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Results of the WOBASZ II study (2013–2014) and comparison with the WOBASZ study  
(2003–2005)**

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## ORIGINAL ARTICLE

### **Prevalence of general and abdominal obesity and overweight among adults in Poland. Results of the WOBASZ II study (2013–2014) and comparison with the WOBASZ study (2003–2005)**

Short title: Changes in the prevalence of obesity and overweight in Poland

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## **Abstract**

**Introduction** Information on the prevalence of and trends in overweight and obesity in Poland is limited.

**Objectives** The aim of the study was to assess the prevalence of general and abdominal obesity and overweight in Polish adults in the years 2013 - 2014, and a comparison with the prevalence in the years 2003 - 2005.

**Patients and methods** The study was conducted in 2 independent, representative samples of the Polish population, comprising 14537 persons (aged 20–74 years) examined in the years 2003–2005 and 6164 persons (aged  $\geq 20$  years) examined in the years 2013–2014. Anthropometric measurements were done by trained nurses.

**Results** In the years 2013–2014, the age-standardized prevalence of obesity (body mass index [BMI]  $\geq 30$  kg/m<sup>2</sup>) was 24.4% in men and 25.0% in women. The prevalence of overweight (BMI, 25.0–29.9 kg/m<sup>2</sup>) was 43.2% in men and 30.5% in women. Abdominal obesity (waist circumference  $\geq 102$  cm in men or  $\geq 88$  cm in women) was noted in 32.2% of men and 45.7% of women. Abdominal overweight (waist circumference, 94–101.9 cm in men or 80–87.9 cm

in women) was present in 27.2% of men and 21.7% of women. Since the years 2003–2005, the distribution of body mass according to the BMI category had shifted to higher values, and an increase in the obesity prevalence was observed in men. The percentage of adults with normal waist circumference decreased significantly in both sexes.

**Conclusions** Every fourth man and woman in Poland is obese, and during the last decade, the prevalence of obesity has increased, particularly in men. Abdominal obesity is observed in every third man and nearly every second woman, and an excess of abdominal fat has increased in both sexes.

**Key words**

abdominal obesity, epidemiology, obesity, overweight, WOBASZ II

**Introduction** The prevalence of obesity in Central and Eastern European countries is higher compared with that in Western and Northern countries [1,2], and the problem of obesity remains a considerable challenge for public health [3,4]. The costs generated by obesity and by its complications are very high and account for 0.1% to 0.7% of the gross domestic product in European countries [5]. In Poland, the cost of treating people with excessive body weight is about 20% of total expenditure on health [6,7]. Obesity is a risk factor for cardiovascular diseases, type 2 diabetes, some cancers, and arthritis. Additionally, it increases cardiovascular risk and promotes hypertension, glucose intolerance, dyslipidemia, and chronic inflammation. Excess of abdominal fat is particularly associated with cardiometabolic impairments [8]. Obesity is also associated with a higher risk of death [9,10]. It is a chronic and complex disease determined by lifestyle behaviors associated with positive energy balance, such as unfavorable diet and sedentary lifestyle [4,11,12]. The transition to a market economy in Poland, from the early 1990s, has been associated with the considerable promotion and availability of inexpensive high-fat and high-sugar processed foods and drinks,

but it has also been accompanied by changes in working and home environments that have led to obesogenic physical activity habits [3,7,13-15]. The increase in the prevalence of obesity in Poland, which has been observed from the 1990s, was one of the factors contributing negatively to changes in the health status of the Polish population in the years 1991 to 2005 [16]. During the past 3 decades, the proportion of adults with a body mass index (BMI) of 25 kg/m<sup>2</sup> or higher has increased worldwide; however, in some developed countries, increasing trends in the prevalence of obesity have slowed down [1,17]. To prevent obesity in Poland, the National Program for the Prevention of Overweight, Obesity and Non-Communicable Diseases through Diet and Improved Physical Activity POL-HEALTH was introduced in 2007 [18]. The monitoring of the prevalence of and trends in obesity and overweight in adults is necessary to evaluate the effectiveness of public health campaigns and for better planning of further interventions. The aim of the present study was to assess the prevalence of general and abdominal obesity and overweight among Polish adults in the years 2013 - 2014, and to compare this with the prevalence in the years 2003 - 2005.

**Patients and methods**        The Multi-center National Population Health Examination Survey (WOBASZ II study) was conducted in Poland in the years 2013 and 2014. WOBASZ II was a nationwide, cross-sectional study conducted on a randomly selected sample of 15200 residents from 16 voivodships around Poland, aged 20 years or older. The sample was recruited from the national population register (PESEL database), using a multistage sampling design. As many as 1557 persons were noneligible, and the final response rate was 45.5%. All participants in WOBASZ II provided written consent to take part in the study. To evaluate changes in the prevalence of obesity and overweight during the last 10 years, data from the first cross-sectional WOBASZ study (2003–2005) were used. Both studies (WOBASZ and WOBASZ II) used independent, random samples of the Polish population, and the same methodology was applied. More details on the WOBASZ and WOBASZ II studies, including

sample sizes and the prevalence of obesity and overweight estimates, have been published previously [19,20].

The measurements of weight, height, and waist circumference were performed by trained nurses in outpatient clinics, using standardized methods. Body weight was measured without shoes and without top garments to record a medical weight, to the nearest 0.1 kg. Height was measured in the standing position without shoes, to the nearest 0.5 cm. Waist circumference was measured at the level of the umbilicus, using an inextensible measuring tape, to the nearest 0.5 cm. BMI was calculated based on measured weight and height, as weight in kilograms divided by squared height in meters. General overweight was defined as the BMI of 25 to 29.9 kg/m<sup>2</sup>, and general obesity—as the BMI of 30 kg/m<sup>2</sup> or higher. Additionally, within the obesity range, obesity class I was considered to be a BMI of 30 to 34.9 kg/m<sup>2</sup>; class II obesity, 35 to 39.9 kg/m<sup>2</sup>; and class III obesity, 40 kg/m<sup>2</sup> or higher. A BMI of less than 25 kg/m<sup>2</sup> was classified as normal body mass. According to European guidelines, waist circumference of 102 cm or higher in men and 88 cm or higher in women was categorized as abdominal obesity, and waist circumference of 94 to 101.9 cm in men and of 80 to 87.9 cm in women, as abdominal overweight [10,21,22]. The crude prevalence rate of general and abdominal obesity and overweight with 95% confidence interval (CI) was calculated for the age groups of 20–34, 35–44, 45–54, 55–64, 64–74, and ≥75 years in men and women. The test for proportions was used to assess differences in percentages between WOBASZ and WOBASZ II in particular age groups. Age-standardized prevalence rates were calculated with the direct method using weights assessed for the population of Poland at the end of 2013 [19]. To compare data on obesity and overweight from the WOBASZ II study with that from the first WOBASZ study, which included adults aged from 20 to 74 years, we used restricted data from the WOBASZ II study for respondents aged from 20 to 74 years. To assess changes in the prevalence of obesity and overweight between the WOBASZ study and the WOBASZ II

study, the rate ratio [RR] was calculated as a quotient of age-standardized prevalence from the WOBASZ II study (2013-2014) and age-standardized prevalence from the WOBASZ study (2003-2005). An RR above the value of 1.00 indicated an increased prevalence in the study period, while an RR below the value of 1.00 represented a decreased prevalence in the study period. RRs were presented with 95% CIs. Statistica version 12 (StatSoft Inc., Tulsa, Oklahoma, United States) and R version 3.0.3 (Development Core Team, Vienna, Austria) programs were used for statistical analyses. A *P* value of less than 0.05 was considered statistically significant.

**Results** Of 6164 participants from WOBASZ II, aged 20 years or older, 5843 persons had their weight and height measured (men, 45.0%), and 5999 adults underwent waist measurements (men, 44.7%). After restriction of data to respondents aged from 20 to 74 years, the measurements of weight and height were available for 5417 adults (men, 45.5%), and measurements of waist circumference—for 5552 adults (men, 45.2%). In the WOBASZ study (2003–2005), the measurements of weight and height were taken from 14367 adults (men, 47.3%), and the measurements of waist circumference—from 14398 adults (men, 47.3%). In the WOBASZ study, the mean BMI was 26.4 kg/m<sup>2</sup> (SD, 5.11), and in the WOBASZ II, it was 27.1 kg/m<sup>2</sup> (SD, 5.19). The mean waist circumference was 90.3 cm (SD, 14.12) in the WOBASZ study and 92.1 cm (SD, 14.01) in the WOBASZ II study.

**Prevalence of general and abdominal obesity and overweight by age group** The percentage of persons with general and abdominal obesity and overweight in the WOBASZ II study is presented by age group in Table 1. The prevalence of general obesity increased with age in both sexes, except for individuals aged 75 years or older. In young adults (35–45 years of age), the prevalence of general obesity was twice as high as in the youngest age group (20–34.9 years). The prevalence of overweight in men older than 35 years remained at the level of 45%, while in women, it increased with age. Abdominal obesity was more frequent in women

than in men in all age groups. The prevalence of abdominal obesity increased with age; however, in the oldest age group of men, it decreased slightly. Compared with the WOBASZ study, in WOBASZ II the prevalence of general and abdominal obesity and overweight within the age groups did not differ significantly.

### **Prevalence of general obesity and overweight in persons aged 20 years or older in**

**WOBASZ II** In adults aged from 20 to 99 years, the age-standardized prevalence rate of obesity was the same in men (24.4%) and in women (25.0%), whereas the prevalence of overweight was higher in men (43.2%) than in women (30.5%). In respondents aged from 20 to 74 years, the prevalence of obesity and overweight was very similar to that in the entire sample (aged 20–99 years) (TABLE 1). We observed a large variation by voivodship in the prevalence of obesity and overweight (TABLE 2). In men, the prevalence of obesity ranged from 29.0% in the Kujawsko-Pomorskie voivodship to 20.8% in the Podkarpackie voivodship, whereas in women it was from 32.1% in the Opolskie voivodship to 18.5% in the Lubuskie voivodship. In men, overweight was the highest in the Świętokrzyskie voivodship (53.7%) and the lowest in the Małopolskie voivodship (37.2%). In women, the percentage of overweight ranged from 36.3% in the Zachodnio-Pomorskie voivodship to 26.7% in the Lubelskie voivodship. The lowest percentage of persons with normal body mass was found in the Świętokrzyskie voivodship (25.4%) in men and in the Opolskie voivodship (34.7%) in women.

In Poland, the age-standardized prevalence of obesity class I was 18.9% in men and 18.0% in women, class II was 4.3% in men and 5.1% in women, and class III (morbid obesity) was 1.2% in men and 1.9% in women. The age-standardized prevalence of class I–III obesity is presented by voivodship in Supplementary material online, *Table S1*. The highest prevalence of morbid obesity was in the Podlaskie voivodship (3.0%) in men and in the Opolskie voivodship (4.0%) in women.

## Ten-year changes in general obesity and overweight in persons aged from 20 to 74 years

Between the years 2003–2005 and 2013–2014, the distribution of BMI categories in the Polish population shifted to higher values (FIGURE 1). In the years 2003–2005 in Poland in men, the prevalence of obesity was 20.0% (95% CI, 18.9–21.1) and in the years 2013–2014, it was 24.2% (95% CI, 22.3–26.2); and in women, 22.3% (95% CI, 21.2–23.3) and 23.4% (95% CI, 21.7–25.1), respectively. The prevalence of overweight in men in Poland in the years 2003–2005 was 40.2% (95% CI, 38.7–41.8), while in the years 2013–2014, it was 43.1% (95% CI, 40.5–45.7); in women, it was 27.7% (95% CI, 26.5–28.9) and 29.5% (95% CI, 27.5–31.4), respectively. In men, in the WOBASZ II study, obesity class I was found in 18.8%; class II, in 4.2%; and class III, in 1.3%, whereas in the WOBASZ study, class I was found in 15.7%; class II, in 3.6%; and class III, in 0.8%. In women, in WOBASZ II, obesity class I was found in 16.4%; class II, in 5.1%; and class III, in 1.8%, while in the WOBASZ study, it was found in 14.7%, 5.7%, and 1.9%, respectively.

These changes resulted in a decrease in the proportion of men with normal body mass from 39.8% in the WOBASZ study to 32.7% in WOBASZ II (RR, 0.82; 95% CI, 0.76–0.89). However, the proportion of women with normal body mass did not change significantly (RR, 0.94; 95% CI, 0.88–1.01). The changes in the prevalence of BMI lower than 25 kg/m<sup>2</sup> (RRs) in 16 voivodships over the period of 10 years are presented in Figure 2. The proportion of men with normal body mass decreased significantly only in the Świętokrzyskie voivodship (RR, 0.61, 95% CI, 0.42–0.90). The 10-year change in the prevalence of obesity and overweight is presented by voivodship in Supplementary material online, *Table S2*. The proportion of persons with obesity increased significantly in the Małopolskie voivodship (RR, 1.73; 95% CI, 1.10–2.73) in men and in the Pomorskie voivodship (RR, 1.46; 95% CI, 1.05–2.02) in women.

### **Prevalence of abdominal obesity and overweight in persons aged 20 years or older in**

**WOBASZ II** In the total sample, the age-standardized prevalence of abdominal obesity in

Poland was higher in women (45.7%) than in men (32.2%), but the percentage of abdominal overweight was higher in men (27.2%) than in women (21.7%). In respondents aged from 20 to 74 years, the results were similar (TABLE 1). The age-standardized prevalence of

abdominal obesity, overweight, and normal waist circumference by voivodship, in men and women aged from 20 to 99 years, is presented in Supplementary material online, *Table S3*.

The range of the prevalence of abdominal obesity across regions was from 21.2% in the Podkarpackie voivodship to 45.1% in the Kujawsko-Pomorskie voivodship in men, and from 36.4% in the Dolnośląskie voivodship to 56.2% in the Pomorskie voivodship in women.

Abdominal overweight varied from 21.4% in the Małopolskie voivodship to 32.6% in the Mazowieckie voivodship in men and from 16.8% in the Mazowieckie voivodship to 32.4% in the Zachodnio-Pomorskie voivodship in women. The lowest prevalence of normal waist circumference was in the Kujawsko-Pomorskie voivodship (29.7%) in men and in the Pomorskie voivodship (24.6%) in women.

### **Ten-year change in abdominal obesity and overweight in persons aged from 20 to 74**

**years** Between the years 2003–2005 and 2013–2014, the distribution of abdominal fat categories clearly shifted to higher values (FIGURE 3). While in the years 2003–2005, the prevalence of abdominal obesity in men was 26.8% (95% CI, 25.6–28.1), 10 years later it was 30.7% (95% CI, 28.6–32.8). In women, the prevalence of abdominal obesity increased from 40.2% (95% CI, 38.7–41.6) in 2003–2005 to 42.2% (95% CI, 40.0–44.5) in the years 2013–2014. In men, the proportion of abdominal overweight was 25.0% (95% CI, 23.8–26.2) in the years 2003–2005 and 27.2% (95% CI, 25.2–29.3) in the years 2013–2014. In women, it was 19.6% (95% CI, 18.6–20.6) and 22.4% (95% CI, 20.7–24.1), respectively. These changes resulted in a significant decrease in the proportion of men and women with normal waist

circumference. It dropped from 48.1% in the WOBASZ study to 42.0% in the WOBASZ II study in men (RR, 0.87; 95% CI, 0.81–0.94) and from 40.2% to 35.4% in women (RR, 0.88; 95% CI, 0.82–0.95). During the decade, the prevalence of normal waist circumference decreased significantly in men in 2 voivodships: Pomorskie and Kujawsko-Pomorskie (FIGURE 4).

RRs of abdominal obesity and abdominal overweight for each voivodship are presented in Supplementary material online, *Table S4*. Between the years 2003–2005 and 2013–2014, the prevalence of abdominal obesity increased in men in the Kujawsko-Pomorskie and Pomorskie voivodships. Abdominal overweight increased in the Opolskie voivodship in men and in the Zachodnio-Pomorskie and Lubelskie voivodships in women.

**Discussion** Based on data collected on a large, random sample of the Polish adult population in the WOBASZ II study, it was shown that the prevalence of excessive body mass was higher in men than in women, which resulted from a higher prevalence of overweight in men. On the other hand, excess abdominal fat was more often present in women than in men, which was due to a higher prevalence of abdominal obesity in women. The prevalence of obesity was higher with age; however, a marked increase was seen in the group above the age of 35 years. A large regional variation in overweight and obesity (both general and abdominal) was found. Over the 10-year period, from the years 2003–2005 through the years 2013–2014, the shift towards higher categories of BMI was significant in men only, whereas the shift towards increased waist circumference was found in both sexes.

The strength of the present study is its large, random sample of Polish adults. Furthermore, in both WOBASZ surveys, the same procedures were used for the measurements of weight, height, and waist circumference, which allows the reliable assessment of changes over time. Finally, we assessed the prevalence of obesity, as well as 3 classes of obesity, in all voivodships.

There are also some limitations to the interpretation of the results of our study. Although the sample selected was representative for the population of Poland, the sample examined would not be fully representative due to the participation rate. The overall response rate in the WOBASZ II study was rather low. However, it was similar to that in the other contemporary population studies [19]. Nonparticipation is generally higher in obese individuals than in the general population [23]. In consequence, it is possible that our assessment of the prevalence of obesity might be underestimated. However, there was no significant correlation between the response rate in 16 voivodships and the prevalence of obesity (in women:  $r = 0.1$ ,  $P = 0.7$ ; in men:  $r = 0.2$ ,  $P = 0.5$ ). The participation rate in the WOBASZ II study was lower than in the first WOBASZ study, which might have an impact on the assessment of trends in obesity. Furthermore, we were not able to assess the real content of body fat; thus, we limited observation to indirect measures, that is, BMI and waist circumference.

Obesity in the WOBASZ II study was more frequent than that found in NATPOL 2011, which was conducted in Poland in 2011 on a smaller sample of individuals aged from 18 to 79 years (obesity was found in 23.6% of men and in 19.7% of women) [24]. In other studies in Poland, the prevalence of obesity was lower than in our study. Gallus et al [25] reported that obesity was found in 12.3% of men and 8.3% of women. In the recent OECD report, [26] the prevalence of obesity in Poland was 16.6% in men and 15.2% in women. However, these studies used self-reported data on weight and height. Our estimate of the prevalence of general obesity in the Polish population is similar to that in other European countries, for example, England (26.0% of men, 23.8% of women) [25,27] or Spain (24.4% of men, 21.4% of women) [28]. Lower prevalence of obesity was found in Sweden (20% of men and women) [29] and Lithuania (19.0% of men and 20.5% of women) [30]. Compared to the United States, the problem of obesity in Poland is less common. According to the NHANES Survey from 2010, [17] 35.7% of adults in the United States are obese with no sex differences [17]. It is

worth mentioning that, in the United States population, a similar prevalence of obesity as we observe now in Poland, was present more than 15 years ago [17]. Higher grades of obesity are associated with excess mortality [9,31]. Obesity class II and class III was found more frequently in Polish women, so they might be more vulnerable to the effects of obesity, including death. Nevertheless, compared to the population of the United States where percentages of obesity class III and obesity class II are 6.3% and 15.2%, respectively, in the Polish population these disorders are present 3 to 4 times less commonly [8]. Abdominal obesity in the WOBASZ II study was more frequent in women, and its frequency was similar to that observed in England (44% of women and 34% of men) [27] and Canada (41% of women and 29% of men) [8]. However, in Poland the rate of abdominal obesity is lower than in the United States, where abdominal obesity is present in 64.7% of women and in 43.5% of men [32]. Overweight, both by BMI and by waist circumference, was observed more commonly in men than in women, which is consistent with the results of other studies [21,33]. According to the comparison of data from both studies (WOBASZ and WOBASZ II), during the last decade in Poland, the distribution of body mass by the BMI category has shifted toward higher values, resulting in a significant decrease in normal body mass and a simultaneous increase in obesity only in men. These results are consistent with earlier 5-year observations in Poland in the NATPOL 2002 study [34]. The combined results of the Polish local and countrywide studies, published by the NCD Risk Factor Collaboration, indicated that between 1975 and 2014, the mean BMI increased more in men (from 24.4 kg/m<sup>2</sup> to 26.9 kg/m<sup>2</sup>) than in women (from 25.2 kg/m<sup>2</sup> to 25.8 kg/m<sup>2</sup>) [33]. The latter observation is similar to the findings in the United States from the years between 1999 and 2010, where obesity increased only in men [17]. Similarly, more men than women became obese in the populations of England [27] and Sweden [35].

Unfavorable changes in the distribution of BMI categories in the Polish population appeared to be faster in men than in women. The reasons for the shape of the changes of obesity by sex are not known. It may be associated with more favorable health behaviors in women [13,36], including dietary habits [37] or physical activity. Results from the NATPOL studies show that women had higher commuting activity compared with men; moreover, between 2003–2005 and 2011, the increase in leisure time physical activity was significant in women only [38]. Nevertheless, the changes in the distribution of body mass by the BMI category and body fat by waist circumference in the Polish population are not unequivocal. Over the last 10 years in Poland, the shift in body fat toward higher values of waist circumference found in both sexes reflect the unfavorable distribution of body fat in the whole population. This finding is consistent with those of other studies [22,32].

The increase in the proportion of people with excess body mass observed in our analysis was confirmed by a systematic increase in the frequency of hospitalizations in Poland due to obesity and type 2 diabetes [39] and may be related to the constantly growing number of deaths due to the category of endocrine, nutritional, and metabolic disorders, including obesity [40]. Our results are in accordance with other WOBASZ observations, in which unfavorable changes in physical activity and significant increase in the prevalence of hypertriglyceridemia were found [41, 42]. Moreover, unfavorable eating habits were reported in the WOBASZ II study [43].

In our study, the prevalence of obesity increased with age, except for the oldest age groups, which is consistent with the findings of other studies [4,31]. In women, the rise in obesity with age may be related to hormonal changes [44], and in men in the older age categories, body mass may be associated with muscle tissue atrophy or may be a result of the attempts to correct earlier nutritional habits [4,45].

The prevalence of obesity may differ across subpopulations within countries, which may be associated with regional differences in socioeconomic factors related to obesity [2]. In our study, the regional pattern of obesity is not clear, but more often obesity was observed in western and northern voivodships of Poland; however, the factors that might explain this variation are not certain. In another study, it was shown that unfavorable economic and social conditions of the regions of northern and north-western Poland were related with unhealthy lifestyle and its health consequences [46].

In conclusion, every fourth adult in Poland is obese ( $\text{BMI} \geq 30 \text{ kg/m}^2$ ), but abdominal obesity is even more common and is present in every third man and nearly every second woman. Compared with the youngest age group, a substantial rise in the prevalence of obesity was found in young adults above the age of 35 years. During the last decade, the prevalence of obesity increased significantly in men; however, an increase in abdominal fat was found in both men and women. There is a clear need for more effective public health campaigns to prevent and treat obesity, especially in men and in young adults.

**Contribution statement** US and AM were responsible for data analysis and interpretation, writing the article, and final approval of the version to be submitted. AP, WD, KK, and WB were responsible for the design and execution of the WOBASZ and WOBASZ II studies, critically reviewed and modified the manuscript, and approved the final version of the manuscript. AW was responsible for acquisition of data, drafting the article and approved the final version of the manuscript. AN, MJ, and AP-W were involved in data collection, edited and approved the final version of the manuscript.

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**Supplementary material online** Supplementary material online is available with the online version of the paper at [www.pamw.pl](http://www.pamw.pl).

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Table 1 Prevalence of general and abdominal obesity and overweight by sex and age group in WOBASZ II (2013/14)

Men	Age, y							
	20–	35–	45–	55–	65–	≥75	20–99 <sup>a</sup>	20–74 <sup>a</sup>
	34.9 % (95% CI)	44.9 % (95% CI)	54.9 % (95% CI)	64.9 % (95% CI)	74.9 % (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
obesity; BMI ≥30.0 kg/m <sup>2</sup>	12.1 (4.8– 19.4)	27.0 (19.5– 34.5)	29.5 (22.0– 37.0)	31.6 (24.7– 38.5)	32.8 (23.6– 42.0)	25.5 (12.3– 38.7)	24.4 (22.5– 26.3)	24.2 (22.3– 26.2)
overweight; BMI, 25.0– 29.9 kg/m <sup>2</sup>	38.3 (32.2– 44.4)	44.7 (38.2– 51.2)	45.1 (38.5– 51.7)	46.3 (40.2– 52.4)	45.5 (37.3– 53.7)	43.6 (32.1– 55.1)	43.2 (40.6– 45.7)	43.1 (40.5– 45.7)
abdominal obesity; WC ≥102 cm	13.8 (6.6– 21.0)	29.7 (22.4– 37.0)	35.3 (28.1– 42.5)	42.2 (35.9– 48.5)	53.7 (46.2– 61.2)	44.4 (33.2– 55.6)	32.2 (30.0– 34.5)	30.7 (28.6– 32.8)
abdominal overweight; WC, 94–101.9 cm	21.7 (14.8– 28.6)	31.4 (24.2– 38.6)	29.6 (22.1– 37.1)	31.9 (25.1– 38.7)	23.5 (13.8– 33.2)	25.4 (12.4– 38.4)	27.2 (25.1– 29.2)	27.2 (25.2– 29.3)
women								
obesity; BMI, ≥30.0 kg/m <sup>2</sup>	9.2 (2.0– 16.4)	17.0 (9.6– 24.4)	26.2 (19.4– 33.0)	36.5 (30.6– 42.4)	48. (40.9– 55.3)	38.7 (29.2– 48.2)	25.0 (23.3– 26.7)	23.4 (21.7– 25.1)

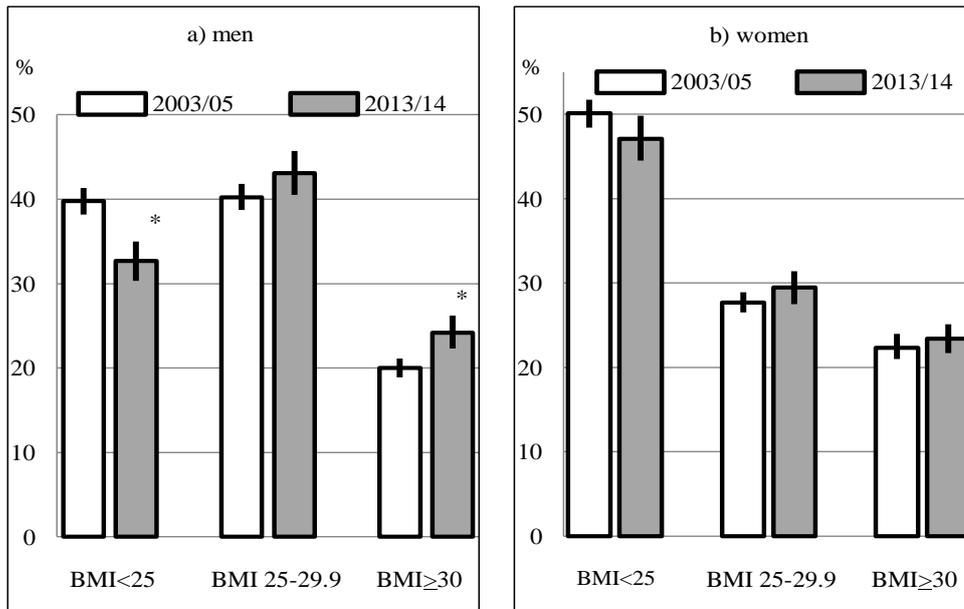
overweight; BMI, 25.0– 29.9 kg/m <sup>2</sup>	21.1 (14.4– 27.8)	26.7 (19.7– 33.7)	35.2 (28.9– 41.5)	37.8 (31.9– 43.7)	34.6 (26.5– 42.7)	38.7 (29.2– 48.2)	30.5 (28.5– 32.4)	29.5 (27.5– 31.4)
abdominal obesity; WC ≥88 cm	20.5 (13.9– 27.1)	34.6 (28.1– 41.1)	45.6 (39.9– 51.3)	64.0 (59.6– 68.4)	74.5 (69.5– 79.5)	75.9 (70.1– 81.7)	45.7 (43.4– 48.1)	42.2 (40.0– 44.5)
abdominal overweight; WC, 80–87.9 cm	21.4 (14.8– 28.0)	23.4 (16.4– 30.4)	28.5 (22.0– 35.0)	20.4 (13.9– 26.9)	17.3 (8.2– 26.4)	12.3 (1.3– 23.3)	21.7 (20.0– 23.3)	22.4 (20.7– 24.1)
<b>a</b> age-standardized								
Abbreviations: BMI, body mass index; WC, waist circumference								

Table 2 Age-standardized prevalence (%) of normal body mass, overweight, and obesity in men and women aged 20 years or older in WOBASZ II by voivodship

Voivodship	Men			Women		
	normal BMI <25 kg/m <sup>2</sup>	overweight BMI, 25– 29.9 kg/m <sup>2</sup>	obesity BMI ≥30 kg/m <sup>2</sup>	normal BMI <25 kg/m <sup>2</sup>	overweight BMI, 25– 29.9 kg/m <sup>2</sup>	obesity BMI ≥30 kg/m <sup>2</sup>
Dolnośląskie	30.6	45.0	24.4	46.8	29.6	23.6
Kujawsko- Pomorskie	31.2	39.8	29.0	49.4	27.7	23.0
Lubelskie	31.1	46.0	22.9	47.1	26.7	26.2
Lubuskie	34.2	40.9	24.9	47.7	33.8	18.5
Łódzkie	32.2	46.1	21.7	48.5	27.4	24.1
Małopolskie	38.7	37.2	24.0	40.4	34.4	25.2
Mazowieckie	32.1	41.4	26.5	40.9	33.8	25.3
Opolskie	32.2	41.6	26.3	34.7	33.1	32.1
Podkarpackie	40.1	39.1	20.8	38.2	30.7	31.2
Podlaskie	33.1	39.5	27.4	48.4	28.3	23.3
Pomorskie	32.8	40.7	26.5	42.1	27.1	30.8
Śląskie	31.5	45.7	22.8	47.1	33.8	19.1
Świętokrzyskie	25.4	53.7	20.9	42.9	33.2	23.9
Warmińsko- Mazurskie	31.6	43.2	25.2	46.2	27.9	25.9
Wielkopolskie	30.4	48.4	21.2	44.1	29.2	26.8
Zachodnio-	34.6	44.5	20.9	41.6	36.3	22.1

Pomorskie						
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FIGURE 1 Body mass index ( $\text{kg}/\text{m}^2$ ) categories in men (A) and women (B) in WOBASZ (2003–2005) and WOBASZ II (2013–2014) studies



\*  $P < 0.05$

FIGURE 2 Rate ratios (95% confidence interval) of normal body mass (body mass index <25 kg/m<sup>2</sup>) in men and women by voivodship

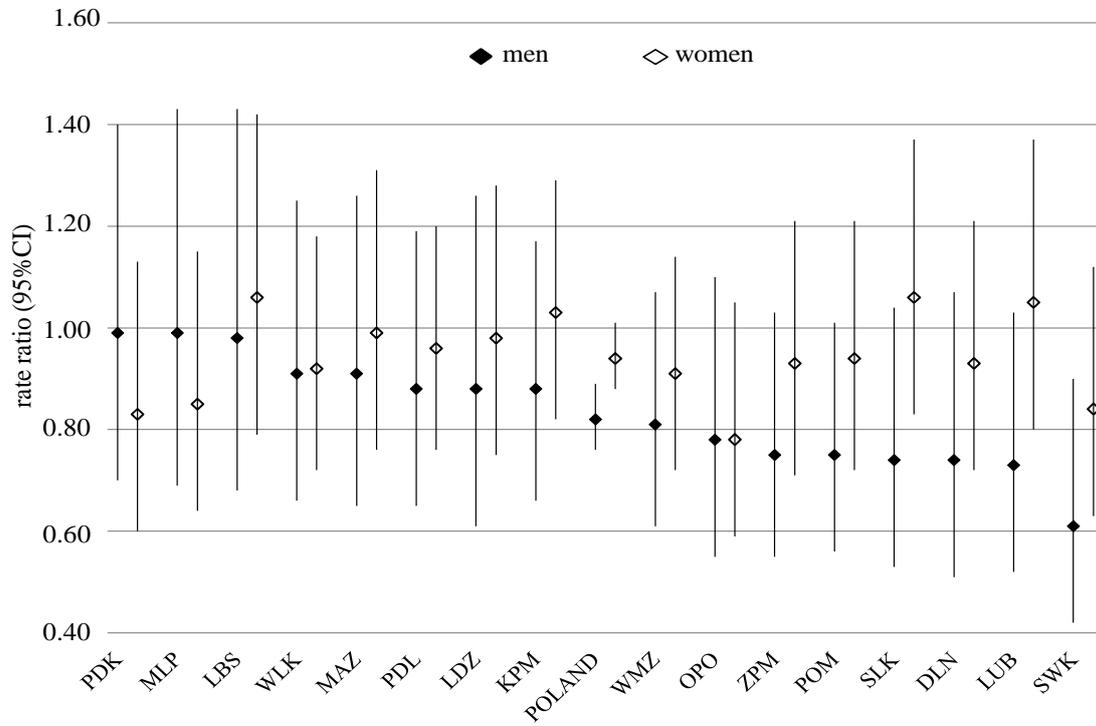
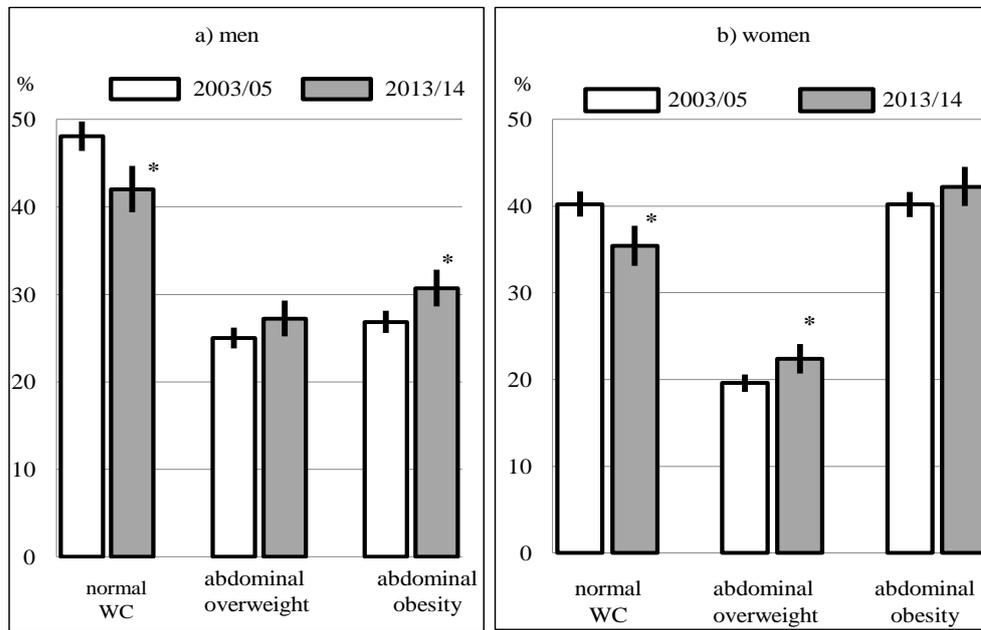


FIGURE 3 Waist circumference categories in men (A) and women (B) in WOBASZ (2003–2005) and WOBASZ II (2013–2014) studies



\*  $P < 0.05$

FIGURE 4 Rate ratios (95% confidence interval) of normal waist circumference in men and women by voivodship

