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*Original scientific paper*

# THE INFLUENCE OF PHYSICAL ACTIVITY ON BODY MASS INDEX VALUES IN ADOLESCENTS

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**ABSTRACT:** Physical activity as an important factor of proper growth and development today, under the influence of modern technologies, is causing a decline in the interest of young people, which results in an increase in BMI and the development of obesity. **The goal.** The aim of the work was to examine the influence of physical activity on BMI values in adolescents. **Methods.** The respondents were students from the first to the third grade of the Bihac secondary medical school, of both sexes. The time of data collection is November 2022. There were a total of 120 respondents. They were divided into two groups, working and control, with 60 students each. The working group consisted of students who did not engage in any physical activity, while the control group consisted of students who engaged in physical activity 1x-3x a week. **Results.** The mean value of BMI in the working group of students was 29.14 kg/m<sup>2</sup> compared to the mean value of BMI of the control group, 21.75 kg/m<sup>2</sup> ( $p=0.044$ ). BMI values among students from the first to the third grade of the working group were equal, without statistical significance ( $p=2.785$ ). In the control group, the BMI values were also equal, but lower compared to the BMI values of the working group. According to gender, the boys of the working group had a mean BMI of 29.26 kg/m<sup>2</sup>, compared to the boys of the control group, BMI of 21.71 kg/m<sup>2</sup> ( $p=0.000$ ). The same is true for girls, the mean BMI of the working group was 29.08 kg/m<sup>2</sup>, while the BMI of the control group was 21.70 kg/m<sup>2</sup> ( $p=0.000$ ). **Conclusion.** The absence of physical activity has a significant effect on the increase of BMI in adolescents and is a risk factor for obesity. The promotion of healthy lifestyle habits, proper nutrition and physical activity should be key features of the lives of children and adolescents.

**Key words.** Physical activity, body mass index, adolescents.

## INTRODUCTION

The basic human need, looking through the history of civilization, in addition to nutrition, also represents movement as the simplest form of physical activity that contributes to better and better health of people, both in the physical and psychological aspects. In everyday life, children need to satisfy their instinctive and natural need for movement, which is achieved through various forms of play that positively affects proper growth and development. Regular physical activity in adolescents has numerous benefits for their health, including healthy growth and development of bones, muscular and cardiorespiratory systems, maintains energy balance, has a beneficial effect on mental health, greater possibility of social interaction, reduction of anxiety and stress (British Heart Foundation, 2004). In the last decades of the 20<sup>th</sup> century, there was a decrease in physical activity among children and adolescents and an increase in BMI (Body Mass Index), which numerous scientific studies have confirmed. The trend of increasing BMI among the young population continues in the new century and takes on an epidemic character in many parts of the world. According to data from the World Health Organization (WHO), obesity is highest in the countries of North America, Central and Eastern Europe, as well as in the countries of the Middle East. It is estimated that in 2016 worldwide, 124 million children and adolescents aged 5 to 19 years were obese (BMI  $\geq 30$  kg/m<sup>2</sup>), and 213 million were overweight (BMI 25.0 - 29.9 kg/m<sup>2</sup>) (Spinelli et al, 2019). In the last three decades of the 21<sup>st</sup> century, there was a sudden increase in BMI in children aged 2 to 18 years in both devel-

oped and developing countries (Güngör, 2014; Lee et al, 2018). Literature data also indicate that children and adolescents in most countries have a low prevalence of the overall level of physical activity, a high prevalence of sedentary/sedentary behavior, which includes time spent awake, sitting or lying down with low energy expenditure (watching television, working on a computer, using smartphones telephone, etc.) and a serious increase in the prevalence of obesity (Zhu et al, 2017). It is considered that physical inactivity along with inadequate nutrition is the main cause of health problems in children and adolescents. The emergence of obesity can also be observed in the context of complex social environments in which children and adolescents grow up. Eating habits and physical activity must be connected and combined in order to have a good result in maintaining a normal body mass (Stanić, 2017). There are a number of expert recommendations to what extent adolescents should participate in physical activities of medium to high intensity - at least one hour a day, while in physical activities that involve strengthening the locomotor system - at least three times a week (Sever, 2019). The mutual influence of certain factors such as family, friends and peers from school and the social community can also be reflected in the way of eating, physical activity and sedentary/sedentary behavior of adolescents. Parents represent the primary social context and pattern of behavior in the approach to nutrition and physical activity that children adopt and develop as healthy or unhealthy lifestyles (Bogl, 2020). Considering the worrying increase in overweight and obesity among children and adolescents, WHO member states set an important goal until 2025 to stop this negative trend and approved a project under the slogan "No increase in overweight and obesity" (Baran, 2020; WHO, 2021).

### **OBJECTIVE**

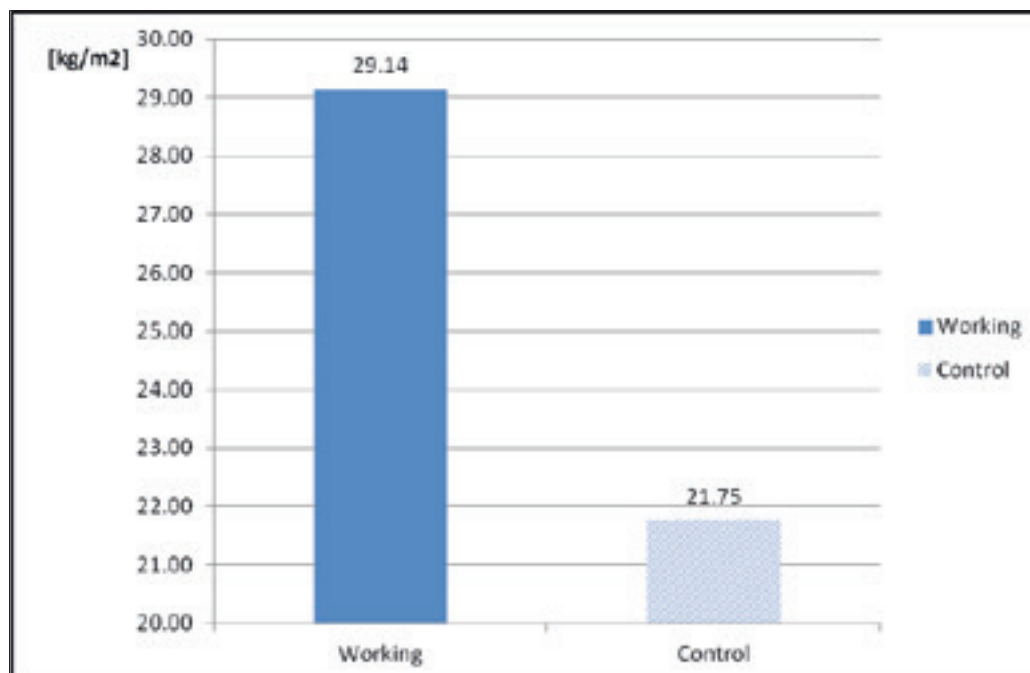
The main goal of this work is to examine the influence of physical activity on BMI values in adolescents from the secondary medical school in Bihać.

### **METHODS AND RESPONDENTS**

The respondents were students from the first to the third grade of the secondary medical school in Bihać, aged 15 to 17, of both sexes. The total number of students in the research was 120. The time of data collection is the period from 04.11. - 29.11.2022. years. The respondents were divided into two groups, working and control, with 60 students in each group. The working group consisted of students from first to third grade who did not engage in any physical activity in their free time, while the control group consisted of students from first to third grade who engaged in physical activity 1x-3x a week, during their free time. Anthropometric measurements of body height and weight were performed on the subjects in order to calculate the BMI value, and were carried out on an Omron scale (BF 511/201-107-00214F/ 2018/Amsterdam). For the purpose of researching the connection between BMI and physical activity, a separate survey questionnaire was created in the form of a test with provided answers. For the purpose of data processing, the arithmetic mean method was applied, and the results were presented graphically. The data were processed in MS EXCEL to determine the arithmetic mean (AVERAGE) and the statistical value p (STAT-p).

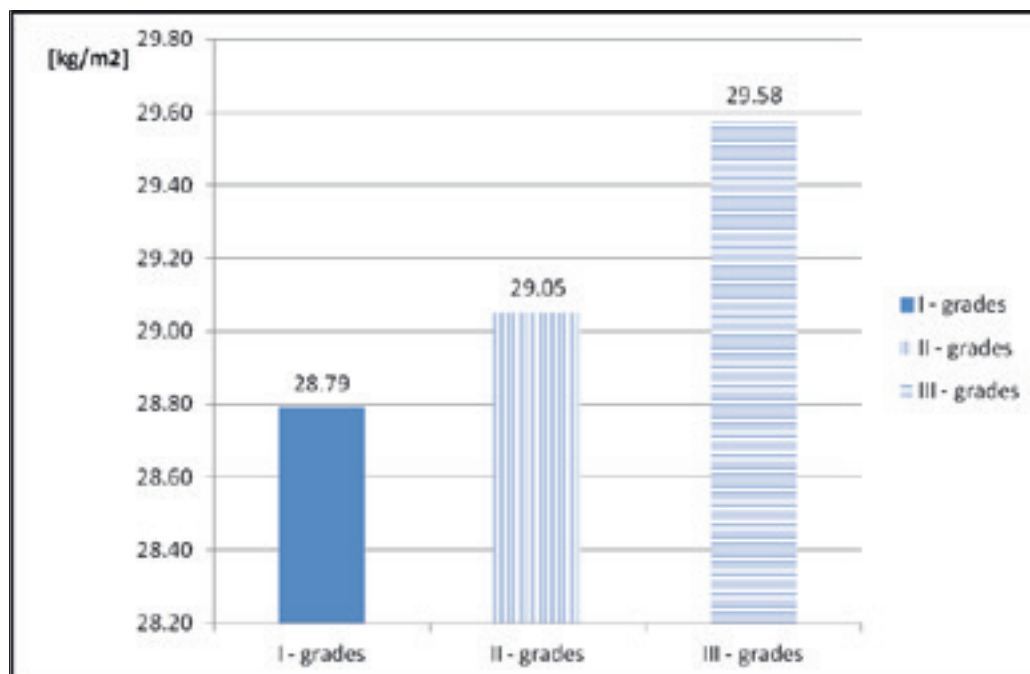
### **RESULTS**

Out of the total number of respondents in our study (120 respondents), 29 male respondents (boys) and 31 female respondents (girls) were represented in the working group that was not physically active. In the control group that was physically active (1x-3x a week) there were 28 male respondents and 32 female respondents. The mean value of BMI in the subjects of the work group was 29.14 kg/m<sup>2</sup>, while in the control group the value of BMI was 21.75 kg/m<sup>2</sup>, which represents a statistically significant difference (p=0.044) (Graph 1).



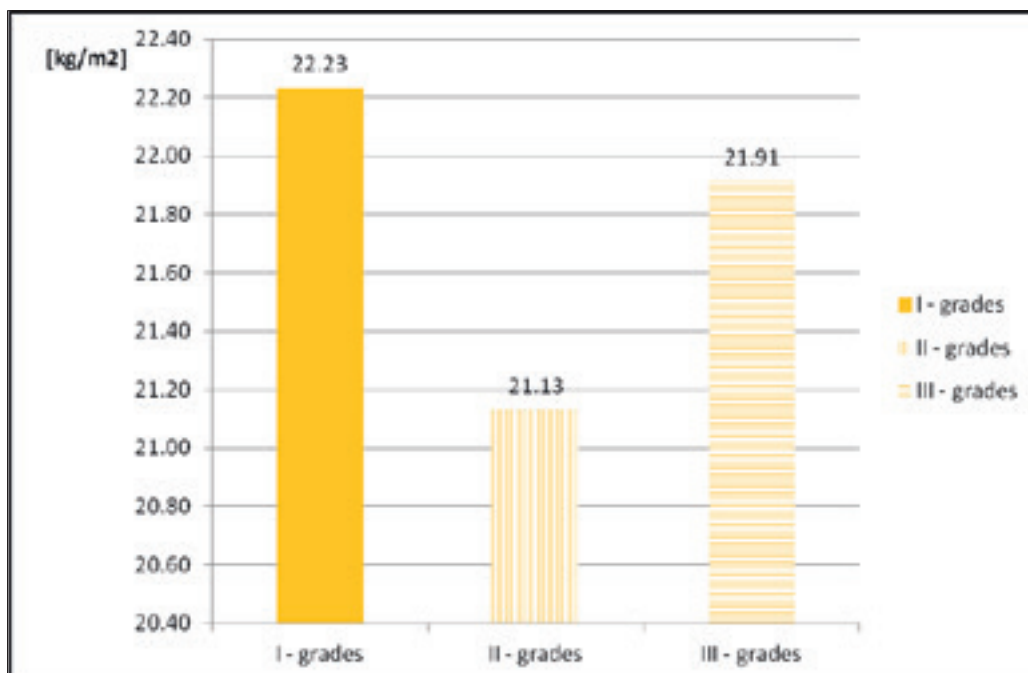
**Graph 1.** Mean value of BMI of the Working and Control groups

The BMI values of the working group of respondents from I to III grades are shown in Graph 2 and show that the mean BMI value for I grade was 28.79 kg/m<sup>2</sup>, for II grade 29.05 kg/m<sup>2</sup>, while the BMI values in III class amounted to 29.58 kg/m<sup>2</sup>, which statistically does not represent a significant difference ( $p=2.785$ ).



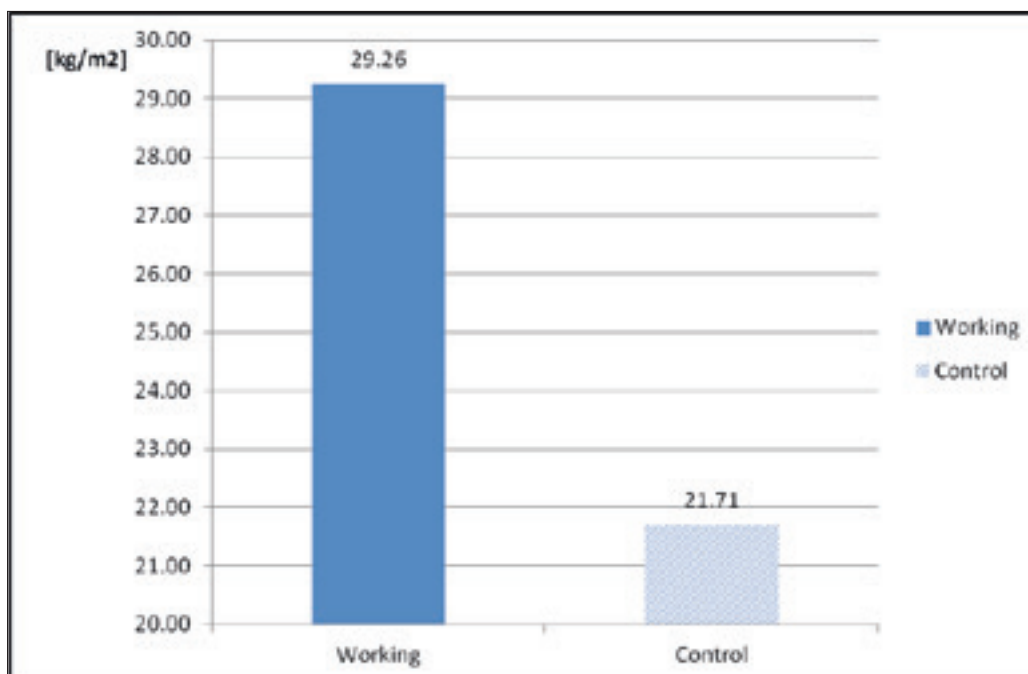
**Graph 2.** Mean values of BMI in the Working Group of subjects from I to III grades

The mean value of BMI in the Control group, by class, is shown in Graph 3. The mean value of BMI for the first class was 22.23 kg/m<sup>2</sup>, for the second class 21.13 kg/m<sup>2</sup>, while for the third class it was 21.91 kg./m<sup>2</sup> which does not represent a statistically significant difference ( $p=2.281$ ).



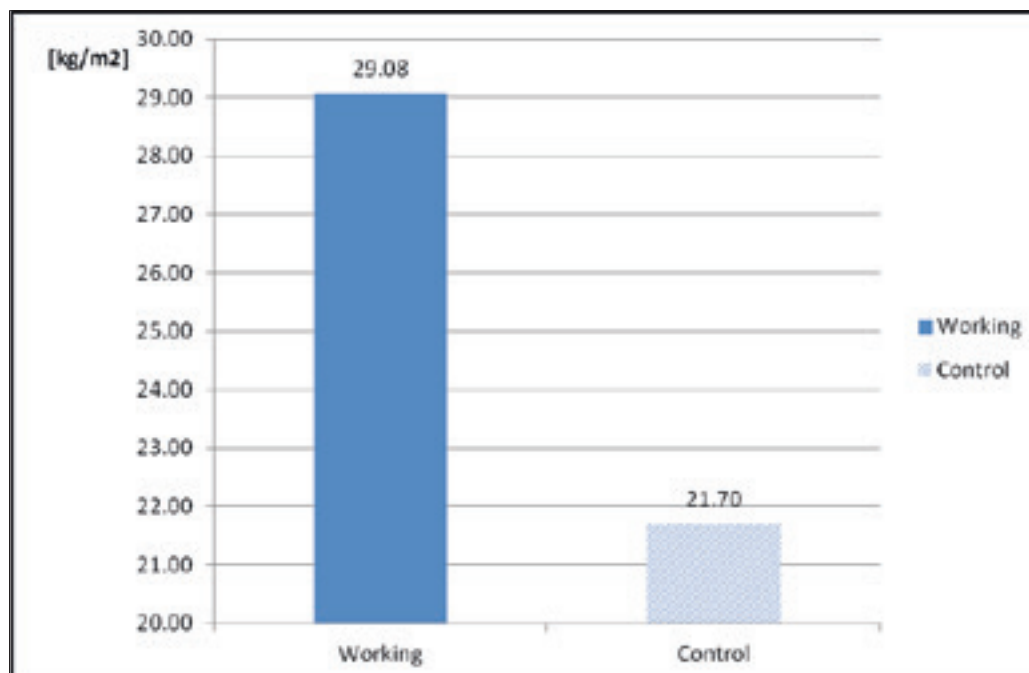
**Graph 3.** Mean values of BMI in the Control Group of subjects from I to III grades

Graph 4 shows the mean values of BMI in male subjects (boys) of the working group, which was 29.26 kg/m<sup>2</sup>, while in male subjects of the control group, BMI was 21.71 kg/m<sup>2</sup>, which represents a significant difference.



**Graph 4.** Mean value of BMI in boys of the Working and Control groups.

Graph 5 shows the mean value of BMI in female respondents (girls) in both groups. We can see that the mean value of BMI in the female subjects of the work group was 29.08 kg/m<sup>2</sup>, while the BMI value in the female subjects of the control group was 21.70 kg/m<sup>2</sup>, which represents a significant difference.



**Graph 5.** Mean value of BMI in girls of the Working and Control groups

## DISCUSSION

Our research included 120 respondents, students of the Bihac High School of Medicine from the first to the third grade. The study showed that physical activity is an important factor that affects the nutritional status of adolescents, but also the BMI (body mass index). In the working group of respondents, who did not engage in any physical activity, in their free time, the mean value of BMI was much higher and amounted to 29.14 kg/m<sup>2</sup> compared to the control group who had physical activity once, twice or three times weekly for 90 minutes (in their free time they engaged in physical activity, aerobic exercises or team games) whose mean BMI was 21.75 kg/m<sup>2</sup>, which represents a statistically significant difference ( $p=0.044$ ) and is in line with other literature data.

Namely, the confirmation that physical activity has a positive effect on the reduction of BMI is proven by a study in Italy in a high school on a sample of 60 obese adolescent girls aged 15-17 years, who were divided into the Work (physically inactive) and Control (physically active) groups. The results of this study indicate that physical activity, program of moderate to vigorous aerobic exercises is effective in reducing body weight in adolescent girls and provides positive and significant effects on the behavior of girls who have obesity problems. It also indicates that physical activity has a strong potential in promoting a number of outcomes that are important for the quality growth of adolescents (Latino et al., 2021).

In accordance with our results, and according to the research of Hills et al. (2011) in many western countries, a large number of adolescents who did not adhere to the recommended guidelines for physical activity had elevated BMI values, i.e. the results of that study show that physically active respondents had lower BMI values and body fat percentage compared to respondents who did not engage in physical activity. Physical activity plays an important role in the prevention of obesity and obesity in childhood and adolescence and reduces the risk of developing obesity in adulthood.

Children are not born obese, but they certainly become obese. Most studies show that body weight increases with age (Singh et al. 2008). Also, weight gain in children causes many problems in early childhood and adolescence including, in more severe degrees of overweight, developmental abnormalities of the

locomotor system and weight-bearing limbs. Metabolic problems such as insulin resistance, the development of diabetes, and higher blood pressure and dyslipidemia are also evident in obese children even when they are young, and later in life cardiovascular complications and early death occur (Gunnell et al. 1998). The results of the study by Bukara-Radujkovic et al. (2019) also prove a positive correlation of reduced physical activity and a sedentary lifestyle, as significant determinants and risk factors in the development of moderate obesity and obesity in childhood.

Physical activity represents the most natural way of spending energy, which has become very limited in developed countries due to rapid technological progress. Research results regarding the impact of physical activity on body mass are different, but they all have in common that regular physical activity in both sexes is associated with a lower percentage of fat in the total body composition. However, some studies show that differences in body fat between physically active and physically inactive children are greater in girls than in boys (Krassas et al. 2001). When we compare the results of our study, by gender, in the boys of the work group, the BMI values were much higher compared to the BMI values of the boys of the control group ( $p=0.000$ ) where physical activity of different intensity was represented once, twice or three times a week. Also, the BMI values of the girls of the work group compared to the BMI values of the girls of the control group were higher, which is in accordance with other literature data. According to research by Zvonar et al. (2019), which included adolescents aged 15 to 18 years who were physically active, the results showed that there are differences in BMI by gender as the classes get older. In fact, the results show that boys have a higher BMI, waist circumference and height compared to girls.

Other literature data also indicate a positive influence of intense and regular physical activity on normal body mass index in girls and boys ( $p<0.05$ ) (Bukara-Radujkovic et al, 2019). Namely, girls who are often physically active had the lowest BMI values (that is normal body mass), and girls who do not engage in physical activity had the highest BMI values. Also, the results of this study show the positive impact of regular (at least 3 times a week for 1 hour) physical activity on the normal BMI of boys. Boys who were engaged in physical activity in addition to well-developed muscle mass had normal body mass values (BMI), which is in accordance with the results of our study. In a multiple study analysis, Elmesmari et al. (2018), which included respondents from Asia, Canada, the USA and Europe, and which included a sample of 12,601 adolescents (of which 3,045 were obese), compared the level of physical activity in obese and non-obese peers. The results of the research showed that daily physical activity is lower than recommended in children and adolescents with obesity, and more so in male obese subjects compared to female subjects. Also, scientific studies confirm the thesis that moderate to intense physical activity compared to low-intensity exercises leads to a reduction in body weight (Keane et al 2017). On the other hand, scientific research into the physical activity of European and North American children and youth shows that the physical activity of school children increases until early adolescence, when it begins to decrease intensively and that in the late adolescence phase it is more pronounced in boys than in girls, although boys physically more active than girls (Malina et al. 1991).

Prevention of obesity in children and adolescents should include children as early as possible. Also, the promotion of healthy lifestyle habits - proper nutrition (which includes a balanced intake of building materials, fruits and vegetables), physical activity and playing sports, should be the task not only of school programs, but should be the responsibility of the family and society as a whole. A nine-country analysis that included England, the United States, Sweden, China, Australia, the Netherlands and Switzerland reported promising reductions in obesity in children and adolescents aged 2 to 19 years (Rokholm et al, 2010). However, although the prevention of childhood obesity is politically attractive, it is not realistic to expect that some quick changes will bring long-term positive solutions in the health of the population and will not

affect the reduction of health costs in diabetes and hypertension that are caused by obesity, so that it has a negligible impact on the burden of disease in the next 40 years. Parents as adults should be positive role models for their children precisely in the promotion of health and healthy lifestyle habits (Rind et al, 2011).

## CONCLUSION

The absence of physical activity among adolescents with a sedentary lifestyle results in a significant increase in BMI compared to peers who practice some of the aerobic exercises or team games one to three times a week in their free time. The development of obesity in children and adolescents can lead to the development of chronic non-communicable diseases and an increase in the rate of morbidity and mortality in adult life. The promotion of healthy lifestyle habits, above all proper nutrition and physical activity, should be the primary task of the family and society as a whole.

## LITERATURE

- Baran R, Baran J, Leszczak J, Bejer A, Wyszynska J., *Sociodemographic and Socioeconomic Factors Influencing the Body Mass Composition of School-Age Children*, Int J Environ Res Public Health. 2022 Sep 7; 19(18):11261. doi: 10.3390/ijerph191811261. PMID: 36141532; PMCID: PMC9517388.
- Bogl LH, Mehlig K, Ahrens W, Gwozdz W, de Henauw S, Molnár D, Moreno L, Pigeot I, Russo P, Solea A, Veidebaum T, Kaprio J, Lissner L, Hebestreit A, *IDEFICS and I. Family Consortia. Like me, like you - relative importance of peers and siblings on children's fast food consumption and screen time but not sports club participation depends on age*, Int J Behav Nutr Phys Act. 2020 Apr 15; 17(1):50. doi: 10.1186/s12966-020-00953-4. PMID: 32295621; PMCID: PMC7160987.
- British Heart Foundation (2004). Couch kids: the continuing epidemic. London: British Hear Foundation
- Bukara- Radujković G, Zdravki D. Physical Activity as An Important Determinant in Developing Childhood Obesity. Med Pregl 2019; LXII (3-4): 107-113. UDK 613.25:613.72]-053.2 DOI: 10.2298/MPNS09041 07B 107
- Elmesmari R., Martin A., Reilly J.J., Paton J.Y., Comparison of accelerometer measured levels of physical activity and sedentary time between obese and non-obese children and adolescents: a systematic review. BMC Pediatr. 2018 Mar 9; 18(1):106. doi: 10.1186/s12887-018-1031-0. PMID: 29523101; PMCID: PMC5844092
- Gunnell DJ, Frankel SJ, Nanchahal K, Peters TJ, Davey Smith G. Childhood obesity and adult cardiovascular mortality: a 57y followup study based on the Boyd Orr cohort. Am J Clin Nutr. 1998 Jun;67(6):1111-8.
- Güngör NK., *Overweight and obesity in children and adolescents*, J Clin Res Pediatr Endocrinol. 2014 Sep; 6(3):129-43. doi: 10.4274/Jcrpe.1471. PMID: 25241606; PMCID: PMC4293641
- Hills A.P., Andersen L.B., Byrne N.M., *Physical activity and obesity in children*, Br J Sports Med. 2011 Sep ;45(11):866-70. doi: 10.1136/bjsports-2011-090199. PMID: 21836171.
- Hills A.P.; Okely, A.D.; Baur, L.A. Addressing childhood obesity through increased physical activity. *Nat. Rev. Endocrinol.* 2010, 6, 543-549.
- Keane E., Li X., Harrington J.M., Fitzgerald A.P., Perry I.J., Kearney P.M., *Physical Activity, Sedentary Behavior and the Risk of Overweight and Obesity in School-Aged Children*, Pediatr Exerc Sci. 2017 Aug; 29(3):408-418. doi: 10.1123/pes.2016-0234. Epub 2017 Apr 7. PMID: 28388271
- Krassas GE, Tzotzas TH, Tsametis C, Konstantinidis T. Prevalence and trends in overweight and obesity. among children and adolescents in Thessaloniki. Greece. J Pediatr Endocrinol Metab 2001; 14(Suppl 5): 1319-26.13.
- Latino F, Cataldi S, Bonavolontà V, Carvutto R, De Candia M, Fischetti F, The Influence of Physical Education on Self-Efficacy in Overweight Schoolgirls: A 12-Week Training Program, Front Psychol. 2021 Nov 3; 12:693244. doi: 10.3389/fpsyg.2021.693244. PMID: 34803792; PMCID: PMC8595474.
- Lee EY, Yoon KH, *Epidemic obesity in children and adolescents: risk factors and prevention*, Front Med. 2018 Dec; 12(6):658-666. doi: 10.1007/s11684-018-0640-1. Epub 2018 Oct 2. PMID: 30280308
- Malina RM, Bouchard C. Growth. maturation and physical activity. Champaign. IL: Human Kinetics: 1991.
- Oxford Textbook of Global Public Health [Internet]. Oxford Textbook of Global Public Health. Oxford University Press; [cited 2022]. Available from: <https://oxfordmedicine.com/view/10.1093/med/9780199661756.001.0001/med-9780199661756>
- Rind E, Jones AP. The geography of recreational physical activity in England. Health Place. 2011 Jan;17(1):157-65.
- Rokholm B, Baker JL, Sørensen TIA. The levelling off of the obesity epidemic since the year 1999 a review of evidence and perspectives. Obes Rev Off J Int Assoc Study Obes. 2010 Dec;11(12): 835-46.
- Sever K. (2019). Prehrana i prevencija pretilosti u školskoj dobi, Završni rad, Sveučilište Sjever <https://urn.nsk.hr/urn:nbn:hr:122:965759>
- Singh AS, Mulder C, Twisk JWR, van Mechelen W, Chinapaw MJM. Tracking of childhood overweight into adulthood: a systematic review of the literature. Obes Rev Off J Int Assoc Study Obes. 2008 Sep; 9 (5):474-88.
- Spinelli A, Buon cristiano M, Kovacs VA,... and Breda J., Prevalence of Severe Obesity among Primary School Children in 21 European

- Countries, *Obes Facts*. 2019;12(2):244-258. doi: 10.1159/000500436. Epub 2019 Apr 26. PMID: 31030201; PMCID: PMC6547273
- Stanić T. (2017), *Pravilna prehrana i tjelesna aktivnost u prevenciji pretilosti učenika*, Diplomski rad, <https://core.ac.uk/reader/264794260>
- WHO (2021), Preuzeto sa: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>
- WHO. Physical status. The use and interpretation of anthropometry. Report of a WHO expert committee; Technical Report Series No 854. WHO, Geneva, 1995.
- Zvonar M, Štefan L, Kasović M, Percentile Curves for Body-Mass Index, Waist Circumference, Waist-To-Height Ratio and Waist-To-Height Ratio(Exp) in Croatian Adolescents, *International Journal of Environmental Research and Public Health*. 2019. 16(11):1920, Preuzeto sa: <https://doi.org/10.3390/ijerph16111920>
- Zhu Z, Tang Y, Zhuang J..and Chen P., *Physical activity, screen viewing time, and overweight/obesity among Chinese children and adolescents: an update from the 2017 physical activity and fitness in China-the youth study*, *BMC Public Health*. 2019 Feb 15;19(1):197. doi:10.1186/s12889-019-6515-9.PMID:30767780;PMCID: PMC6376726

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