (76). Findings from a review of prospective observational studies published in English between 1990 - 2007 reported that physical activity showed more consistent inverse associations with fatness outcomes than for weight status, but the magnitudes of association were modest (56). Our study has shown a statistically significant association between conducting physical activities less than 7 h a week and the occurrence of overweight/obesity.

Several studies have specifically examined the relationship between television viewing and adolescents' risk of overweight. Although some find only weak relationships (77, 78), several others have found that hours of television viewing were closely associated with increased levels of obesity in cross-sectional and prospective studies (79-85). This discrepancy may reflect the replacement of television viewing with other forms of inactivity in older children, especially for girls. The results of a prospective study by Gortmaker et al. (86) showed a strong dose-response relationship between hours of television viewing and the prevalence of overweight at the end of the period. Those children who watched more than 5 h of television per day were five times as likely to be overweight than their counterparts who watched 2h or less of television per day. Our research has shown that there is no statistically significant association between overweight and habits of watching television.

The link between pediatric obesity, higher body fat and sleep duration has been widely demonstrated in the literature (87). In contrast to other sources of inactivity, short sleep duration is associated with excess weight (88). Interestingly, differences in risk have been shown between boys and girls, with the relationship between sleep and overweight seeming to be stronger among boys (89, 90). Our research has shown that there is no statistically significant association between overweight and sleep duration.

The limitations of the study are the difficulties in determining the direction of the cause-effect relationship and the fact that the resulting association does not necessarily reflect the association between the exposure and the morbidity risk, which are the main limitations of these studies. These deficiencies can be remedied by performing longitudinal studies, but those studies are expensive, time-consuming and involve a risk of the respondents dropping out. When it comes to data collection, the observed limitation is biasness in the data provision (older respondents and girls).

5 CONCLUSION

The prevalence of overweight, including obesity, in Serbia has reached the level of leading Southern European countries. This study showed an association between sex, age, physical inactivity and habit of skipping breakfast with the prevalence of overweight among adolescents in Serbia.

These findings should be an integral part of further preventive interventions, especially those oriented towards younger adolescents, who are physically inactive, have a habit of skipping breakfast and are boys.

LIST OF ABBREVIATIONS

WHO	World Health Organization
BMI	Body Mass Index
IOTF	The International Obesity Task Force
CDC	Centers for Disease Control and Prevention
NCHS	National Center for Health Statistics
EAs	Enumeration Areas
EHRM	European Health Risk Monitoring
Wealth Index	Demographic and Health Survey Wealth Index

OR   Odds Ratio
Cl   Confidence Interval
SPSS   Statistical Package for the Social Sciences
SD   Standard Deviation

CONFLICT OF INTEREST

The authors declare that no conflict of interest exist.

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Ethical approval was received from the Review Board of the Ministry of Health of Serbia and the Institute of Public Health of Serbia.

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