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Comparison of anthropometric indicators related to overweight and obesity by place of residence in a local community with a high social deprivation rate – a cross-sectional study

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Abstract

Introduction and Objective. Obesity is considered a major public health concern. The aim of the study is to compare anthropometric indicators related to overweight and obesity by place of residence in a local community with a high social deprivation rate, based on the example of residents of the Janów District in eastern Poland, taking into account gender strata differences.

Materials and method. The cross-sectional epidemiological study was carried out in a study group of 3,752 individuals. The following anthropometric measurements and laboratory tests were performed to identify the anthropometric indicators related to overweight and obesity: body mass index (BMI), waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) and body adiposity index (BAI).

Results. Mean age of the study group was 51.92 ± 8.15. Overweight and obesity-related indicators were more prevalent in rural than urban areas among women, and were as follows: BMI (28.77 ± 5.37 vs. 27.62 ± 5.09; $p < 0.001$), WHR (0.87 ± 0.07 vs. 0.85 ± 0.07; $p < 0.001$), WHtR (0.57 ± 0.09 vs. 0.57 ± 0.08; $p < 0.001$) and BAI (33.58 ± 5.48 vs. 32.82 ± 5.4; $p = 0.002$). Men's mean WHR was higher in rural than in urban areas (0.96 ± 0.07 vs. 0.95 ± 0.62; $p < 0.001$).

Conclusions. The study shows that women living in rural areas had a mean BMI that was 1.1 higher than that of women living in urban areas, as well as 0.02 higher WHR and WHtR and 0.8 higher BAI. In contrast, men living in rural areas had a 0.001 higher WHtR and WHR than men living in urban areas. In the multivariable models, after having considered potential confounding variables, women living in rural areas had approximately a 60% higher probability of being obese, while men had approximately a 30% higher probability of being obese.

Key words

obesity, overweight, public health, rural, urban

INTRODUCTION

Obesity is a chronic disorder of multifactorial origin characterised by an excessive or abnormal accumulation of fat caused by an energy imbalance between calories consumed and calories expended [1]. Overweight and obesity are significant risk factors for non-communicable diseases (NCDs), particularly, cardiovascular diseases (CVDs), diabetes, musculoskeletal conditions, and some cancers [2]. Over the past forty years, the number of obese people worldwide has tripled [3], and in 2016, 1.9 billion adults were classed as overweight in [2]. In Europe, it is estimated that approximately 16% of all individuals are obese, and nearly 50% are overweight [4, 5]. According to the results of a 2019–2020 study involving a representative sample of Poles, the prevalence of overweight was 42.2% (52.4% of all men and 32% of all women), and the prevalence of obesity was 16.4% (14.3% of all men and 16.2% of all women) [6]. Due to the growing number of overweight and obese people and the relation between these conditions and NCDs, it is of key important to monitor the prevalence of overweight and obesity in order to prevent or reduce the clinical and public health burden related to their occurrence. One of the goals of Poland's National Health Programme for 2021–2025 was to reduce overweight and obesity [7].

It should be noted that there are many discrepancies in health condition between rural and urban residents [8, 9], and according to some studies, the incidence and mortality rates of NCDs are higher in rural areas [10]. This might be because rural residents have less access to healthcare services [11], but they also tend to exhibit anti-health behaviours more frequently, such as smoking [12] and leading more sedentary lives [13]. Additionally, it has been observed that urbanization has an impact on people's health in both rural and urban areas [14]. The widespread availability of inexpensive, high-energy food and motorized transportation, combined with the rapid expansion of mass media, have made rural areas more urbanized [15, 16]. The World Health Survey [17] results also indicate that the effects of urbanization on the prevalence of overweight and obesity are similar in rural and urban areas. Since rural areas differ from urban areas in terms of socio-demographic, socio-economic and cultural

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factors, population-based studies evaluating the prevalence of overweight and obesity among rural and urban residents in relation to these factors, particularly in specific local communities, are needed [18].

In 1989, Poland, a high-income country in Central Europe, led the political transformation and market economy shift as the first nation to do so in this region [19]. As a consequence, the quality of life and living conditions have gradually improved, although not for all Poles. After 1989, factors such as education, job mobility, occupation, etc., had a major impact on the dynamics of improving living conditions and quality of life. The prevalence of overweight and obesity was impacted by these changes, which primarily affected rural residents [20]. In 2004, following Poland's accession to the European Union, many social and economic changes directly affected eating habits (for instance, through the European Single Market and the General Food Law Regulations) [21]. According to the Central Statistical Office (GUS), there was a 70% increase in the gross domestic product (GDP) in 2020, as compared to 2005, the year following Poland's EU accession [22].

Between 1997 – 2017, the prevalence of overweight in Poland increased from 38% – 47.3% among all men and from 30% – 32.2% among all women. At the same time, the prevalence of obesity increased from 16% – 17.9% among all men, but decreased from 19% – 16.1% among all women [23]. Therefore, the growing incidence rate of overweight and obesity may have been caused by growing social disparities and easier access to material goods as a result of the system transformation and subsequent changes occurring in Poland. However, there are regional differences in the country's prevalence of obesity and overweight [6], with socio-economic status (SES) playing a significant role.

The residents of Janów District in eastern Poland are an example of a local community with a low-socio-economic status (SES). SES is a measure of social deprivation at district-level based on an index involving five different dimensions: income, employment, standard of living, education and access to goods and services. According to the data of 2013, Janów District was among the 20% of all districts in the Lublin Province most at risk of social deprivation [24]. Additionally, an analysis of several socio-economic characteristics of the area's residents in the time preceding the study revealed unfavourable outcomes, compared to nationwide indicators: a higher percentage of individuals with only a primary education, a higher unemployment rate compared to the overall population, and a higher percentage of social benefit recipients, compared to the average in other districts in the Lublin Province [25, 26, 27].

OBJECTIVE

The aim of the study was to compare anthropometric indicators related to overweight and obesity, such as BMI, WHR, WHtR and BAI, by place of residence in a local community with a high social deprivation rate based on the example of residents of the Janów District, eastern Poland, while accounting for differences in gender strata.

MATERIALS AND METHOD

Study design and participants. Between 14 June 2015 – 20 March 2016, a prevention and health promotion programme entitled 'Take your health to heart' ('Weź sobie zdrowie do serca') was conducted in the Janów District of Lublin Province in eastern Poland, during which data was collected and used for scientific studies. The 'Norwegian Financial Mechanism 2009 – 2014's Programme PL 13, Reducing Social Inequalities in Health', made it possible to implement the programme in Janów District, as it provided funding for local communities with high standardised mortality ratios (SMRs). With regard to Janów District, the mortality ratios were associated with cardiovascular diseases [28]. A description of the programme and the group of beneficiaries is described in detail in a further section [29]. In summary, the programme was intended for people aged 35 – 64. An analysis of epidemiological data on the incidence of cardiovascular disease among Janów District residents revealed that the risk rises sharply between the ages of 35 – 64. On the other hand, the majority of CVD patients were over 65, and health services in this age group are primarily focused on symptom management. Recruitment and promotion of survey participation were carried out through district and municipal local governments and cooperating institutions (religious associations, workplaces, associations, and institutions of public utility), as well as by addressing telephone invitations to individuals qualified for the study. In order to ensure equal access to survey participation, 15 registration points were set up in the Janów district (14 mobile – itinerant points in various towns and cities and one stationary point in the Municipal Hospital in Janów Lubelski, which also served as a coordinating point) [28].

A total of 4,040 individuals declared to take part in the study, representing 21.45% of the total number of eligible persons. There were 421 individuals (10.42%) among the study participants who did not take part because they did not meet the inclusion criteria. The inclusion criteria included: (1) age between 35 – 64 years; (2) no history of cardiovascular incident; (3) no diagnosis of coronary artery disease; (4) providing informed consent to participate in the study. A history of cardiovascular incidents (myocardial infarction or stroke) or a diagnosis of coronary artery disease disqualified 288 would-be participants from further studies. Finally, the cohort consisted of 3,752 participants meeting the inclusion criteria.

Ethics approval. Ethical approval was granted by the Bioethics Committee at the Medical University in Lublin (Decision No. KE-0254/112/2014), and the study was conducted in accordance with the Declaration of Helsinki. Each participant gave written informed consent to take part in this study.

Data collection. A team of specially trained nurses collected data, took anthropometric measurements and drew blood samples. Every study participant completed a survey and had their anthropometric measurements (weight, height, waist and hip circumferences) taken.

Anthropometric measurements and determination of anthropometric indicators related to overweight and obesity. All participants had their body height, weight, waist

circumference and hip circumference measured. A platform scale was used to measure body weight (without shoes or outer clothing) to the nearest 0.1 kg, and an altimeter was used to measure height to the nearest 0.1 cm. In the next step, BMI was calculated for each study subject (defined as body weight in kilograms (kg) divided by height in meters squared (kg/m^2)). In accordance with WHO guidelines, the following BMI classification system was applied: underweight -BMI ≤ 18.5 kg/m^2, normal weight – BMI 18.5–24.9 kg/m^2, overweight – 25.0 – 29.9 kg/m^2, and obese – BMI ≥ 30 kg/m^2 [30].

Waist circumference (WC) was measured between the lowest rib margin and the upper iliac crest, and hip circumference (HC) was measured at the height of the greater trochanter of the femur. Both measurements were taken using a flexible measuring tape. The study subject exhaled air and spread his or her legs apart by 25 – 30 centimetres to distribute body weight during both measurements. Both measurements were taken while standing. The waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) were then calculated [31].

Based on anthropometric measurements and biochemical results, respondents were calculated the Body Adiposity Index (BAI): BAI = [HC (cm)/height (m)^{1,5}] – 18 [32].

Covariates. A questionnaire was used to collect information regarding age, gender, place of residence, marital status, education, smoking status, frequency of alcohol consumption, and diagnosed chronic diseases.

There were two categories of smoking status: non-smoker – the respondent had never smoked or had stopped smoking at least one month prior to the study, and smoker – the respondent smoked at least one cigarette a day or had smoked a cigarette in the last month.

In addition, the study subjects were asked about their alcohol consumption in the year preceding the study. The respondents had to answer how often they consumed 1–2 standard measures of alcohol, with each meassure equalling 10 g of pure ethyl alcohol. The following options were available: 'I do not drink alcohol at all', 'I drink alcohol less than once a month', 'I drink alcohol once a month to once a week', and 'I drink alcohol more than once a week'.

In order to determine the level of physical activity, the respondents were asked if they engaged in regular physical activity for at least 30 minutes a day, at least five times a week. Physical activity was considered adequate if the respondent declared performing ≥ 150 minutes of vigorous activity each week [33].

The Patient Health Questionnaire-9 (PHQ-9) was used to screen depressive symptoms (DS) over the previous two weeks. The total score is calculated by adding the scores for nine items (from 0 – 27). A PHQ-9 score of 10 or higher was thought to indicate an increased risk of DS [34, 35].

The participants were asked if they were receiving diabetes treatment. The possible answers were 'yes' or 'no'. The respondents were not asked for which type of diabetes they were receiving treatment.

Statistical analysis. Continuous variables were presented as means with standard deviation (SD). The Shapiro–Wilk test was applied to test the normal distribution of variables. Categorical variables were reported as percentages. The Chi square test was used to compare the distribution of categorical variables. The unpaired Student's test was performed to assess intergroup differences in numerical variables. The relationship between the values of anthropometric indicators related to overweight and obesity and place of residence, linear regression was employed. The results are presented as beta coefficient (the differences between rural and urban) with 95% confidence interval (95% CI). The logistic regression model was used to investigate the association between prevalence of obesity and place of residence. The results are presented as odds ratio (OR) with 95% confidence interval (95% CI). Three sets of multivariable models by gender strata were performed (linear and logistic regression): model A – adjusted for age and education; model B – with additional adjustment for smoking status, marital status and physical activity; and model C – with additional adjustment for alcohol consumption, diabetes and depressive symptoms. Analyses were performed using IBM Corp. software released in 2021 (IBM SPSS Statistics for Windows; version 28.0.; IBM Corp, Armonk, NY, USA). P-values <0.05 were accepted as statistically significant.

RESULTS

General characteristics of participants. Table 1 shows the characteristics of the study group by place of residence. More than half of the 3,752 respondents (58.66%, n = 2,201) were female, living in rural areas (66.87%, n = 2,509) and in relationships (87.95%, n = 3,300). Mean age of the study group was 51.92 ± 8.15, and rural residents were slightly younger than urban residents (p = 0.002). Rural residents were more likely to score 10 or higher on the depressive symptom test, were less likely to have a university degree, and were less likely to be smokers, compared to urban residents.

It was observed that the mean values of BMI, WHR, and WHtR were significantly higher in rural residents than in urban residents when anthropometric indicators related to overweight and obesity were considered. However, based on BMI, rural residents had a higher prevalence of overweight, whereas urban residents had a higher prevalence of obesity.

Relationship between anthropometric indicators related to overweight and obesity by place of residence and across the gender strata. Figure 1 shows a comparison of mean values of anthropometric indicators related to overweight and obesity and place of residence across the gender strata. With regard to women, the mean values of four indicators related to overweight and obesity in rural vs. urban areas were as follows: BMI (28.77 ± 5.37 *vs.* 27.62 ± 5.09; p < 0.001),

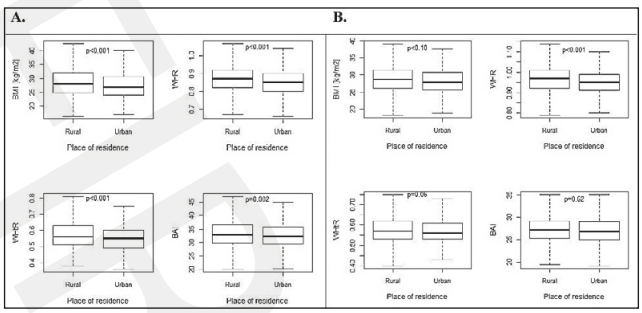

Figure 1. Comparison of mean values of anthropometric indicators related to overweight and obesity and place of residence across the gender strata: A – women, B – men.

Table 1. Characteristics of the study group by place of residence

Variables	Rural areas (n = 2,509)	Urban areas (n = 1,243)	Total (n = 3,752)	p
Age [years] [a]	51.65 ±7.99	52.45 ± 8.43	51.92 ± 8.15	0.002
Gender: [b]				
Female	1,438 (57.31)	763 (61.38)	2,201 (58.66)	0.02
Marital status: [b]				
Married	2,237 (89.16)	1063 (85.52)	3,300 (87.95)	
Single (bachelor/bachelorette)	156 (6.22)	116 (9.33)	272 (7.25)	0.002
Widow/widower	116 (4.62)	64 (5.15)	180 (4.8)	
Education: [b]				
University	310 (12.36)	435 (35)	745 (19.86)	< 0.001
Smoking status: [b]				
Smoker	379 (15.1)	216 (17.38)	595 (15.86)	
Former smoker	499 (19.89)	283 (22.77)	782 (20.84)	0.009
Never-smoker	1,631 (65.01)	744 (59.85)	2,375 (63.3)	
Alcohol consumption: [b]				
None or less than once a month	2 246 (89.52)	1 099 (88.41)	3 345 (89.15)	
Between once a month and once a week	153 (6.1)	84 (6.76)	237 (6.32)	0.59
More than once a week	110 (4.38)	60 (4.83)	170 (4.53)	
Physical activity: [b]				
≥ 150 min a week	1 089 (43.4)	515 (41.43)	1 604 (42.75)	0.25
Diabetes: [b]				
Yes	87 (3.47)	60 (4.83)	147 (3.92)	0.04
Patient Health Questionnaire (PHQ-9): [b]				
≥ 10	429 (17.1)	176 (14.16)	605 (16.12)	0.02
BMI: [a]	28.84 ±4.98	27.97 ±4.91	28.55 ± 4.98	< 0.001
Underweight [≤ 18.4 kg/m^2] [b]	11 (0.44)	3 (0.24)	14 (0.38)	
Normal [18.5 – 24.99 kg/m^2] [b]	557 (22.2)	348 (28)	905 (24.12)	< 0.001
Overweight [25 – 29.99 kg/m^2] [b]	995 (39.66)	516 (41.51)	1 511 (40.27)	
Obesity [≥ 30 kg/m^2] [b]	946 (37.7)	376 (30.25)	1 322 (35.23)	
WHR [a]	0.91 ± 0.08	0.89 ± 0.08	0.9 ± 0.09	< 0.001
WHtR [a]	0.57 ± 0.08	0.56 ±0.07	0.57 ±0.08	< 0.001
BAI [a]	30.92 ± 5.69	30.67 ± 5.49	30.84 ± 5.63	0.2

Data is presented as: [a] mean ± SD; [b] n (%); BMI - body mass index; WHR - waist-hip ratio; WHtR - waist to height ratio; BAI - body adiposity index

WHR (0.87 ± 0.07 *vs.* 0.85 ± 0.07; p < 0.001), WHtR (0.57 ± 0.09 *vs.* 0.55 ± 0.08; p < 0.001) and BAI (33.58 ± 5.48 *vs.* 32.82 ± 5.4; p = 0.002). With regard to men, it was observed that those living in rural areas had higher mean WHR than men living in urban areas (0.96 ± 0.07 *vs.* 0.95 ± 0.62; p < 0.001). Moreover, a tendency towards a higher mean WHtR was observed in men living in rural areas, compared to men living in urban areas (0.58 ± 0.06 *vs.* 0.57 ± 0.06; p = 0.06).

Figure 2 shows the distribution of category of BMI by place of residence across the gender strata. There was a higher prevalence of obesity among women living in rural areas compared to those living in urban areas, with the percentage of women with normal weight being lower (nine percentage points) and the percentage of women with obesity higher (eight percentage points) in rural areas. In men, no significant relationship was observed between BMI and place of residence.

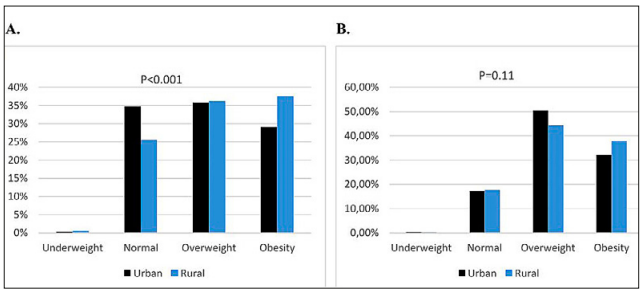

Figure 2. Distribution of BMI by place of residence across the gender strata: A – women, B – men

Multivariable relationships between anthropometric indicators related to overweight and obesity by place of residence and across the gender strata. Table 2 shows the relationship between place of residence and anthropometric indicators related to overweight and obesity across the gender strata. Women living in rural areas had roughly 1.1 higher BMI, approximately 0.02 higher WHR and WHTR, and approximately 0.8 higher BAI, compared to women living in urban areas, after adjusting for age, education, smoking status, level of physical activity, alcohol consumption, diabetes, and presence of depressive symptoms. Men living in rural areas had approximately 0.01 higher WHtR and WHR than men living in urban areas in the fully adjusted model. With regard to BMI, there was a trend that showed that men living in rural areas had a BMI that was about 0.4 higher compared to those living in urban areas.

Most of the results remained unchanged after adjusting for covariates such as age, education, smoking status, level of physical activity, alcohol consumption, diabetes, and the presence of depressive symptoms. Nevertheless, when compared to univariate analysis, the strength of the examined association was weaker in multivariable models, particularly among women.

Table 3 shows the relationship between place of residence and the prevalence of obesity across the gender strata. In one-dimensional models, rural respondents were more likely to be obese compared to urban respondents in both women and men. In the fully adjusted model, women living in rural areas had an approximately 60% higher probability of being obese, while men had an approximately 30% higher probability of being obese.

DISCUSSION

Obesity is a major challenge for public health because it is related to increased morbidity and mortality due to NCDs. This cross-sectional study compares the values of anthropometric indicators related to obesity and overweight by place of residence and gender strata on the example of a local community with a high deprivation rate. According to the study findings, women living in rural areas had significantly higher mean BMI, WHR, WHtR and BAI than women living in urban areas. Regarding the men, respondents living in rural areas had a significantly higher mean WHR and WHtR than respondents living in urban areas. In

Table 2. Relationship between place of residence and anthropometric indicators related to overweight and obesity across the gender strata

		Female			Male		
		b	95% CI	*p*	b	95% CI	*p*
BMI	Model A	1.169	(0.708; 1.630)	< 0.001	0.436	(-0.056; 0.929)	0.083
	Model B	1.071	(0.608; 1.534)	< 0.001	0.435	(-0.049; 0.920)	0.078
	Model C	1.105	(0.646; 1.564)	< 0.001	0.457	(-0.021; 0.936)	0.061
WHR	Model A	0.015	(0.008; 0.021)	< 0.001	0.011	(0.004; 0.018)	0.002
	Model B	0.015	(0.009; 0.021)	< 0.001	0.012	(0.005; 0.019)	0.001
	Model C	0.016	(0.009; 0.022)	< 0.001	0.012	(0.005; 0.019)	0.001
WHtR	Model A	0.018	(0.011; 0.025)	< 0.001	0.006	(-0.001; 0.013)	0.076
	Model B	0.017	(0.010; 0.024)	< 0.001	0.007	(0.000; 0.013)	0.056
	Model C	0.018	(0.011; 0.025)	< 0.001	0.007	(0.000; 0.014)	0.043
BAI	Model A	0.839	(0.371; 1.308)	< 0.001	0.106	(-0.288; 0.500)	0.598
	Model B	0.710	(0.240; 1.179)	0.003	0.096	(-0.295; 0.487)	0.631
	Model C	0.721	(0.253; 1.189	0.003	0.098	(-0.290; 0.485)	0.621

Results are presented as differences between rural and urban. Model A – adjusted for age and education; Model B – adjusted for age, education, smoking status, marital status and physical activity; Model C – adjusted for age, education, smoking status, marital status, physical activity, alcohol consumption, diabetes and depressive symptoms. BMI – body mass index; WHR – waist-hip ratio; WHtR – waist to height ratio; BAI – body adiposity index; b – standardized beta coefficient; CI – confidence intervals

Table 3. Relationship between place of residence and prevalence of obesity across the gender strata

BMI	Crude			Model A			Model B			Model C		
	OR	95% CI	*p*	OR	95%CI	*p*	OR	95%CI	*p*	OR	95%CI	*p*
Female												
Urban areas	1			1			1			1		
Rural areas	1.47	(1.21; 1.77)	< 0.001	1.60	(1.30; 1.97)	< 0.001	1.56	(1.27; 1.93)	< 0.001	1.59	(1.29; 1.99)	< 0.001
Male												
Urban areas	1			1			1			1		
Rural areas	1.29	(1.03; 1.62)	0.027	1.31	(1.03; 1.65)	0.07	1.32	(1.04; 1.68)	0.023	1.34	(1.05; 1.71)	0.017

Model A - adjusted for age and education; Model B - adjusted for age, education, smoking status, marital status and physical activity; Model C - adjusted for age, education, smoking status, marital status, physical activity, alcohol consumption, diabetes and depressive symptoms; OR - odds ratio; CI - confidence intervals.

addition, after having considered potential confounding variables, women living in rural areas had an approximately 60% higher probability of being obese, while men had an approximately 30% higher probability of being obese.

Other Polish studies have confirmed that there is a higher prevalence of obesity and overweight among people living in rural areas. A study by Stoś et al. [6] conducted between 2019 – 2020 involving 1,831 people, described a similar result: rural residents had a nearly 1.4-fold higher likelihood of being overweight or obese (measured by BMI) than urban residents. Studziński et al. [36] carried out a secondary analysis using data from the national cross-sectional survey 'LIPIDOGRAM 2015 – 2016'. Following an analysis of 13,724 primary health care patients' data, it was found that rural residents had significantly higher BMI and WHR, compared to urban residents. This relationship was observed in both the study population and across the gender strata. Even considering demographic variables, health behaviours (such as smoking, physical activity and alcohol consumption), the presence of comorbidities (such as diabetes) or depressive symptoms, residing in a rural area is an independent risk factor for obesity and overweight.

There may be several explanations for the higher prevalence of overweight and obesity among rural residents. SES may have an indirect impact on body weight through poorer eating habits [37], limited access to recreation facilities [38], insufficient knowledge about health [39], or less physical activity [14,40]. Indeed, research indicates that high-SES individuals in low- and middle-income countries (LMICs) favour high-calorie foods and avoid physical activities, whereas high-SES individuals in high-income countries typically adhere to dietary guidelines and engage in regular exercise [41]. According to a nationwide study carried out in the United States of America (USA), for example, rural residents consumed more sugar-sweetened beverages and less fruit and fibre. Moreover, Suliga et al. [42], in a study conducted among 7,997 Polish adults aged 37–66 years, found that rural residents were more likely to have a traditional-carbohydrate dietary habits, i.e., a higher intake of potatoes, refined cereals, soups, sugar, sweets, high-fat milk and less whole-grain products. In contrast, the results suggest that urban residents were more likely to follow a healthy diet, which is defined as eating more fruits and vegetables, sauerkraut, whole grains, eggs, fish, nuts, and less refined cereal.

As stated above, leisure time and physical activity also play key roles in the prevalence of overweight and obesity. According to a number of cross-sectional studies [43, 44], rural residents are less likely to be physically active and to follow activity-related guidelines on a regular basis. Nonetheless, findings of own research show that rural residents declared themselves to be more physically engaged. This was most likely caused by the fact that respondents included domestic and agricultural labour as a physical

activity. Although domestic work is a protective factor, agriculture and rural areas are increasingly mechanised. This means that agricultural labour increases the risk of being overweight or obese as mechanized labour uses less energy than manual labour [45]. Nevertheless, the degree of rurality and geographic location must also be considered in order to gain a better understanding of the relationship between the prevalence of overweight and obesity among rural and urban residents [46].

The results of own study, which have also been supported by other research, show that women in rural areas have an up to 60% higher prevalence of obesity and more unfavourable results on the anthropometric parameters related to overweight and obesity, compared to women in urban areas [47, 48]. A common explanation for obesity is the number of births and biological factors associated with obesity, such as hormonal changes or the use of contraceptive methods [49, 50]. Moreover, there are disparities resulting from the occupations held, such as women performing low-energy expenditure jobs, focusing more on housework, and having less free time for physical activity [14, 49, 51].

With regard to the results among men, living in rural areas was associated with a higher risk of abdominal obesity and a roughly 30% higher risk of obesity, which may support the above findings. Interestingly, there was no relation between the place of residence and the likelihood of a higher BAI value in the male study group. The reason for this is that body height and hip circumference are used to determine body adiposity index (BAI); accordingly, body height may play a significant factor in the likelihood of becoming overweight or obese, as research indicates that short stature is linked to an increased risk of obesity [52]. Men are generally typically taller than women and finish their growth in height at a later age than women. However, an earlier termination of growth in height may promote the development of fat mass in adulthood, as demonstrated by a different study [53]. These findings need to be confirmed.

Limitations of the study. This study has several limitations. 1) Since the study was cross-sectional, it was impossible to determine a cause-and-effect relationship. In addition, the anthropometric and blood pressure data came from one-day measurements and therefore, a longitudinal study is suggested. 2) The BMI employed in the analyses might not be entirely accurate in determining the individual's overweight and obesity, particularly when comparing people of varying ages and levels of physical activity. Since WC is strongly associated with visceral fat content and, consequently, with metabolic risk, the assessment of abdominal adiposity (in this case, WHR, WHtR, and BAI) aims to minimize the possibility of this bias [54]. 3) Thirdly, the respondents' physical activity was measured using a single question.

CONCLUSIONS

The study carried out in a local community with a high social deprivation rate, showed that, compared to women living in urban areas, women residing in rural areas had higher mean values of the anthropometric indicators related to overweight and obesity (BMI, WHR, WHtR, and BAI), and men residing in rural areas had higher mean values of WHR, compared to men living in urban areas. In addition, it was found that women living in rural areas had a mean BMI that was 1.1 higher than that of women living in urban areas, as well as 0.02 higher WHR and WHtR and 0.8 higher BAI. In turn, men living in rural areas had a 0.001 higher WHtR and WHR compared to men living in urban areas. In the one-dimensional models, after having considered potential confounding variables, women living in rural areas had an approximately 60% higher probability of being obese, while men had an approximately 30% higher probability of being obese.

In conclusion, for decision-makers and public health authorities, this study has practical implications by emphasizing how critical it is to launch a nationwide campaign on the risk factors of overweight and obesity, as well as their effects on rural communities. This type of campaign should be funded separately and targeted specifically at women living in rural areas. It is worth considering the implementation of comprehensive lifestyle modification counselling aimed at assisting women in losing weight, particularly those who live in rural areas and with low SES. This could be implemented as a component of coordinated primary health care.

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