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ORIGINAL ARTICLE

Every second adult inhabitant of Poland (aged 18–64) is overweight – results of representative cross-sectional studies conducted in 2017–2020

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Abstract

Introduction and Objective. Being overweight or obese increases the risk of numerous serious diseases and health conditions. It is also a reason for an increased risk of disability. The aim of the study was to assess the prevalence of general and abdominal obesity and overweight in Polish adults.

Materials and method. A total of 2,000 individuals randomly selected from the Polish population were evaluated. The group included 999 men aged 19–64. Analyses were based on the standardized measurements of weight, height and waist circumference.

Results. Excess body weight was noted in 51% of respondents (55% of men, 47% of women). There was a significant increase in BMI with age (19–30 years: 24.15 ± 3.93, 31–50 years: 25.75 ± 4.15 and 51–64 years: 27.23 ± 4.69 kg/m2). Men were over 43% more likely to develop excess body weight than women (OR = 1.438). The odds increased with age (OR = 1.046). Abdominal overweight was found in 21.2%, and abdominal obesity in 27.2% of respondents. The prevalence of abdominal obesity was higher in women (39.6%) than in men (14.1%). The prevalence of abdominal obesity and overweight increased with age (19–30 years: 32.1%, 31–50 years: 47.9% and 51–64 years: 66.2%).

Conclusions. Excess body weight occurs much more commonly in men than in women, with women suffering from obesity more often. The visceral distribution of the adipose tissue dominates in the Polish population, which is a serious risk factor for metabolic diseases. The chances of developing abdominal obesity in the studied population increase with age. Determining the risk of diet-related diseases requires further analyses comprising physical activity and nutrition against socio-demographic data.

Key words

adult population, nutritional status, overweight, anthropometric measurements

INTRODUCTION

The high prevalence of excess body weight in the populations of most countries continues to be a major public health problem worldwide [1–5]. In Poland in 2000, more than half of the adult population had excessive body weight (overweight or obesity), with the abnormality more common in men than in women (56.7% vs. 48.6%). A study conducted a few years later (2003–2005) as part of the WOBASZ Multicenter National Population Health Survey among Polish adults aged 20–74, showed overweight in 60.2% of men and 50% of women, including obesity in 20% of men and 22% of 3% of women. The next WOBASZ study (WOBASZ II, 2013–2014) [6] again found an increased prevalence of overweight and obesity (67.3% of men and 52.9% of women, including obesity in 24.2% and 23.4% of women, respectively). A smaller percentage of overweight individuals in the Polish population was shown in the European Health Survey (EHIS, 2014), where overweight was found in 62% of adult men and 46% of women, including obesity in 15.6% of women and 18.1% of men [7].

When discussing the results of these surveys, it is important to note the differences in their methodology. In the WOBASZ II survey, respondents were weighed by nurses, while the EHIS survey was based on respondents' declarations. After several years, the prevalence of excessive body weight in the Polish population was again reported to be on the rise. The EU-SILC Survey 2017 report shows that a body mass index (BMI) ≥ 25 kg/m^2 was present in 77.3% of respondents aged 16 and over, including obesity in 32.4% [8]. The results of a survey conducted by the Centre for Public

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Opinion Research (CBOS) published in 2019, for the first time showed a lower percentage (59%) of people with excessive body weight, compared to previously published data. The results of a 2019 survey published by the Public Opinion Research Centre (CBOS) indicated a lower percentage of Polish people with excess body weight (59%). The survey was based on the respondents' declarations and revealed obesity in every fifth person [9].

Being overweight or obese increases the risk of numerous serious diseases and health conditions including hypertension, stroke, coronary artery disease, congestive heart failure, type 2 diabetes, cancers (cancers of the breast, endometrial, colorectal, ovarian, oesophageal, pancreatic, kidney, and prostate cancer), and chronic back pain. Excess body weight is also the reason for an increased risk of disability [10], and such issues also contribute to an increase in the mortality rate among obese people. A population-based cohort study conducted in the United Kingdom including more than 3.6 million people aged 16 and over, showed that the life expectancy from the age of 40 years was 4.2 years shorter in obese (BMI ≥30.0 kg/m^2) men and 3.5 years shorter in obese women, and 4.3 years shorter in underweight (BMI <18.5 kg/m^2) men and 4.5 years shorter in underweight women, compared to individuals with healthy weight (BMI 18.5–24.9 kg/m^2) [11].

The health consequences associated with obesity depend on the distribution of the adipose tissue in the body. The accumulation of fat within the abdominal cavity is the most dangerous for health. This is accompanied by an increased secretion of inflammatory cytokines by macrophages infiltrating the adipose tissue, which leads to chronic low-grade inflammatory state in the body. This type of obesity also contributes to the reduction of insulin sensitivity of tissues, the development of insulin resistance, and the risk of developing type 2 diabetes [12 -14].

Numerous methods are used to assess the nutritional status in a population. The simplest and cheapest include anthropometric methods based on body weight and height measurements, and waist and hip circumferences [15, 16]. The results obtained from the measurements alone or after their inclusion in the calculations of specific indices are interpreted using fixed cut-off points. The body mass index (BMI) is one of those indices. It is used to screen the nutritional status of a population; however, it does not indicate the distribution of the adipose tissue. Waist circumference (WC), waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) may be used for this purpose. The measurement of waist circumference is recommended by the WHO as an indicator of central adiposity measurement, and may be used in routine check-up measurements as a BMI-independent cardiovascular risk assessment factor. Waist circumference should be below 80 cm in women and below 94 cm in men in the European population [17].

The distribution of adipose tissue in the abdominal area, also in people with normal body weight, is evidenced by the value of the WHtR (waist-to-height ratio), which denotes the ratio of waist circumference to body height. It is believed that taking these two body proportional parameters into account has greater predictive power than waist circumference used alone in screening tests. WHtR is independent of gender and age (>5 years of age) and ethnic group. Values ≥ 0.5 indicate an increased risk of cardiovascular disease and diabetes [18].

OBJECTIVE

The aim of the study is to provide the most recent national estimates of body weight and some indexes which characterizes the type of obesity among the representative adult Polish population, including more detailed analyses by age and gender.

MATERIALS AND METHOD

Design. The data analyzed in the presented study were obtained from a representative cross-sectional study of the dietary habits and nutritional status of the adult Polish population conducted in 2017–2020 as a part of the National Health Programme (NPZ 02), financed by the Ministry of Health. The study comprised the data of 2,000 individuals – 999 men aged 19–64, randomly selected from the population living on the territory of the Republic of Poland. Prior to the pandemic triggered by COVID-19 (October 2017 – March 2020), all data had been collected using the Computer-Assisted Personal Interviews (CAPI) method; thereafter, the Computer-Assisted Telephone Interviews (CATI) method was used (June – December 2020) [19]. The number of respondents who had completed the study before the outbreak of the COVID-19 pandemic was 1,684.

DATA COLLECTION AND INSTRUMENTS

Anthropometric measurements. The analyses were based on the measurements of weight, height and waist circumference. Prior to the pandemic, the weight, height and waist circumference of the respondents were measured according to established standards. The body weight of the respondents was measured with Omron portable electronic scales (model HBF-212) with an accuracy of 0.1 kg. The measurement of body height was performed with a graduated anthropometric tape for linear measurements and a drafting triangle. The measurements were made with an accuracy of 0.1 cm. Waist circumference was measured with a graduated anthropometric tape. During the pandemic, the respondents declared their body weight and height values. No waist circumference data were collected. The data on body weight and height were used to calculate the BMI (kg/m^2) values. Anthropometric measurements were conducted in respondents' homes by experienced, trained interviewers. Out of concern for the quality of the survey results, interviewer training was conducted by a team of experts from Warsaw Medical University at the beginning of the project. As part of research quality control, refresher trainings were conducted throughout the project. The study data were processed by two independent quality control systems. Basic (standard) quality control measures were implemented by the research company according to an approved scheme. The MUW team carried out an independent quality control procedure to verify that each questionnaire was completed correctly. A detailed description of the anthropometric measurements have been provided elsewhere [19].

Ethical considerations. The study was approved by the Ethical Review Board at the Medical University of Warsaw (Approval No. AKBE/163/17 and AKBE/164/17), and

conducted in accordance with the General Data Protection Regulations [20].

Statistical analysis. Waist circumference, BMI and WHtR indices were analyzed using descriptive statistics methods. BMI measurements were presented as an arithmetic mean with a 95% confidence interval (95%CI) and standard deviation (SD) throughout the sample comprising the gender and age group variables. The values of selected percentiles were also calculated. The individual categories of BMI, WHR and WHtR indices were presented as numbers (N) and frequencies (%). For each frequency, 95%CI was also determined by bootstrapping with 10,000 repetitions.

A null hypothesis testing approach was used for statistical inference. The difference between the mean BMI values was calculated using the Student's t-test or one-way analysis of variance (ANOVA). However, differences in the frequency of individual BMI categories were tested using the Mann-Whitney U test with eta-squared ($\eta 2$) effect size. Differences in the frequency of individual WHtR categories were tested using the chi-squared test with odds ratio (OR) and 95%CI. Correlations between BMI and WHtR were calculated by determining the Pearson's r correlation coefficient.

A logistic regression model was used to estimate the chances of developing overweight or obesity, including abdominal obesity. The regression model parameters were estimated using the maximum likelihood method. OR was determined along with 95%CI for two independent variables: gender and age. Moreover, the adjusted OR in the multivariant regression model was calculated for these variables, comprising: place of residence, education, financial situation, marital status of the respondents, professional situation, and the presence of cardiovascular disease.

Data were analyzed using STATISTICA™, version 3.13 (TIBCO® Software Inc., Palo Alto, California, United States). For all analyses, a 5% level of statistical significance was set to reject the null hypothesis.

RESULTS

Sample characteristics. As regards the examined representative sample for the general population of Poland, the average age was 41.1 years [95%CI: 40.6–41.6] (±12.47). The age ranged from 18 – 64 (coefficient of variation: 30.3%). The respondents differed significantly in terms of gender depending on their place of residence, province, level of education, current financial situation of the family, marital status and selected professional situations. However, the group of men and women did not differ significantly regarding the presence of cardiovascular diseases or age (Tab. 1).

Body Mass Index (BMI). A normal BMI was recorded in 47% of the study population. Excess body weight (BMI > 25 kg/m^2) was reported in 51% of the respondents, while only 2% of the population of Poland aged 19–64 was underweight. Overall, a higher percentage of people with excessive body weight was recorded in the group of men than in the group of women (55 vs 47%). The mean BMI in the group of women was significantly lower compared to the group of men (M: 25.57 (± 5.14) vs 25.98 (±3.50), t = -2.095; p = 0.036). The analysis comprising age groups showed a significant increase in the mean BMI value in older groups (M: 24.15 (± 3.93) vs 25.75 (± 4.15) vs 27.23 (± 4.69), F = 68.427; p < 0.001). Furthermore, it was observed that the increase in average BMI with age of the respondents was stronger in the group of women than in men (Tab. 2).

Analysis of the prevalence of overweight and obesity measured by BMI categories showed a statistically significant difference between the groups of men and women. Disregarding the age group of the respondents, it was found that men were more commonly overweight than women (43.19 vs 30.43%), while obesity and morbid obesity were more common in women than in men (15.02 vs 11.02% and 1.70 vs 0.50%, respectively). Conversely, assessment of the prevalence of overweight and obesity taking age groups into account, indicated statistically significant differences only in the youngest age category, where both variables were more often observed in men than in women (Tab. 3).

Waist circumference. The prevalence of abdominal obesity and overweight by age and gender is presented in Table 4. Almost half of the respondents (48.4%) had their waist circumference indicative of the occurrence of overweight (F 80.0–87.9 cm; M 94.0–101.9 cm), or abdominal obesity (F ≥ 88 cm / M ≥ 102 cm), including abdominal overweight found in 21.2% of the respondents and abdominal obesity in 27.2% of the respondents. The prevalence of abdominal obesity was significantly higher (p < 0.001) in women (39.6%) than in men (14.1%). Furthermore, the incidence of abdominal overweight was higher in the group of women than men (22.1 vs. 20.2%). The prevalence of abdominal obesity and overweight increased with the age of the study population from 32.1% in people aged 19–30 years, through 47.9% in the 31–50 group, to 66.2% in the 51–64 group. The incidence of abdominal obesity was significantly higher in women than in men in each age group. As regards the oldest age group analyzed, almost every second woman (48.6%) had abdominal obesity. In the group of men at this age, abdominal obesity affected 21.9% of the respondents.

Waist-to-height ratio. The ratio of waist circumference to body height indicated an excessive distribution of adipose tissue in the visceral region in over half the respondents (52.4%). Analysis of the prevalence of overweight and obesity measured by the WHtR index showed no statistically significant differences between the groups of men and women, regardless of the age group of the subjects. The highest percentage of respondents with WHtR above 0.5 was found in the oldest age group (Tab. 5).

Correlation between BMI and WHtR. Analysis of the correlation between BMI and WHtR indicated the presence of much stronger relationships. Again, the strongest correlation between those rates was recorded among women aged 31–50 years (r = 0.80; p < 0.001), while in the same age group in men, this correlation was the weakest (r = 0.59; p < 0.001) (Fig. 1).

Chances of becoming overweight and obese. Analysis with the logistic regression model indicated that the chances of developing overweight / obesity measured by the BMI index were dependent on the age and gender of the respondents. It was confirmed that men were over 43% more likely to develop those conditions than women (OR = 1.438; p < 0.001). In addition, the odds also increased with age (OR = 1.046; p < 0.001) (Tab. 6).

Table 1. Socio-demographic sample characteristics by gender in Poland (2017–2020)

Variable	Total (n=2000)	Men (n=999)		Women (n=1001)		χ^2	p-value*
	n	N	%	n	%		
Province							
Lower Silesian (Dolnośląskie)	149	69	6.91	80	7.99	112.529	<0.001
Kuyavian-Pomeranian (Kujawsko-Pomorskie)	119	38	3.80	81	8.09		
Lublin (Lubelskie)	112	54	5.41	58	5.79		
Lubusz (Lubuskie)	44	22	2.20	22	2.20		
Łódź (Łódzkie)	130	91	9.11	39	3.90		
Lesser Poland (Małopolskie)	177	94	9.41	83	8.29		
Mazovian (Mazowieckie)	288	123	12.31	165	16.48		
Opole (Opolskie)	52	25	2.50	27	2.70		
Subcarpathian (Podkarpackie)	113	73	7.31	40	4.00		
Podlasie (Podlaskie)	64	31	3.10	33	3.30		
Pomeranian (Pomorskie)	118	60	6.01	58	5.79		
Silesian (Śląskie)	226	99	9.91	127	12.69		
Świętokrzyskie (Świętokrzyskie)	65	16	1.60	49	4.90		
Warmian-Masurian (Warmińsko-Mazurskie)	76	39	3.90	37	3.70		
Greater Poland (Wielkopolskie)	176	90	9.01	86	8.59		
West Pomeranian (Zachodniopomorskie)	91	75	7.51	16	1.60		
Place of residence							
village	774	391	39.14	383	38.26	27.267	0.001
towns up to 10,000 inhabitants	138	84	8.41	54	5.39		
towns 10–19,000 inhabitants	136	67	6.71	69	6.89		
towns 20–49,000 inhabitants	222	103	10.31	119	11.89		
towns 50–99,000 inhabitants	176	91	9.11	85	8.49		
cities 100–199,000	161	88	8.81	73	7.29		
cities 200–499 thousand inhabitants	178	77	7.71	101	10.09		
cities 500,000–1 million inhabitants	125	70	7.01	55	5.49		
city >1 million inhabitants	90	28	2.80	62	6.19		
Age group							
19–30	489	249	24.92%	240	23.98%	1.729	0.421
31–50	948	482	48.25%	466	46.55%		
51–64	563	268	26.83%	295	29.47%		
Education							
Primary or junior high school	83	49	4.90%	34	3.40%	82.144	<0.001
Vocational	549	348	34.83%	201	20.08%		
Secondary	1012	482	48.25%	530	52.95%		
Tertiary	**356**	**120**	**12.01%**	**236**	**23.58%**		
Financial situation							
We are wealthy, we do not have to save even for larger expenses	10	6	0.60%	4	0.40%	9.835	0.043
The money is enough for all expenses, and we can save some	593	327	32.73%	266	26.57%		
We have enough money to cover everyday expenses, but we can't afford to spend more.	1290	616	61.66%	674	67.33%		
We must deny ourselves many things to have enough money to live on.	93	44	4.40%	49	4.90%		
Money is not enough even for the most urgent needs.	14	6	0.60%	8	0.80%		
Marital status							
Unmarried	526	335	33.53%	191	19.08%	62.371	<0.001
Married/cohabitation relationship	1309	599	59.96%	710	70.93%		
Divorced/separated	119	54	5.41%	65	6.49%		
Widow(er)	46	11	1.10%	35	3.50%		
Professional situation							
Retired/disability pensioner	180	70	7.01%	110	10.99%	9.680	0.002
Parental leave, unemployed, runs the house	162	42	4.20%	120	11.99%	40.696	<0.001
Casual employment	132	61	6.11%	71	7.09%	0.790	0.374
Permanent employment	1471	793	79.38%	678	67.73%	34.866	<0.001
Studies	96	46	4.60%	50	5.00%	0.167	0.683
Cardiovascular diseases[1]							
no	1841	925	92.59%	916	91.51%	0.803	0.370
yes	159	74	7.41%	85	8.49%		

[1] hypertension, a history of stroke, a history of myocardial infarction, coronary heart disease, heart failure, atherosclerosis of the arteries of the lower extremities, lipid disorders.
* chi-squared test

Table 2. Means and Percentiles of BMI (kg/m^2) by sex and age in Poland (2017–2020)

Gender / Age (y-o)	N	Mean (SD)	-95%CI	+95%CI	Percentiles						
					5th	10th	25th	50th	75th	90th	95th
Women											
18–30	240	23.21 (4.42)	22.65	23.77	18.03	18.71	20.55	22.18	25.35	28.65	30.40
31–50	466	25.59 (4.83)	25.15	26.03	19.47	20.44	21.89	24.65	28.37	32.15	34.96
51–64	295	27.46 (5.38)	26.85	28.08	19.03	20.70	23.75	26.93	30.63	34.66	36.50
Men											
18–30	249	25.06 (3.37)	24.67	25.46	20.98	21.53	23.05	24.52	26.62	29.13	31.01
31–50	482	25.91 (3.77)	25.60	26.21	21.89	22.47	23.68	25.18	27.47	30.04	31.20
51–64	268	26.98 (3.15)	26.53	27.43	21.56	22.47	24.53	26.79	28.76	31.58	34.37
Total:											
18–30	489	24.15 (3.93)	23.80	24.50	18.71	19.78	21.60	23.62	25.91	28.83	31.00
31–50	948	25.75 (4.15)	25.49	26.02	20.26	21.13	23.08	24.98	27.92	30.86	33.42
51–64	563	27.23 (4.69)	26.84	27.62	20.21	21.64	24.21	26.83	29.65	33.87	35.38

CI – confidence interval.

Table 3. BMI categories by gender and age in Poland (2017–2020)

Age (y-o) / BMI categories (kg/m^2)	Total				Women				Men				z	p-value*	η^2
	N	%	-95%CI	+95%CI	N	%	-95%CI	+95%CI	N	%	-95%CI	+95%CI			
18–30:															
BMI <18.5	18	3.7	2.0	5.3	18	7.5	4.6	10.4	0	0.0	0.0	0.0			
BMI 18.5-24.9	300	61.4	56.9	65.8	160	66.7	60.8	72.9	140	56.2	50.6	61.4			
BMI 25.0-29.9	141	28.8	24.7	33.1	48	20.0	15.4	24.2	93	37.4	31.7	43.5	-4.689	<0.001	0.045
BMI 30.0-39.9	26	5.3	3.3	7.6	10	4.2	2.1	6.3	16	6.4	4.0	9.2			
BMI ≥40.0	4	0.8	0.2	1.6	4	1.7	0.0	3.3	0	0.0	50.6	61.4			
31–50:															
BMI <18.5	11	1.2	0.5	1.9	10	2.2	1.1	3.2	1	0.2	0.0	0.6			
BMI 18.5-24.9	464	49.1	45.9	52.1	237	51.0	46.6	55.6	227	47.2	42.9	51.9			
BMI 25.0-29.9	348	36.8	33.5	39.7	146	31.4	27.0	35.4	202	42.0	38.0	45.6	-1.006	0.314	0.001
BMI 30.0-39.9	113	12.0	10.0	14.0	66	14.2	11.2	17.1	47	9.8	7.3	12.2			
BMI ≥40.0	10	1.1	0.4	1.7	6	1.3	0.6	2.1	4	0.8	0.2	1.7			
51–64:															
BMI <18.5	11	2.0	0.9	3.2	10	3.4	1.7	5.3	1	0.4	0.0	1.5			
BMI 18.5-24.9	176	31.3	27.7	35.0	93	31.6	26.4	36.9	83	31.0	26.1	36.2			
BMI 25.0-29.9	246	43.8	39.4	47.8	110	37.4	32.5	42.4	136	50.8	45.1	56.0	0.652	0.515	0.001
BMI 30.0-39.9	121	21.5	18.1	25.2	74	25.2	20.7	29.5	47	17.5	13.4	22.0			
BMI ≥40.0	8	1.4	0.5	2.5	7	2.4	1.0	4.1	1	0.4	0.0	1.5			
Total															
BMI <18.5	40	2.0	1.4	2.7	38	3.8	2.7	5.0	2	0.2	0.0	0.5			
BMI 18.5-24.9	940	47.1	44.9	49.4	490	49.1	45.8	52.0	450	45.1	41.9	48.1			
BMI 25.0-29.9	735	36.8	34.7	38.9	304	30.4	27.5	33.5	431	43.2	39.9	46.1	-2.255	0.024	0.003
BMI 30.0-39.9	260	13.0	11.6	14.4	150	15.0	12.8	17.2	110	11.0	9.3	12.9			
BMI ≥40.0	22	1.1	0.7	1.6	17	1.7	1.0	2.5	5	0.5	0.1	1.0			

CI – confidence interval; η^2 – eta squared; y-o – years old.
* Mann-Whitney U test

Table 4. Prevalence of abdominal obesity and abdominal overweight, by gender and age in Poland (2017-2020)

Age (y-o) / WC categories (cm)	Total				Women				Men				χ^2	p-value*
	N	%	-95%CI	+95%CI	N	%	-95%CI	+95%CI	N	%	-95%CI	+95%CI		
19–30:														
F < 80 / M < 94	318	67.9	63.9	72.2	137	57.6	51.7	63.9	181	78.7	73.5	83.5		
F 80.0-87.9 / M 94.0-101.9	73	15.6	12.4	19.0	43	18.1	13.4	23.1	30	13.0	9.1	17.4	28.028	<0.001
F ≥ 88 / M ≥ 102	77	16.5	13.0	19.7	58	24.4	19.3	29.8	19	8.3	4.8	12.2		
31–50:														
F < 80 / M < 94	474	52.0	49.0	55.5	168	37.4	32.7	41.9	306	66.2	62.1	70.6		
F 80.0-87.9 / M 94.0-101.9	187	20.5	17.9	23.4	92	20.5	19.6	24.5	95	20.6	16.9	24.2	105.597	<0.001
F ≥ 88 / M ≥ 102	250	27.4	24.7	30.3	189	42.1	37.4	46.5	61	13.2	10.2	16.2		
51–64:														
F < 80 / M < 94	182	35.8	31.3	40.0	65	23.2	18.2	28.2	117	51.3	45.2	58.3		
F 80.0-87.9 / M 94.0-101.9	140	27.6	23.6	31.7	79	28.2	22.9	33.6	61	26.8	21.1	32.0	52.159	<0.001
F ≥ 88 / M ≥ 102	186	36.6	32.1	40.9	136	48.6	42.5	53.9	50	21.9	16.2	27.6		
Total														
F < 80 / M < 94	974	51.6	49.2	53.8	370	38.3	35.1	41.2	604	65.7	62.5	68.8		
F 80.0-87.9 / M 94.0-101.9	400	21.2	19.4	23.0	214	22.1	19.5	24.6	186	20.2	17.6	22.8	181.893	<0.001
F ≥ 88 / M ≥ 102	513	27.2	25.1	29.3	383	39.6	36.6	43.1	130	14.1	11.9	16.3		

Abdominal overweight: Men (M): WC 94-101.9 cm; Women (F): WC 80-87.9 cm
Abdominal obesity: Men (M): WC ≥ 102; Women (F): WC ≥ 88 cm
CI – confidence interval
* chi-squared test

Table 5. WHtR categories by gender and age in Poland (2017–2020)

Age (y-o) / WHtR categories	Total				Women				Men				χ^2	p-value*	OR (95%CI)
	N	%	-95%CI	+95%CI	N	%	-95%CI	+95%CI	N	%	-95%CI	+95%CI			
18–30:															
≤0.5	299	63.9	59.2	68.4	160	67.2	60.9	73.1	139	60.4	54.3	66.1	2.339	0.126	1.34 (0.92–1.96)
>0.5	169	36.1	31.6	40.8	78	32.8	26.9	39.1	91	39.6	33.9	45.7			
31–50:															
≤0.5	433	47.5	44.3	50.8	216	48.1	43.7	52.8	217	47.0	42.6	51.5	0.118	0.731	1.05 (0.81–1.36)
>0.5	478	52.5	49.2	55.7	233	51.9	47.2	56.3	245	53.0	48.5	57.4			
51–64:															
≤0.5	167	32.9	28.7	36.8	98	35.0	29.3	40.4	69	30.3	24.6	36.8	1.278	0.258	1.24 (0.85–1.80)
>0.5	341	67.1	63.2	71.3	182	65.0	59.6	70.7	159	69.7	63.2	75.4			
Total															
≤0.5	899	47.6	45.5	49.9	474	49.0	45.6	52.2	425	46.2	42.6	49.2	1.505	0.220	1.12 (0.93–1.34)
>0.5	988	52.4	50.1	54.5	493	51.0	47.8	54.4	495	53.8	50.8	57.4			

OR – odds ratio; CI – confidence interval; y-o – years old.
* chi-squared test

Table 6. Overweight / obesity (BMI ≥ 25.0 kg/m^2) prediction regression model

	OR	-95% CI	+95% CI	Wald stat.	p-value
Intercept	0.136	0.096	0.191	130.066	<0.001
Gender (F vs M)	1.438	1.197	1.727	15.111	<0.001
Age (y-o)	1.046	1.038	1.054	135.925	<0.001
Intercept	0.015*	0.001	0.259	8.391	0.004
Gender (F vs M)	1.443*	1.177	1.767	12.505	<0.001
Age (y-o)	1.035*	1.024	1.046	40.659	<0.001

OR – odds ratio; CI – confidence interval; F – women; M – men; y-o – years old.
* adjusted Odds Ratio: place of residence, education, financial situation, marital status of the respondents, professional situation and the presence of cardiovascular disease

Table 7. Obesity (WHtR > 0.50) prediction regression model

	OR	-95% CI	+95% CI	Wald stat.	p-value
Intercept	0.164	0.116	0.233	103.238	<0.001
Gender (F vs M)	1.185	0.982	1.429	3.126	0.077
Age (y-o)	1.046	1.038	1.054	125.069	<0.001
Intercept	0.024*	0.001	0.384	6.923	0.009
Gender (F vs M)	1.221*	0.991	1.504	3.521	0.061
Age (y-o)	1.034*	1.023	1.046	36.567	<0.001

OR – odds ratio; CI – confidence interval; F – women; M – men; y-o – years old.
* adjusted Odds Ratio (OR): place of residence, education, financial situation, marital status of the respondents, professional situation and presence of cardiovascular disease.

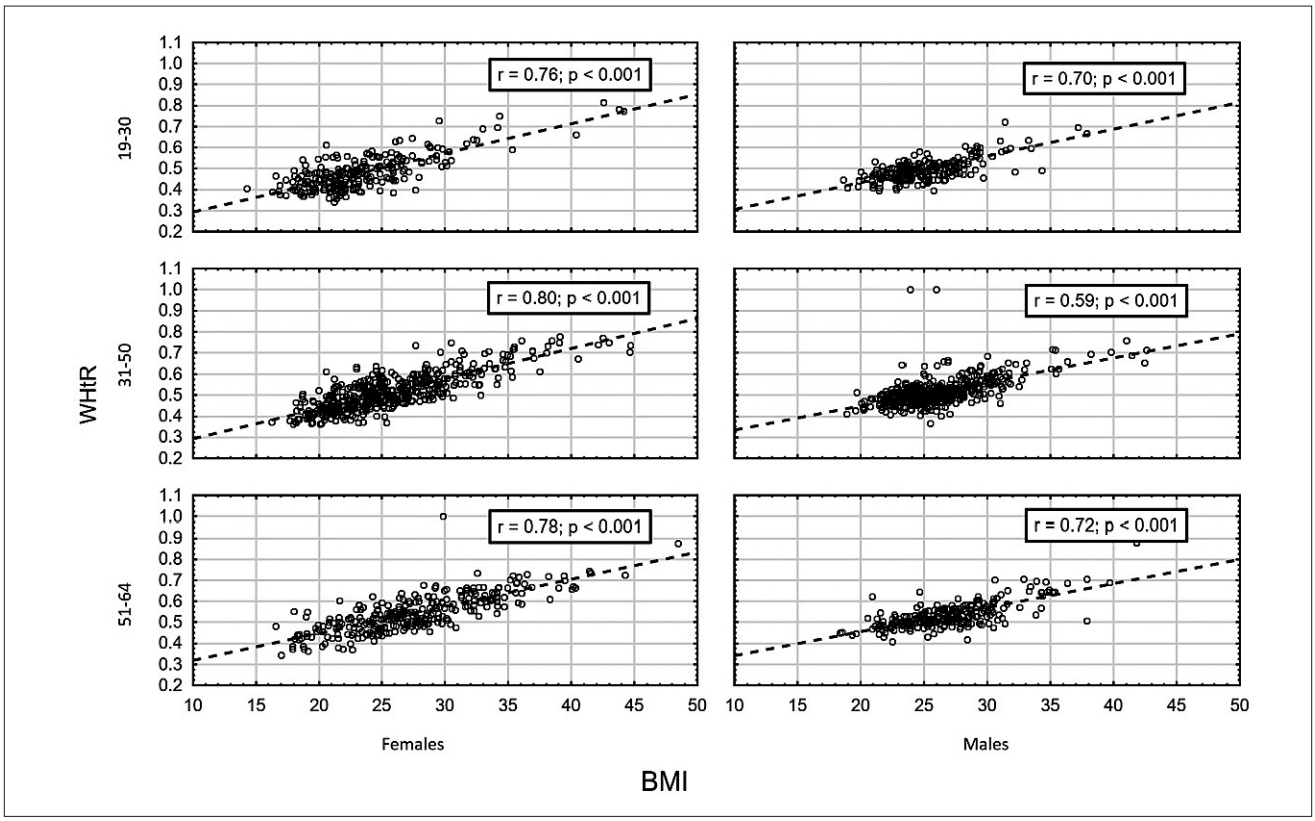

Figure 1. Correlation between BMI and WHtR indices by gender and age in Poland (2017–2020) (Pearson's r correlation coefficient).

The logistic regression analysis model indicated that the chances of developing obesity measured by the WHtR index were dependent on the age, but not on the gender of the respondents. It was found that the chances of developing obesity increased with age (OR = 1.046; p < 0.001) (Tab. 7).

DISCUSSION

The average BMI in this study was slightly over 25 kg/m^2 in Poland, and increased with the age of the study population. Both overweight and obesity were more common in men.

On the basis of the survey, it was satisfying to find that the prevalence of overweight and obesity has decreased in the adult population of Poland, reaching values from surveys published in 2000 [21]. In the group of men, the proportion of respondents with a BMI indicating excessive body weight decreased by 12.3% and in women by 5.9%, compared with the WOBASZ II study [6].

The WOBASZ study included a population aged 20–74 years, while the present study was conducted in people aged 19–64 years. It is also worth mentioning the results of a study conducted in Poland as part of a project co-financed by the EFSA (European Food Safety Authority) and the Polish Ministry of Science and Higher Education [22], in which it was found that excess body weight in people aged 18 years and over occurred in 68.9% of men and 48.2% of women, including obesity found in 16.5% of men and 16.2% of women. The current study, which included people aged 19–64, showed that excessive body weight affected every second person: 55% of men and 47% of women, including obesity in 11.5% and 16.7% of the respondents, respectively. It also demonstrated that the percentage of people with excessive body weight increased with age, which may explain the higher results obtained in the study by Stoś et al., who described the results for an entire adult population.

Based on the analysis of the logistic regression model, in which the OR was adjusted to the place of residence, education, financial situation, marital status of the respondents, professional situation and the presence of cardiovascular disease, it was found that men were more at risk of developing excess body weight, and this phenomenon intensified with the age of the respondents.

According to a multicentre study, the results of which were published in *Obesity Facts* in 2017:

(…) when comparing countries it is important to compare 'like with like'. Ideally, the data should have been collected in a uniform manner using similar procedures and with stratification for age, social class and gender – all of which have a pervasive influence on obesity [23].

Although such comparisons are difficult, presenting the situation in individual countries is very valuable.

Analyzing the available data, it can be concluded that in Spain (2014–2015) – 21.6% of adults aged 25–64 were obese (22.8% men and 20.5% women). In a similar period (2013–2014), obesity was present in 25% of adult inhabitants of Poland, and the prevalence decreased to 14.1% [26].

There is a high percentage of overweight people in the UK, where 67% of men and 60% of women are overweight. including obesity in 26% and 29% of the subjects, respectively [24].

The Australian Bureau of Statistics National Health Survey (2017–2018) report indicates that the prevalence of overweight and obesity has increased in the adult population compared to the 2014–2015 study, from 63.4% – 67%. Also in the United States, the percentage of people with excess body weight is still very high. According to the 2017–2018 National Health

and Nutrition Examination Survey (NHANES) data, every 7th resident had excessive body mass, including 42.4% of obese people.

According to data published by the Organization for Economic Cooperation and Development (OECD) over the past decade, the prevalence rate of overweight and obesity increased in Canada, France, Mexico, Switzerland and the United States, while it stabilized in England, Italy, Korea and Spain [26]. Also, the results of the current study seem to indicate stabilization.

When discussing the issue of excess body weight, attention should be paid to the distribution of fat in the body. The greatest risk to health is associated with the distribution of the adipose tissue in the visceral area with fat surrounding the organs of the abdominal cavity, worsening their efficiency and functioning. Abdominal body fat distribution is an important risk factor for several diseases, such as cardiovascular diseases, stroke, CVD, hypertension, and type 2 diabetes [17,27].

Both waist circumference and BMI are positively associated with morbidity and mortality regardless of age, gender, and ethnicity. A strong relationship was observed between those variables in cohort studies. It is also known that, regardless of BMI, there is a significant variation in waist circumference. Moreover, in any BMI category, adults with higher waist circumference values are more likely to experience adverse health risks compared to people with lower waist circumference [28]. It is worth noting different interpretations of waist circumference test results. As demonstrated in a study by Ross et al. presenting the Consensus Statement from the IAS and ICCR Working Group on Visceral Obesity, different cut-off points are used to estimate the prevalence of abdominal obesity. However, regardless of the population, a steady average increase in waist circumference over time is observed. As shown in this study, a reversal of this unfavourable trend seems to have been observed, especially among adult men. Compared to 2013, the percentage of excessive waist circumference decreased by 23.6% in men (57.9% vs. 34.3%), and by 2.9% in women (64.6% vs. 61.7%). It is worth noting a significant decrease (by 16.6%) in the percentage of men with abdominal obesity (30.7% vs. 14.1%). The respective value decreased by 2.6% in women (42.2% vs. 39.6%). Moreover, it should be emphasized that although the 2013 study concerned the population aged 20–74, the age was standardized. Despite favourable changes in waist circumference, it should be noted that almost half of the study population was characterized by the excessive distribution of the adipose tissue in the abdominal area. The WC value indicated the presence of abdominal obesity in over 27% of the respondents, and abdominal overweight was found in 21%. The analysis of WC values indicated that Polish women very often struggled with this type of obesity as young as at 31–50 years of age. This problem occurred in 42% of the respondents. As regards the oldest age group, over 48% of women and 22% of men were characterized by abdominal obesity. This may be related to hormonal changes in women during menopause, and an increase in the distribution of the adipose tissue in the abdominal area [29].

Since excessive distribution of the adipose tissue in the abdominal area is a risk factor for the development of cardiovascular diseases, the National Cardiac Societies [17] recommend that people with a waist circumference indicative of abdominal obesity lose weight.

Analysis of data based on the WHtR index, where the cut-off point value did not depend on gender, showed the accumulation of the adipose tissue in the abdominal area in 52% of the respondents. The prevalence of this phenomenon increased with the age of the respondents, amounting to 36.1% in people aged 19–30 and 67.1% in those aged 51–64 years. This relationship occurred regardless of gender, and the differences between men and women were statistically insignificant.

Due to ethnic differences and body structure in individual populations of the world, international comparisons of anthropometric measurements of circumferences and body height are difficult.

Although the measurements and analyses of the current study indicate an improvement in the situation in recent years, there is still a significant risk of developing metabolic diseases related to obesity, especially abdominal obesity in women. Analysis of the obtained results in relation to the incidence of some of them, physical activity and diet will allow for better characteristics of the studied population.

Strengths and limitations of the study.

Advantages:

1) conducting the research in a representative group (2000) of the inhabitants of Poland aged 18–64;
2) performing anthropometric measurements by interviewers (until the outbreak of the COVID-19 epidemic);
3) a comprehensive epidemiological study in which anthropometric indices may be used to analyze the relationship between these parameters and diet, health and physical activity;
4) this is the first study of this type, allowing such a broad diagnosis of the nutritional status of the adult Polish population based on anthropometric measurements.

Weaknesses:

The main weakness was changing the way data were collected during the pandemic. The COVID-19 epidemic forced the abandonment of surveys in respondents' homes, and thus modified the data collection methodology. This may have affected the quality of anthropometric surveys. Measurements taken by respondents on their own, despite detailed instructions, may have been less accurate than those taken by trained, experienced interviewers.

CONCLUSIONS

Every second resident of Poland aged 18–64 has excess body weight. This phenomenon occurs much more commonly in men than in women, with women suffering more often from obesity. The visceral distribution of the adipose tissue dominates in the Polish population, which is a serious risk factor for metabolic diseases. The chances of developing abdominal obesity in the studied population increases with age. In order to better characterize the study population and determine the risk of diet-related diseases, it is necessary to conduct further analyses using data on blood pressure, physical activity and dietary habits, and compare them with socio-demographic data.

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