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# Differences in obesity status among adolescents living in urban and rural areas of the municipality of Pljevlja

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**Abstract**

Overweight and obesity are one of the biggest challenges today, and they can vary by the type of settlement in which adolescents live. The aim of this study is to assess the general state and differences in obesity status among adolescents by type of settlement. This research included 139 respondents of both genders from urban and rural areas of the municipality of Pljevlja, with an average age of 15.6±0.6. Body Mass Index (BMI), Waist to Height Ratio (WHtR), and body fat (BF) were used to assess obesity status. To assess the difference by type of settlement, the Chi-square test was used with a statistical significance of $p \leq 0.05$, and data processing was performed in the statistical program SPSS version 23. According to BMI values, 23.3% of male adolescents were overweight, and 12.3% were obese, while 7.6% of female adolescents were overweight and 3% are obese. By WHtR values, 24.7% of male and 9.1% of female adolescents belonged to the obese group. According to the BF values, female adolescents from rural areas were significantly more overweight than their peers from urban areas ($p=0.025$), while no differences were found in other variables. When it comes to male adolescents, no differences were found in any variables. The problem of overweight and obesity should be considered in future research, especially in male adolescents.

***Keywords:*** *adolescents, obesity, urban, rural, Pljevlja*

## Introduction

Pljevlja is a municipality in the very north of Montenegro, and it covers an area of 1346 km², which territorially makes it the third largest municipality in Montenegro (Radojicic, 2015). According to Mostat (2011), Pljevlja has 30,786 inhabitants, of which 19,489 (63.30%) live in urban, and 11,297 (36.70%) live in rural areas, while the number of adolescents aged 10 to 19 is 3,773. Adolescence is a period of life of 10 up to 19 years and is one of the fastest and most important phases of human development, both physical, emotional, cognitive, social, and many others (WHO, 2017). Therefore, in this period, it is very important to take care of all the components that can affect their health.

Obesity status is one of the important components that affect the health of adolescents. Today, we have an increasing trend of overweight and obesity in children and adolescents, which together represent one of the leading health problems (WHO, 1995). Childhood obesity is associated with an increased incidence of hypertension, diabetes, metabolic disorders, heart disease, and an increased risk of premature mortality during adulthood (Mohan et al., 2019). In addition to all the other problems that overweight and obesity lead to, it poses a great risk that children and adolescents who were overweight or obese during that period will remain so in adulthood (Jain, Pant, Chopra, & Tiwari, 2010). It is estimated that in 2010, overweight and obesity caused 3.4 million deaths (Ng et al., 2014). The sheer numbers of the overweight and obese population are alarming. It is estimated that in the USA 20% of children belong to the overweight group (Matsushita, Yoshiike, Kaneda, Yoshita, & Takimoto, 2004), while 4% of the entire youth population is considered severely obese (Skelton, Cook, Auinger, Klein, & Barlow , 2009). Also in China, from 1985 to 2014, overweight increased from 2.1% to 12.2%, and the obesity rate from 0.5% to 7.3% (Sun et al., 2020). If these trends continue

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without adequate interventions, overweight and obesity in China will amount to 28% in 2030, that is, it will reach the number of 48.49 million overweight and obese children (Larsen, Wang, & Popkin, 2014). When it comes to Montenegro, the results are also not to be praised. According to the data of Milasinovic, Bojanic, Cvorovic, and Kukic (2019), every third child in Montenegro, aged 9 to 13, is overweight or obese.

It was found that many aspects of health (Berkman, Kavachi, & Glimoru, 2000), and obesity status (Aberle et al., 2009) differ in relation to the socioeconomic position and type of settlement. If once various diseases related to obesity status were considered an urban problem, today they have spread alarmingly to the rural population as well (Vafa, & Ghazalli, 2020). This is supported by the data of a global study (NCD Risk Factor Collaboration, 2019) that the global increase of BMI from 1985 to 2017 increased by more than 55%, and in some low and middle-income regions by more than 80%, due to growth in rural areas. Therefore, the aim of this research is to assess the obesity status and the differences among adolescents living in urban and rural areas in the territory of the municipality of Pljevlja.

## Metod

*Procedure*

This research is of a cross-sectional type, while the measurements were carried out in accordance with the standards of the ISAK manual (Marfell-Jones, Olds, Stev, & Carter, 2006). Initially, confirmation of access to the experimental procedure was obtained from the school directors in the schools where the testing was conducted. The testing was conducted by teaching assistants of the Faculty for Sports and Physical Education from Niksic in the morning hours. Measurement lists were provided for each individual, and the assessors were aware and previously trained about the measurement procedure and data entry. The type of settlement was defined by students entering the place where they live in a modified questionnaire. On the basis of the place of residence, and with the help of the spatial urban planning solution of the municipality of Pljevlja, the students are divided into urban and rural areas. The spatial urban planning solution was taken over in the Pljevlja municipality building from the secretariat for spatial planning.

*Participants*

The sample of respondents in this research consisted of 139 students of the first and second grades of secondary schools in the municipality of Pljevlja, with an average age of 15.6±0.6 years. Of these, 73 respondents were male adolescents, and 66 were female adolescents, while 77.7% of adolescents lived in urban and 22.3% in rural areas (Table 1). The sample of respondents was obtained by random sampling. Adolescents with chronic diseases, physical or mental deficiency were excluded from this research.

**Table 1.** Sample of respondents

| Participants | Male | Female | Overall |
|---|---|---|---|
| Urban | 58 | 50 | 108 |
| Rural | 15 | 16 | 31 |
| Overall | 73 | 66 | 139 |

*Variables*

For obesity status, the following anthropometric measures were measured: body height (BH), body mass (BM), waist circumference (WC), subscapular skinfold (SS), and triceps skinfold (TS). By measuring anthropometric characteristics, anthropometric indexes were calculated: Body Mass Index (BMI), Waist to Height Ratio (WHtR), and percentage of body fat (BF). The assessment of obesity status was determined by calculating the percentage values for the BMI values for each respondent according to the standards of the Center for Disease Control and Prevention (CDC) where the respondents were classified into groups of underweight (<5th percentage), normal (5th - 85th), overweight (>85th ≤95th), and obese (>95th). WHtR is also one of the most reliable methods for assessing obesity status and

**Table 2.** Differences in obesity status by type of settlement

| | Male | | | | | | | Female | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Urban | | Rural | | Overall | | Chi | Urban | | Rural | | Overall | | Chi |
| | n | % | n | % | n | % | p | n | % | n | % | n | % | p |
| BMI | | | | | | | | | | | | | | |
| Underweight | 3 | 5.2 | 0 | 0 | 3 | 4.1 | 0.546 | 2 | 4 | 0 | 0 | 2 | 3 | 0.072 |
| Normal | 33 | 56.9 | 11 | 73.3 | 44 | 60.3 | | 44 | 88 | 13 | 81.3 | 57 | 86.4 | |
| Overweight | 15 | 25.9 | 2 | 13.3 | 17 | 23.3 | | 4 | 8 | 1 | 6.3 | 5 | 7.6 | |
| Obese | 7 | 12.1 | 2 | 13.3 | 9 | 12.3 | | 0 | 0 | 2 | 12.5 | 2 | 3 | |
| WHtR | | | | | | | | | | | | | | |
| Normal | 43 | 74.1 | 12 | 80 | 55 | 75.3 | 0.639 | 47 | 94 | 13 | 81.3 | 60 | 90.9 | 0.123 |
| Obese | 15 | 25.9 | 3 | 20 | 18 | 24.7 | | 3 | 6 | 3 | 18.8 | 6 | 9.1 | |
| Body Fat | | | | | | | | | | | | | | |
| Underweight | 8 | 13.8 | 4 | 26.7 | 12 | 16.4 | 0.542 | 2 | 4 | 0 | 0 | 2 | 3 | 0.025 |
| Normal | 25 | 43.1 | 7 | 46.7 | 32 | 43.8 | | 44 | 88 | 10 | 62.9 | 54 | 81.8 | |
| Overweight | 10 | 17.2 | 2 | 13.3 | 12 | 16.4 | | 4 | 2 | 3 | 18.8 | 4 | 6.1 | |
| Obese | 15 | 25.9 | 2 | 13.3 | 17 | 23.3 | | 0 | 6 | 3 | 18.8 | 6 | 9.1 | |

Legend: BMI - Body Mass Index; WHtR - Waist to height ratio; Chi - Chi-squared test; p - significant value;

represents the ratio of waist circumference to body height. A respondent whose WHtR is more than 0.5 is considered to belong to the obese group (Ashwell, Gunn, & Gibson, 2012). The BF was calculated by the Slaughter equation, using the subscapular skinfold (SS) and the triceps skinfold (TS) (Slaughter et al., 1988), after which were calculated fat percentages for each subject, which are classified into groups of underweight (<5th percentage), normal (5th - 85th), overweight (>85th ≤95th) and obese (>95th) (McCarthy, Cole, Fry, Jebb, & Prentice, 2006).

*Statistical analysis*

The data obtained in this research were processed using descriptive statistical procedures, and the arithmetic means and standard deviation were determined. Chi-square test with a statistical significance of $p \leq 0.05$ was used to assess the differences in the obesity status among adolescents by type of settlement.

## Results

The results that show the obesity status of adolescents and their differences by type of settlement are shown in Table 2. For BMI values, it was shown that 23.3% of male adolescents were overweight, and 12.3% obese. When it comes to female adolescents, 7.6% were overweight, and 3% were obese. For WHtR values, 24.7% of male, and 9.1% of female adolescents belonged to the obese group. According to BF values, 16.6% of male adolescents were overweight and 23.3% obese, while 6.1% of female adolescents were overweight and 9.1% obese. When it comes to differences in the obesity status of adolescents by type of settlement, it was shown that according to the BF values, 18.8% of female adolescents living in rural areas showed a statistically significant higher overweight level compared to 2% of their peers from urban areas ($p=0.025$). Differences in BMI and WHtR values were not found.

## Discussion

The aim of this research was to estimate the level of obesity and its differences among adolescents living in urban and rural areas in the territory of the municipality of Pljevlja. Based on the above results, it can be seen that according to the BMI values, the municipality of Pljevlja has 23.3% overweight and 12.3% obese male adolescents, and 7.6% overweight and 3% obese female adolescents. The results of this research are similar to those obtained by Malovic (2019) where 22.2% of respondents were overweight and 16.3% obese, and those obtained by Bacovic where 19.6% were overweight and 16.4% obese. Also, when looking at the data of Vrevic, Malovic, Bacovic, Bojanic, and Bajramovic (2021), where 12.3% of children from Herceg Novi were overweight, and even 27.69% were obese, it can be concluded that Montenegrin cities have a problem with overweight and obesity. If, in addition to the BMI values, we look at the WHtR values, where 24.7% of male adolescents and 9.1% of female adolescents belong to the obese group, and the BF values, where 16.6% of male adolescents were overweight and 23.3% were obese, and 6.1% of female adolescents were overweight and 9.1% obese, it can be seen that the results are not commendable, especially when it comes to male adolescents. If these values are compared with the values of a global study (Health at a Glance: Europe 2020, 2020) where, according to BMI values, 23% of male adolescents and 15% of female adolescents were overweight or obese, it can be concluded that male adolescents are above these values, while female adolescents are within normal limits compared to their peers from Europe.

When it comes to the differences in the obesity status by type of settlement, it was shown that female adolescents living in rural areas were significantly more overweight compared to their peers living in urban areas ($p=0.025$) according to the BF values, while there were no differences for BMI and WHtR values. There were no differences for for male adolescents. If we take into account that the assessment of the obesity status obtained on the basis of the percentage of fat by skinfold values gives more accurate data compared to other indices (Etchison et al., 2011), we can say that female adolescents living in rural areas of Pljevlja have bigger issues with overweight and obesity, in relation to those living in rural areas. Similar results were also shown by the research of Joens-Matre et al. (2008), which suggests that the prevalence of obesity in rural regions was 25% and was significantly higher than children who lived in urban regions (19%) and children who lived in small towns (17%). Furthermore the research by Biehl et al. (2013) showed that Norwegian children living in rural regions have a 1.5 times higher risk of being overweight or obese by BMI values and 2.2 times by WHtR values in relation to their peers living in urban areas. The reason for the increasing obesity of children and adolescents living in rural areas can be the consumption of high-calorie foods, lower rates of physical activity caused by lack of space and resources, more time spent in front of computers and TV screens, and lack of health education, all of them significantly affecting overweight and obesity (Davis, Bennett, Befort, & Nollen 2011).

Based on the results of this research, it can be concluded that Pljevlja as a municipality has a problem with overweight and obesity. This should be considered as an alarm to approach the process of solving obesity through informing parents, better involvement of physical education professors, better affirmation of physical activities through different forms especially in the population of male adolescents. Also, as our findings suggest that girls living in rural areas were more obese than their peers living in urban areas, it is necessary to pay more attention to rural regions by providing resources, equipment, and adequate space for performing physical activities, as well as providing the necessary health education. Also, this research can be an excellent starting point for future research on this topic, especially for assessing the difference by type of settlement. Further research on this topic, and with higher sample size - especially in Montenegro - is necessary in order to reinforce our findings.

This research also has limitations. Namely, the biggest limitation is reflected in the small number of respondents, especially the percentage of respondents from the rural areas of Pljevlja. Also, when it comes to assessing the obesity status of adolescents, only adolescents from the first and second grades of secondary schools were included in this research. Therefore, recommendations for future research are to include a larger sample of respondents, and respondents of different ages in order to obtain an even more accurate picture. It is also necessary to carry out the same and similar research in other cities, as well as a national study in order to determine the general condition and raise awareness of the importance of the problem of overweight and obesity.

## Conclusion

Based on our findings, it can be concluded that solving the problem of overweight and obesity is necessary for both urban and rural adolescents. Greater attention should be paid to female adolescents living in rural areas, as according to this study's results, the overweight trend has increased more among them compared to their peers living in urban areas. It should also be noted that further research on similar topics is necessary in all cities of Montenegro in order to raise awareness of this problem, which has been characterized by the World Health Organization for a long time as one of the biggest health problems (WHO, 1995).

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