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Comparison of Obesity Prevalence and Dietary Intake in School-Aged Children Living in Rural and Urban Area of Croatia

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ABSTRACT: The aim of this study was to explore the differences in nutritional status and dietary intakes in 12∼17 year-old children living in urban (Zagreb) and the rural (Sinj and Drniš) area of Croatia. A validated food frequency questionnaire was used to assess dietary intake. For each participant, body weight and body height were measured and bioelectrical impedance was used to estimate the body fat percentage. There was an overall of 310 children included: 105 (33.9%) from urban area and 205 (66.1%) from rural area; 191 (61.6%) were female with a mean age 14.9 (range 12∼17) years. When adjusted for age and gender, there was no statistically significant difference in body mass index for age Z-scores between urban and rural parts (0.23±0.07 vs. 0.30±1.15; P=0.650) or in average daily energy intake (2,479.2±1,111.2 kcal vs. 2,338.2±920.2 kcal; P=0.702). There was a statistically significant difference in nutritional status between genders, with a higher percentage of boys being overweight or obese compared to girls. When combined, 'Fast food' and 'Snacks' were major contributors to the total energy intake for both areas. The mean contribution of 'Fast food' to total energy intake was significantly higher in the urban area. The prevalence of obesity among Croatian children is high and unrelated to the urban/rural setting, which could be partially explained by the high intake of 'Fast food' and 'Snacks'.

Keywords: obesity, children, body mass index, diet

INTRODUCTION

The prevalence of overweight and obesity is rapidly rising among children in many countries around the world with the exception of a few high-income countries where a leveling-off has been perceived recently (1). No intervention or policy measures have been identified that could potentially stop or slow down this epidemic phenomenon (2). Obesity in children is not only a risk factor for obesity and other health related consequences in adulthood, but serious complications can occur already in childhood (2,3).

There are variations in the prevalence of obesity between countries as well as within a country. It seems that in adult populations in Europe, those living in rural areas, have a higher prevalence of overweight and obesity than those living in urban areas (4). Research in children and adolescents has been unequivocal as some studies in Europe have shown a higher prevalence in rural children (5), others in urban (6-8), while the difference in Croatia hasn't been well defined (9). It has been proposed that a specific living area is an important factor influencing nutritional intake and that differences in dietary habits between urban and rural areas could explain variations in the prevalence of obesity between the regions of the same country (1). It has also been proposed that differences in children's health-related physical fitness profiles could be partially explained by the level of urbanization (10).

In order to implement specific policy measures, it is important to identify the difference in regional distribution of obesity as well as national specific high-risk foods and eating habits. Data on overweight, obesity, and food intake in Croatia is scarce, especially when it comes to regional differences. The aim of this study was to compare the nutritional status and dietary intake between one urban and one rural area among school-aged children in Croatia.

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MATERIALS AND METHODS

Study design

This was a prospective cross-sectional study. It was restricted to two areas in Croatia, urban and rural with the aim of determining the differences in the characteristics of the two main variables: nutritional status and food consumption between these two regions. Urban subjects were from the Croatian capital, Zagreb, and the rural subjects from Sinj and Drniš, located in the continental part of Split-Dalmatia County. These areas were selected not only because they differ based on urban-rural parameter, but also because they represent completely different Croatian geographic areas [continental (Zagreb) vs. Mediterranean (Sinj and Drniš)] and, therefore, the most pronounced difference was expected.

The study was conducted in randomly selected elementary and high schools that responded positively to the invitation to participate in the study. Permission for the study was obtained from appropriate authorities, and parents were informed about the survey from the school principals, and their written consent was obtained. The study was approved by the Ethics Committee Children's Hospital Zagreb (IRB number: 21102014).

Food intake

Information about food consumption was obtained with a validated food frequency questionnaire (FFQ). The FFQ is a tool that estimates the frequency of consumption of different foods as well as their quantity. The FFQ that used contained 87 different items divided into 8 different food groups: "Milk and milk products", "Cereals and grains", "Juices and sodas", "Fruits", "Vegetables", "Snacks", "Meat, poultry, eggs, and fat", and "Fast food". The FFQ included frequently consumed national foods and estimated frequency and quantity of consumption of food items in the last month. Available frequencies of food consumption were: "never", "1～3 times a month", "once a week", "2～4 times per week", "5～6 times per week", "once a day", "2～3 times per day", "4～5 times per day", or "6+ times per day". Available portion sizes were small, medium and large and their meaning was explained by pictures.

Children included in the study were ≥12 years old, for whom it was generally assumed that they were old enough to recognize and describe quantities necessary for filling out an FFQ (11). Frequency of consumption was obtained in a form of personal interviews with trained interviewers. FFQs were collected during late winter or early spring time.

The individual food records data obtained by the FFQ were analyzed by Microsoft Office Excel 2007 worksheet that was generated using a combination of US Department of Agriculture (12) and Kaić-Rak and Antonić (13) food composition databases. Approximately 10 min were taken to administer the FFQ for each participant by a trained interviewer. The frequency of consumption of food items was multiplied by the portion size to calculate the amount of nutrients consumed in a 30 days period, which was then divided by 30 to estimate an average daily energy and nutrient intake per each participant.

Nutritional intake was compared to Germany Austria, and Switzerland Reference Values for Nutrient Intake (14).

Anthropometric measurements

Anthropometric measures and body fat percentage were assessed for each participant. Anthropometric assessment included measurements of body weight (BW) and body height (BH) were measured by 2 trained persons. Body weight was measured on an electronic scale with subjects being dressed in a light-weight gym clothes. Body height was measured with a portable stadiometer. Bioelectrical impedance was used to estimate the body fat percentage (Maltron BF900, Maltron International Ltd., Rochford, UK). Z-scores for each participant were estimated by the Growth Analyzer software (BW/age, BH/age, BW/BH; Growth Analyzer, Rotterdam, The Netherlands).

Obesity prevalence was determined by using two different growth charts: World Health Organization (WHO) Growth reference data for children and adolescents (5～19 years) (15) and International Obesity Task Force (IOTF) body mass index (BMI) cut-offs for thinness, overweight, and obesity (16).

Statistical analysis

Normality of the data distribution was analyzed with the Shapiro-Wilk test. Differences in quantitative variables, according to their distribution, were analyzed with the parametric *t*-test or the non-parametric Mann-Whitney U-test. The chi-square test was used to estimate differences in the distribution of qualitative variables. *P*-values of <0.05 were considered as statistically significant. Statistical analysis was performed using SPSS 19.0 (SPSS Inc., Chicago, IL, USA) statistical software.

RESULTS

Overall, 105 urban and 205 rural school-aged children were included in the study. The mean age was 15.5±1.8 years and 14.2±2.1 years for the urban and rural subjects, respectively ($P<0.0001$). In total, 66.1% of children were living in the rural area and 33.9% in the urban area.

Difference in obesity degree between rural and urban areas

Table 1 shows the basic characteristics of the study population in total and divided by urban and rural areas.

Table 1. Basic characteristics in a sample of Croatian children aged 12~17 years (N=310)

	Total	Zagreb	Sinj and Drniš	*P**
Body height (cm)	166.61 (10.67)	168.60 (9.61)	165.63 (11.05)	
Z-score body height/age (SD)	0.04 (1.02)	−0.16 (1.00)	0.15 (1.02)	0.1
Body weight (kg)	57.58 (12.99)	60.37 (12.17)	56.21 (13.18)	
Z-score body weight/age (SD)	0.23 (1.13)	0.09 (1.15)	0.30 (1.12)	0.7
BMI (kg/m^2)	20.54 (3.17)	20.94 (2.88)	20.34 (3.29)	
Z-score BMI/age (SD)	0.28 (1.12)	0.23 (1.07)	0.30 (1.15)	0.7
Body fat (%) determined by BIA	22.03 (8.52)	20.97 (6.89)	22.66 (9.31)	0.02

Data presented as mean (standard deviation, SD).
*Difference between groups stratified by age and gender.
BMI, body mass index; BIA, bioelectrical impedance analysis.

When adjusted for age and gender, there was no statistically significant difference in BMI-for-age Z-scores between urban and rural areas (0.23±1.07 for urban vs. 0.30±1.15 for rural area; P=0.7), yet there was a statistically significant difference in body fat percentage between the two centers (21.0±6.9% for urban vs. 22.7±9.3% for rural area; P=0.02) (Table 1).

Comparison of nutritional status between the two areas and genders are presented in Table 2. In total, 2.8% of subjects were underweight, 19.4% overweight, and 5.9% obese when using the WHO cut-off reference values. When using the IOTF cut-off values, 10.4% of subjects were underweight, 16.3% overweight, and 2.1% obese. There was no difference in the distribution in nutritional status between areas, but there was a statistically significant difference in nutritional status between genders, with a higher percentage of boys being overweight or obese compared to girls (38.5% vs. 17.6% for WHO criteria and 24.1% vs. 15% for IOTF criteria).

Difference in energy and nutrient intake between rural and urban area

Mean nutrient intakes by the study center are presented in Table 3. After adjusting for age and gender, there was no statistically significant difference in average daily energy intake between the urban and rural areas (2,479.2±1,111.2 kcal vs. 2,338.2±920.2 kcal; P=0.702). As for the macronutrient profiles, including energy derived from proteins, carbohydrates, and fats, the results were similar between the two study centers, apart from fats. The contribution of fat to total energy intake was above the recommended level for both areas, with participants from the rural area having a significantly higher proportion of fat in total energy intake compared to participants from the urban area (40.2±7.4% vs. 37.8±7.1%, P=0.007).

Table 4 shows the mean contribution of different food groups to total daily energy intake per study center. The food group ranking in terms of % energy contribution was similar between the rural and urban areas. Two main sources of daily energy intake were 'Meat products and fats' followed by 'Grains and cereal', although, when combined, 'Fast food' and 'Snacks' were the major contributors to the total energy intake for both areas. The mean contribution of 'Fast food' to total energy intake was significantly higher for children in the urban area compared to children from the rural area (15.1±6.8% kJ vs. 13.1±8.0% kJ, P=0.03), while the opposite was found for 'Fruits' (4.9±4.2% kJ vs. 6.8±4.8% kJ; P=0.001).

Table 2. Distribution of body mass index (WHO and IOTF criteria) by residence and gender (N=310)

	Underweight	Normal	Overweight	Obese	*P*
Residence					
Zagreb (WHO)	3 (3.2%)	69 (72.6%)	19 (20.0%)	4 (4.2%)	0.83
Sinj/Drniš (WHO)	5 (2.5%)	138 (71.5%)	37 (19.1%)	13 (6.7%)	
Zagreb (IOTF)	11 (11.6%)	69 (72.6%)	15 (15.8%)	0	
Sinj/Drniš (IOTF)	19 (9.8%)	136 (70.5%)	32 (16.6%)	6 (3.1%)	0.35
Gender					
Girls (WHO)	7 (3.9%)	141 (78.8%)	25 (14.0%)	6 (3.6%)	<0.001
Boys (WHO)	1 (0.9%)	66 (60.6%)	31 (28.4%)	11 (10.1%)	
Girls (IOTF)	25 (13.9%)	128 (71.1%)	24 (13.3%)	3 (1.7%)	0.016
Boys (IOTF)	5 (4.6%)	77 (71.3%)	23 (21.3%)	3 (2.8%)	

Data are presented as n (%).
WHO, World Health Organization; IOTF, International Obesity Task Force.

Table 3. Mean nutrient intakes in the study population in total and by region (N=310)

	Total	Zagreb	Sinj/Drniš	*P**
Energy (kJ)	9,827.7 (4,059.6)	10,247.3 (4,578.9)	8,948.5 (3,451.5)	0.302
Energy (kcal)	2,385.5 (988.8)	2,479.2 (1,111.2)	2,338.2 (920.2)	0.702
Protein (%E)	17.3 (2.7)	17.4 (2.3)	17.3 (2.9)	0.827
Carbohydrates (%E)	48.0 (7.8)	48.6 (7.6)	47.7 (7.8)	0.297
Sugar (%E)	21.8 (6.1)	22.2 (6.0)	21.6 (6.2)	0.421
Total fat (%E)	39.4 (7.4)	37.8 (7.1)	40.2 (7.4)	0.007
SFA (g)	42.1 (20.3)	43.0 (22.2)	41.6 (19.2)	0.667
MUFA (g)	34.4 (16.9)	34.7 (19.7)	34.2 (16.9)	0.919
PUFA (g)	17.7 (8.1)	17.4 (8.2)	18.0 (8.1)	0.343
Linoleic acid (g)	11.9 (5.4)	11.8 (5.7)	11.9 (5.3)	0.589
Cholesterol (mg)	279.7 (196.9)	253.7 (212.2)	292.8 (144.7)	0.101
Fe (mg)	14.7 (6.4)	14.9 (6.7)	13.8 (5.5)	0.185
Ca (mg)	929.1 (415.3)	973.7 (425.6)	906.6 (409.3)	0.103

Data presented as mean (standard deviation, SD).
*Difference between groups stratified by age and gender.
SFA, saturated fatty acids; MUFA, monunsaturated fatty acids; PUFA, polyunsaturated fatty acids.

Table 4. Mean contribution of different food groups to total energy intake by region

Contributon to total energy (%)	Total	Zagreb	Sinj/Drniš	*P*
Milk and milk products	15.4 (8.3)	15.9 (7.9)	15.2 (8.5)	0.461
Grains and cereals	20.6 (8.9)	21.2 (7.7)	20.3 (9.5)	0.411
Juices and sodas	5.2 (4.2)	5.2 (4.3)	5.2 (4.1)	0.926
Fruits	6.2 (4.7)	4.9 (4.2)	6.8 (4.9)	0.001
Vegetables	3.8 (2.4)	3.8 (2.3)	3.8 (2.4)	0.965
Meat and fat	24.9 (10.8)	23.9 (10.4)	25.4 (11.0)	0.239
Snacks	19.6 (6.9)	10.0 (6.6)	10.9 (7.0)	0.291
Fast food	13.8 (7.7)	15.1 (6.8)	13.1 (8.0)	0.029

Data presented as mean (standard deviation, SD).

DISCUSSION

The present study showed a higher prevalence of children with excess weight, comparable with previous data on overweight and obesity (9). These results were expected and are reflecting a growing trend of overweight and obesity and the size of the problem in the study population. A study by Colić-Barić et al. (9) from 2004 found a higher prevalence of normal weight among children in the rural area of Croatia. In their sample, they found that boys aged 8～9 years from the urban area had a significantly higher BMI compared to their rural counterparts, whilst the opposite was found for girls aged 15～16 years. Our results indicate that during the time of the study, a difference in nutritional status between rural and urban areas in Croatia disappeared. However, we have found that urban children have significantly lower body fat percentage compared to rural children. We can assume that children from urban areas have more opportunities to carry out regular physical activity (by being introduced to different sport groups), consequently contributing to different body composition, although for a definite conclusion, data about physical activity levels should be collected in future research.

As for the difference in urban vs. rural prevalence of overweight and obesity, results from other countries are inconclusive. A study in Greece has shown that body weight status varied widely among participants with prominent regional influences (17). A study from Albania has shown that prevalence of both overweight and obesity was remarkably higher among urban children (6) while the opposite situation was observed in Norway (5). These different outcomes might partially be a result of no internationally accepted definition of rurality－characteristic of rural areas vary greatly and to better understand the relationship between obesity and a place of residence the degree of rurality, the socioeconomic status and the geography should also be considered (4). Also, it has been shown that in adults, the prevalence of overweight and obesity is higher in eastern European countries and among those from lower socioeconomic status (4), indicating that socioeconomic status is an important factor in dietary patterns of different regions (18).

The results of this study have shown statistically significant differences in the distribution of body mass index between boys and girls, with higher percentage of

boys compared to girls being overweight or obese. This difference was more pronounced when the WHO cut-off values were used. The same outcomes have been observed in Albania and Norway (5,6). Although differences in obesity rates between males and females have been shown to be generally small and inconsistent, some differences in dietary behavior have been observed-studies of adolescents have found that females are more likely to pay attention to foods as a way to influence health and to meet nutritional recommendations (19).

As for the difference in nutritional status according to different references, when using WHO cut-off reference values 25.8% vs. 24.2% of subject from rural and urban part were overweight or obese, respectively, while noticeably a lower prevalence was found for the IOTF cut-off reference values, 19.7% vs. 15.8%, respectively. Our study confirmed previous findings that the use of different reference charts provides different results (20,21). It has been reported that the WHO system of classification yields a higher prevalence of overweight/obesity than that of the IOTF and CDC system of classifications because its reference population is intended to be non-obese (20). Therefore, attention should be paid to the type of reference charts used when comparing different results or during follow-ups of the same cohort.

As for nutritional intake, no difference in total daily energy intake and other nutritional characteristics have been observed between rural and urban parts, except for a significantly higher contribution of fat intake to total daily energy in children from rural areas. Intake of total fat, sugar and SFA was above recommended for both areas, while the average intake of calcium was bellow the recommended level of 1,200 mg/d (Table 3).

As for the mean contribution of different food groups to total energy intake, when combined, the biggest contributor to total energy intake were 'Snacks' and 'Fast food'. It is important to emphasize that Sinj and Drniš are located in the Mediterranean part of Croatia and are historically known to have followed Mediterranean-like diets. Although children from rural areas had significantly lower intake of 'Fast food' and higher intake of 'Fruits' compared to children from urban areas, their overall nutritional intake was not representative of the Mediterranean diet. These results indicate that differences in dietary intake and food choices are becoming less prominent in rural vs. urban parts and are less geographically dependent with "westernized diet" taking place instead of a "traditional diet". This has been observed in other studies as well as analyses from multinational European studies have found low adherence to a Mediterranean-like dietary pattern in most Mediterranean countries, showing that a Mediterranean-like diet is not necessarily associated with living in a Mediterranean region (22). It has also been shown that low adherence to a Mediterranean diet is associated with a high prevalence of overweight/obesity in children from Mediterranean countries of the European Union (23).

We are aware of several limitations of this study, mainly related to the small sample size. Furthermore, for more accurate nutritional intake, a 3-day food diary would be more appropriate; however, the FFQ used in this study was evaluated and strongly correlates with the results of 3-day nutritional intake diary. Finally, although the schools in the study participants were randomly selected, only those that provided a positive response to the invitation were included.

In conclusion, results from this study show that the prevalence of obesity among Croatian children is high and unrelated to an urban/rural setting. Unsurprisingly, low adherence to a Mediterranean like dietary pattern combined with a high consumption of energy-dense foods was observed. In order to improve this raising negative trend, a coordinated activity of all involved parties such as families, educational institutions, health professionals and other stake holders will be required.

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AUTHOR DISCLOSURE STATEMENT

The authors declare no conflict of interest.

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