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ORIGINAL ARTICLE

Estimation of physical activity and prevalence of excessive body mass in rural and urban Polish adolescents

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Abstract

Excessive body mass and sedentary lifestyle are well-known factors for cardiovascular risk, which when present in the young population may have significant health consequences, both in the short- and long-term. The aim of the study was to evaluate the prevalence of overweight, obesity, and sedentary lifestyle in two teenage populations living in an urban or rural area. An additional aim was to compare their physical activity. The study was designed and conducted in 2009. The study population consisted of 116 students aged 15-17 years – 61 males (52.7%) and 55 females (47.3%), randomly selected from public junior grammar schools and secondary schools in the Poznań Region. There were 61 respondents from a rural area – 32 males (52.5%) and 29 females (47.5%), whereas 55 teenagers lived in an urban area – 29 males (47.5%) and 26 females (47.3%). Students were asked to complete a questionnaire, which was especially prepared for the study and contained questions concerning health and lifestyle. A basic physical examination was carried out in all 116 students, including measurements of the anthropometric features. Calculations were performed using the statistical package STATISTICA (data analysis software system), Version. 8.0. When comparing these two populations, no statistically significant differences were detected in the ratio of weight-growth, with the exception of the fact that the urban youths had a larger hip circumference (97.1 v. 94.3 cm, $p<0.05$). In the group of urban students there were also significantly more subjects with excessive body weight (27.3% v. 24.6%, $p<0.05$), with a predominant proportion of obese students (60%). There were significantly more male obese individuals (66.7%). In the population of rural teenagers, obesity rate did not differ statistically significantly from the percentage of overweight (11.5% v. 13.1%, $p>0.05$), the problem of excessive weight affected both sexes in a similar proportion (25% boys and 24.1% girls, $p>0.05$). In this paper it is shown that there were differences concerning physical activity of teenagers living in urban and rural areas. Urban students much more often declared an active lifestyle (72.7% v.42.6%, $p<0.05$), used a variety of additional forms of activity (not counting compulsory physical education classes). They also spent many more hours a week performing sport (7.0±4.2 h v. 4.9±4.1h, $p<0.05$), and less hours spent passively on 'screen viewing behaviour' (2.3±1.5h v. 3.1±1.5h, $p<0.05$). About 52.5% of rural teenagers replied that compulsory physical education classes were their only form of physical activity. No statistically significant differences between urban and rural population were detected in the ratio of weight-growth, with the exception of the fact that urban youths had a larger hip circumference. In the group of urban teenagers, there were significantly more subjects with excessive body weight, with a predominant proportion of obese students. However, urban students much more often declared an active lifestyle and spent many more hours a week performing sport. Their declared time for 'screen viewing behaviour' was shorter. These observations describing Polish teenagers are consistent with some literature data, but more studies are needed to clarify the influence of environmental conditions, such as 'urban-rural' differences in the health and lifestyle of the young population.

Key words

obesity, physical activity, adolescence

INTRODUCTION

In numerous studies conducted among the adult population, it was observed that subjects from a rural area much more often had excessive body mass and low physical activity, compared to urban dwellers [1-3]. Observations concerning differences in the level of physical activity and anthropometric parameters in the population under 18 years of age are divergent. The cross-sectional study of US children and adolescents at the age of 10-17 years showed that in the rural regions the prevalence of excessive body mass was higher (16.5% v.14.3%), despite the lower proportion of subjects with a sedentary lifestyle (25.2% v.29.1%) [4]. However, Canadian researchers did not show statistically significant differences in the level of physical activity between urban students and their rural peers, although the latter spent less time on 'screen viewing behaviour'. Overweight and obesity were found much more often in rural areas, which was similar to observations in the above-mentioned American study [5]. Booth et al., who examined more than 2,000 Australian students aged 8-10 years, found no statistically significant 'urban-rural' differences in the level of physical activity in male subjects, while for girls, it was noted that a higher percentage of physically active female students was noted in rural schools during summer [6].

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In a study conducted in New Zealand, children and adolescents aged 5-15 years were examined – 2,792 students living in urban areas and 483 peers from rural areas. The authors of this study reported that rural subjects had a significantly lower BMI compared to their urban counterparts, who were also much more often overweight or obese: boys 1.3 times more likely (95% confidence limits 1.2-1.7, $p < 0.01$), girls 1.4 times more likely (95% confidence limits 1.2-1.7, $p < 0.01$). There were no statistically significant differences in the frequency of physical activity between students from both regions [7]. The results of this study were consistent with the observations taken in another New Zealand project (*Energize*), which showed that young people from rural areas are thinner than their peers from urban areas [8].

OBJECTIVE

The relationship between the prevalence of excessive body mass and specificity connected with the region of residence ('urban-rural') is still unclear. The aim of this study was to investigate possible differences in anthropometric parameters and physical activity among the population of Polish adolescents living in two regions: urban or rural.

MATERIAL AND METHODS

The study was designed and conducted in 2009. The study population consisted of 116 students aged 15-17 years – 61 males (52.7%) and 55 females (47.3%), randomly selected from public junior grammar schools and secondary schools in the Poznań Region. There were 61 respondents from a rural area – 32 males (52.5%) and 29 females (47.5%), whereas 55 teenagers lived in an urban area – 29 males (47.5%) and 26 females (47.3%). Subjects were chosen from the urban and rural areas in such a way that they actually differed in the context of local communities and educational backgrounds. The authors of the presented paper made an effort to avoid so-called 'intermediate environments' and analyzed only the typical urban and typical rural regions.

Students were asked to complete the questionnaire which was especially prepared for the study, and underwent pre-pilot studies. The questionnaire enabled collection of the following information concerning physical activity of the examined adolescents:

- self-reported lifestyle (active or sedentary);
- favourite kind of sport;
- frequency of physical activity;
- number of hours spent on physical activity per week;
- preferred form of physical activity (e.g. compulsory physical education classes, spontaneously taken physical activity);
- number of hours spent passively on 'screen viewing behaviour' per week;

The estimated 'screen viewing behaviour' included television or video viewing and playing video or computer games. Subjects were asked to report thoroughly the number of days to estimate viewing frequency, as well as the number of hours to describe viewing duration. The declared time for each type of the 'screen viewing behaviour' was added, which enabled the determination of an accumulated screen time and then assigned an arbitrary unit on the basis of following scale: 0 hour, 1-4 hours, 5-9 hours, ≥ 10 hours per week.

A basic physical examination was carried out in all study participants, including anthropometric measurements, performed in accordance with current guidelines. Students were measured during morning lessons, dressed in gym clothes, without shoes. The examination included:

- measurement of body height (in centimeters) and weight (in kilograms), with the use of medical scales:
  - measurement of body height – the examined person stood upright, with upper limbs hanging loosely at both sides, with palms facing the thighs; lower limbs were straight, with the following points located in one vertical line: the posterior edge of the heel and the biggest bulge of the buttocks, thoracic kyphosis and occiput
  - measurement of body weight – the subject stood upright, looked straight ahead, with feet together, with body weight distributed equally on both legs
- waist measurements (in centimeters) and hip measurement (in centimeters), with the use of a centimeter tape:
  - waist circumference (WC) – the examined person stood upright; the measurement carried out immediately after expiration; the measurement estimated the smallest diameter of the trunk, between the bottom edge of costal the arch and hips
  - hip circumference (HC) – the subject stood upright; the measurements should be carried out at the level of the pubic symphysis, and estimated the biggest bulge of the buttocks.

Anthropometric analysis was performed on the basis of four indicators:

- Body Mass Index (BMI):

$$BMI = \frac{\text{body mass [kg]}}{\text{body height [m]}^2}$$

- Weight-height indices:
  - Quetelet's index (WSQ):

$$WSQ = \frac{\text{body mass [kg]}}{\text{body height [cm]}}$$

  - Rohrer's index (WSR):

$$WSR = \frac{\text{body mass [kg]} \times 10^5}{\text{body height [cm]}^3}$$

  - Książyk's index, Body Mass Coefficient (WMC):

$$WMC = \frac{\text{body mass [kg]}^{1.425} \times 71.84}{\text{body height [cm]}^{1.275}}$$

In this study, the authors used the WHO guidelines to identify excessive body mass: overweight was recognized when BMI was between 85-95 percentile for age and gender, whereas obesity was detected in subjects with BMI value at and above the 95th percentile. The BMI value at and below the 5th percentile gave the right to identify underweight. Palczewska and Niedźwiecka from the Institute of Mother and Child in Warsaw prepared centile charts for assessing the physical development of Polish children and adolescents [9].

Statistical analysis of the presented data was performed using the methods of descriptive statistics. Measurable variables, such as height, weight, waist circumference, hip circumference, BMI, WSQ, WSR, and WMC, were described with the use of the minimum value, maximum value, arithmetic mean and standard deviation. Normality of data distribution was verified by the Shapiro-Wilk test. Once confirmed, compliance

with the normal distribution, to compare the two groups, Student's t-test or the Welch test was used for independent variables, depending on the homogeneity of variance, which was checked by the Leven test.

When not confirmed, compatibility with the normal distribution, the non-parametric test for two groups was applied (Mann-Whitney test).

To analyze the relationship between the above-mentioned parameters, the Pearson linear correlation coefficient were calculated (when confirmed compliance with the normal distribution) or non-parametric Spearman correlation coefficient.

Categorial parameters, such as parameters related with physical activity, were described with numbers and the corresponding percentage. The mutual dependence of categorical parameters was studied using the Chi2 test, Fisher exact test and Fisher's exact test-Freeman-Halton.

Statistical hypotheses were verified at significance level $\alpha<0.05$.

Calculations were performed using the statistical package STATISTICA (data analysis software system), Version. 8.0.

ETHICS APPROVAL

This study was undertaken with the approval of following institutions and individuals: the Bioethics Committee at Poznań University of Medical Sciences, the Superintendent of Education in the Poznań Region, and the school principals. The teenagers were well-informed about the aim and methods used in this study. They gave informed written consent to participate in the study. Informed written consent was also obtained from all the parents or legal guardians of participating adolescents.

RESULTS

While analyzing the anthropometric parameters of the study population, it was noted that subjects from the urban area had a significantly higher hip circumference (97.1 v. 94.3 cm, $p<0.05$), whereas there was no statistically significant difference in body weight, height, waist circumference, BMI, WSQ, WSR and WMC. Between urban teenagers there was a significantly higher percentage of subjects with excessive body mass (27.3% v. 24.6%, $p<0.05$), of whom 60% were obese. Urban obese adolescents were predominantly male (66.7%). In the group of rural youths, the obesity rate (11.5%) did not differ significantly from the overweight rate (13.1%), and the problem of excessive body mass affected both sexes in a similar proportion (25% boys and 24.1% girls). Comparison of the anthropometric data between rural and urban adolescents is shown in Table 1. The division of the rural and urban population based on BMI value is presented in Table 2.

The examined youths were asked to self-estimate their lifestyle. In the urban group, 72.7% of the respondents described their style of life as 'active', whereas in the rural group only 42.6% of adolescents considered it to be active; the difference was statistically significant ($p<0.05$). The average number of hours per week spent on physical activity was 4.9 ± 4.1 h in the rural population, and 7.0 ± 4.2 h in the urban population; the difference was also statistically significant ($p<0.05$).

Table 1 Comparison of anthropometric parameters between rural and urban adolescents.

PARAMETER	RURAL ADOLESCENTS x ± SD	URBAN ADOLESCENTS x ± SD	P
Body weight	62.3 ± 13.0	64.4 ± 11.2	0.1672 (NS) (Mann-Whitney test)
Body height	170.0 ± 8.2	171.1 ± 8.1	0.4441 (NS) (t-Student test)
BMI	21.6 ± 3.8	22.1 ± 3.7	0.3169 (NS) (Mann-Whitney test)
WSQ	437.3 ± 83.2	450.9 ± 54.4	0.5801 (NS) (Mann-Whitney test)
WSR	1.5 ± 0.3	1.6 ± 0.2	0.2283 (NS) (Mann-Whitney test)
WMC	48.3 ± 13.4	50.1 ± 8.9	0.6541 (NS) (Mann-Whitney test)
WC	76.6 ± 9.6	76.9 ± 10.3	0.9360 (NS) (Mann-Whitney test)
HC	94.3 ± 8.6	97.1 ± 7.8	0.0429 (Mann-Whitney test)

Table 2 Division of rural and urban population based on BMI.

BMI [kg/m^2]	RURAL ADOLESCENTS (n=61)		URBAN ADOLESCENTS (n=55)	
	n (percentage of the population)		n (percentage of the population)	
	boys	girls	boys	girls
Normal weight	43 (70.5%)		36 (65.4%)	
	22	21	17	19
Underweight	3 (4.9%)		4 (7.3%)	
	2	1	3	1
Overweight	8 (13.1%)		6 (10.9%)	
	5	3	3	3
Obesity	7 (11.5%)		9 (16.4%)	
	3	4	6	3

More than 60% of teenagers from the rural area declared that they spent approximately 1-4 hours per week on physical activity, whereas 70.9% of their peers from the urban area spent at least 5 hours a week actively. In the rural group, the most common answers to the question about frequency of physical activity was: 'twice' (52.5%), 'four times a week' (13.1%), 'every day' (13.1%); in the urban group – 'five times a week' (25.4%), 'twice a week' (21.8%), 'four times a week' (20%) and 'every day' (15%). The declared number of hours and frequency of physical activity per week are presented in Table 3 and Table 4.

Table 3 Declared number of hours per week spent on physical activity among rural and urban adolescents.

Declared number of hours per week spent on physical activity	RURAL ADOLESCENTS (n=61)	URBAN ADOLESCENTS (n=55)
	n (percentage of the population)	n (percentage of the population)
0 h	0	0
1 – 4 h	37 (60.7%)	16 (29.1%)
5 – 9 h	16 (26.2%)	24 (43.6%)
≥ 10 h	8 (13.1%)	15 (27.3%)

Table 4 Declared frequency of physical activity per week among rural and urban adolescents.

Declared frequency of physical activity per week	RURAL ADOLESCENTS (n=61)	URBAN ADOLESCENTS (n=55)
	n (percentage of the population)	n (percentage of the population)
once	0	1 (1.8%)
twice	32 (52.5%)	12 (21.8%)
3 times	5 (8.2%)	5 (9.1%)
4 times	8 (13.1%)	11 (20.0%)
5 times	5 (8.2%)	14 (25.4%)
6 times	3 (4.9%)	4 (7.3%)
every day	8 (13.1%)	8 (14.6%)

Study participants were also asked what type of physical activity they had: 1) only compulsory lessons of physical activity at school, 2) compulsory lessons of physical activity and various optional activities at school, 3) compulsory lessons of physical activity and spontaneous physical activity (e.g. playing football, cycling), 4) compulsory lessons of physical activity and various optional activities at school, and spontaneous physical activity (e.g. playing football, cycling). The majority of subjects from the rural area chose option 1 ('only compulsory lessons of physical activity at school', 52.5%), approximately 28% of the respondents chose option 2 ('compulsory lessons of physical activity and various optional activities at school'), while in the urban group, a similar number of respondents chose presented options (23.6-27.3%). Detailed information is shown in Table 5.

Table 5 Declared type of physical activity among rural and urban adolescents.

Declared type of physical activity	RURAL ADOLESCENTS (n=61)	URBAN ADOLESCENTS (n=55)
	n (percentage of the population)	n (percentage of the population)
Only compulsory lessons of physical activity at school	32 (52.5%)	13 (23.6%)
Compulsory lessons of physical activity and various optional activities at school	6 (9.8%)	13 (23.6%)
Compulsory lessons of physical activity and spontaneous physical activity (e.g. football playing, cycling)	17 (27.9%)	15 (27.3%)
Compulsory lessons of physical activity and various optional activities at school and spontaneous physical activity (e.g. football playing, cycling)	6 (9.8%)	14 (25.5%)

Football was the favourite kind of sport in both groups (13.1% rural adolescents and 16.3% urban adolescents). Compared to urban youths, more than twice as many rural teenagers declared that they did not have a favourite sport: 57.4% v. 23.6%, respectively, $p< 0.05$. The declared preferences concerning the favourite sport are shown in Table 6.

Estimation of 'screen viewing behaviour' revealed that there was a statistically significant difference between both groups: in the rural population the average number of hours spent per week in this way was 3.1 ± 1.5 h, while in urban respondents it was 2.3 ± 1.5 h ($p< 0.05$). The declared number of hours spent on 'screen viewing behaviour' are presented in Table 7.

Table 6 The declared favourite kind of sport in rural and urban adolescents.

Declared favourite sport	RURAL ADOLESCENTS (n=61)	URBAN ADOLESCENTS (n=55)
	n (percentage of the population)	n (percentage of the population)
Football	8 (13.1%)	9 (16.3%)
Jogging	4 (6.6%)	6 (10.9%)
Cycling	3 (4.9%)	5 (9.1%)
Dancing	1 (1.6%)	4 (7.3%)
Strolling	1 (1.6%)	3 (5.5%)
Exercises in the gym	2 (3.3%)	2 (3.6%)
Volleyball	7 (11.5%)	0
Swimming	0	5 (9.1%)
Basketball	0	3 (5.5%)
Combat sports	0	3 (5.5%)
Tennis	0	2 (3.6%)
No favourite sport	35 (57.4%)	13 (23.6%)

Table 7 Declared average number of hours spent per week on 'screen viewing behaviour' in rural and urban adolescents.

Declared number of hours spent per week on 'screen viewing behaviour'	RURAL ADOLESCENTS (n=61)	URBAN ADOLESCENTS (n=55)
	n (percentage of the population)	n (percentage of the population)
0 h	0	2 (3.6%)
1 – 4 h	54 (88.5%)	46 (83.7%)
5 – 9 h	7 (11.5%)	7 (12.7%)
≥ 10 h	0	0

DISCUSSION

Obesity. The presented comparative characterics for anthropometric parameters, declared physical activity and lifestyle gave interesting results. Urban youths had a significantly higher hip circumference, while there was no statistically significant difference in other estimated parameters. What is more, in the young population from the urban area there was a higher percentage of respondents with excessive body mass, among whom at least half was obese; boys were obese much more often than girls. However, there was no statistically significant difference between the percentage of overweight and obesity in the rural group; these results were not associated with sex: the problem of excessive body mass concerned girls and boys in similar proportions. As in the present study, Wang et al. observed more cases of overweight and obesity in children and adolescents living in urban areas [10]. Turkish researchers also found a significantly higher BMI in a population of urban primary school students, but they did not show significant differences in waist circumference, hip circumference, and waist-hip ratio between urban and rural respondents. The higher percentage of subjects with excessive body mass in the population from urban areas has also been reported by researches from New Zealand [7,8].

It should be emphasized that some reports presented different relationships. In a population of over 2,000 students, McMurray et al. showed that rural youths had a higher BMI value. In the mentioned study, logistic regression proved that students living in rural areas had an increased (54.7%) risk of obesity (p=0.0001) [12]. A higher prevalence of excessive body mass among rural children and adolescents was also noticed in a study conducted in the state of Georgia in the USA, and involved over 3,000 students. These authors noted that young obese people were often boys [13]. The increased prevalence of overweight and obesity in rural areas has also been reported by other researches [4,5,14-17].

Explaining these differences in the relationships described in various rural and urban areas, it should be remembered that a style of life – whether rural or urban – varies considerably between countries and continents. This is why 'rusticity' and 'urbanity' can mean something different in different studies. There is no doubt that in highly developed countries the 'village' may be quite different from the 'village' in developing countries. What is more, some discrepancies between results of the present study and observations made by other authors may also be due to demographic differences, particularly associated with ethnicity and the socio-economic situation of the respondents.

The appropriate use of anthropometric measurements is an important issue, especially in studies conducted in children and adolescents. In the present study, assessing the weight-height ratios a Body Mass Index (BMI) was used, as well as some weight-height indexes, such as: Quetelet's index, Rohrer's index and Książyk's index (Body Mass Coefficient). Unfortunately, available data on overweight and obesity in children and adolescents were often based on different materials and different research methods, which made them less comparable.

Physical activity. The present study showed differences in the physical activity of adolescents from urban and rural areas. Urban students significantly more often declared an active life style and the use of various forms of activity, as well as spending much more time actively, and less time on 'screen viewing behaviour'. Similar observations were reported by Kristjansdottir et al., who examined 3,270 subjects aged 11-16 years, and concluded that young people from rural areas were less physically active in their leisure time and more often had a sedentary lifestyle, compared to their urban peers [18]. Ozdinenc et al. showed opposite results in Turkish students aged 9-11 years. In their study, a higher percentage of physically inactive subjects was detected in urban areas. Children and adolescents from rural regions preferred to spend time actively outdoors, whereas urban adolescents more often practiced sports in gyms. However, a greater number of hours spent on 'screen viewing behaviour' was declared by urban students in the Turkish study [11].

Contrary to the present study, in a young population from Cameroon, Proctor et al. found that rural youths were more than twice as active, compared to peers from urban areas. They also reported that the physical activity of young people from rural areas was usually associated with physical work on the farm [19]. But it should be noted that the amount of physical effort is clearly dependent on the technical level of agricultural development. If the cultivation process and animal husbandry are almost fully automated, the farmer's physical effort is not as great as in poorly equipped farms. Some authors have explained that children and adolescents from rural areas are more active because everyday rural life forced them to perform physical effort, and also created more opportunities to spend time outdoors [20,21].

Hodgkin et al. showed no significant differences in physical activity between rural and urban young populations, but pointed out that subjects from rural areas spent significantly less time on 'screen viewing behaviour' [7]. Similarly, McMurray et al., in a group of more than 2,000 students, noted no statistically significant differences in declared physical activity [12].

Analyzing the problem of various observations concerned with 'rural-urban' differences in the prevalence of obesity and sedentary lifestyle, it is clear that the discrepancy results from certain facts. One important limitation of such studies is in applying the questionnaire method to assess the lifestyle of the respondents. These studies are relatively easy to perform and enable the collection of reliable data, but such reports may be less accurate. The different understanding of the term 'physical activity' in urban and rural areas must be taken into account. Teenagers from rural regions are usually active due to their work on the farm, but they may not report work-related effort as 'physical activity'. In the case of the urban population, physical activity is primarily recreational, which is a way of spending leisure time [20]. It should be also emphasized that urban youths are often in a privileged position, having easier access to many forms of physical activity and the possibility to try various sports disciplines [18]. In the presented study, the favourite form of activity, regardless of region, and thus regardless of availability of more attractive forms of recreation, was football.

SUMMARY AND CONCLUSIONS

1. Urban youths had a significantly higher hip circumference, but there was no statistically significant difference in other anthropometric parameters. What is more, in the young population from the urban area there was a higher percentage of subjects with excessive body mass, among which at least half were obese, and boys were obese much more often than girls.
2. Urban adolescents significantly more often declared an active style of life and the use of various forms of activity; they also spent much more time actively and less time on 'screen viewing behaviour'.
3. These observations in Polish teenagers are consistent with some literature data. However, there remains a need to conduct more studies, to include various countries, continents and climate zones, to explain the influence of 'urban-rural' differences on the health and lifestyle of the young population.

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