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PHYSICAL ACTIVITY AND DIETARY HABITS IN YOUNG FEMALES WITH VARYING LEVELS OF BODY FAT AND FAT DISTRIBUTION

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Abstract

Introduction. Physical activity and good diet are the primary determinants of body weight. The aim of the study was to compare physical activity and eating behaviours of overweight and obese females (taking into consideration their body fat distribution) with individuals with normal levels of body fat. ***Material and methods.*** The study included females aged 20-35. The study group consisted of 449 subjects, who were categorised into groups based on their body fat percentage: underweight, normal body fat, overweight and obese. The WHR index was computed in individuals who were overweight or obese. The assessment of physical activity levels was conducted using data obtained from the IPAQ, while eating behaviours were examined using the Dietary Habits And Nutrition Beliefs Questionnaire developed by the Polish Academy of Sciences. ***Results.*** Females who were overweight or obese exhibited greater values of the examined physical characteristics in comparison to individuals with normal levels of body fat. Subjects with fat tissue in the abdomen area had higher values of somatic characteristics. There were no statistically significant differences in physical activity levels between individuals with normal body fat and overweight or obese females. However, when the second group was divided into those with abdominal fatness and those with peripheral fatness, it was observed that individuals with abdominal fatness had lower levels of physical activity, including both total activity as well as vigorous and moderate activity. There were no significant differences in eating behaviours found between the groups. ***Conclusions.*** The amount and placement of fat tissue in young females is more closely linked to their levels of physical activity rather than their eating habits and knowledge about food and nutrition.

Key words: women, physical activity, dietary habits, fat distribution

Introduction

Physical activity and good diet, together with heredity, are the primary determinants of body weight, including body fat. Physical activity plays a significant role in promoting preventive health by positively impacting cardiovascular, respiratory, skeletal, and muscular health [1, 2]. Research has demonstrated that engaging in physical activity can have beneficial impacts on mental well-being, such as enhancing mood, boosting self-esteem, and decreasing symptoms of anxiety and depression [3, 4]. Furthermore, lack of regular physical activity can significantly contribute to the development of at least 20 chronic diseases, such as those affecting the cardiovascular and respiratory systems, musculoskeletal system, neurological system, and metabolism (including obesity), as well as cancer [5, 6].

Optimal nutrition is achieved by following appropriate dietary patterns and behaviours, along with selecting certain items that can meet the body's energy requirements and supply critical macro- and micronutrients [7]. Research on dietary habits of various population groups suggests that fundamental nutritional principles are seldom adhered to. Modern humans consume an excessive amount of simple carbohydrates and fat, which includes saturated fatty acids and cholesterol. However, their diet lacks an adequate supply of vitamins, minerals, and fibre. This dietary pattern has been supported by studies conducted by Mazurek Melnyk, Slevin, Militello, Teall, and McGovern in 2016, as well as Goluch in 2021 [8, 9]. This leads to the buildup of surplus energy in the body, which is stored as fat tissue, resulting in overweight and obesity [10].

Obesity, a chronic condition associated with modern society, is increasingly prevalent in Poland and globally, reaching epidemic proportions in the 21st century [11]. Based on OECD assumptions, it is projected that between 2020 and 2050, the presence of overweight and its associated diseases will reduce people's life expectancy by approximately 3 years. This will also affect social inequalities as there will be more work absences and reduced productivity among individuals with excess body fat. Additionally, the expenses related to treating obesity-related diseases will further contribute to these issues [12]. Hence, it is crucial to prioritise the prevention of obesity and its associated consequences, as well as the promotion of physical exercise among individuals of all ages, including children, adolescents, and adults [13, 14].

The objective of the study was to compare physical activity and nutritional habits of overweight and obese females (taking into consideration their body fat distribution) with individuals with normal weight.

Material and methods

Research material

The study included 449 females aged 20-35. The subjects were students from two universities in Biala Podlaska (n = 378, age 20-27), as well as female teachers aged 25-35 who were employed at schools located in Biała Podlaska (n = 71, age 27-35). The mean age of the participants was 24.3 years.

Methods

During the study, we assessed the subjects' body build and body composition by gathering data from a body composition analyser IOI 353 and taking essential anthropometric measurements, such as waist and hip circumference, using an anthropometric tape. The females were divided into groups based on their body fat percentage: underweight, normal body fat, overweight, and obese. Table 1 displays the number of individuals in each group, categorised according to their body fat percentage. Underweight subjects were excluded from the subsequent analysis. The waist-to-hip ratio (WHR) index was used to assess the kind of fat distribution in overweight and obese individuals. A WHR value greater than 0.85 indicates abdominal fatness, whereas a WHR value less than 0.85 indicates peripheral fatness (Tab. 1).

Table 1. Number of subjects in groups selected on the basis of body fat percentage and WHR

Groups	n
Underweight	78
Normal body fat	232
Overweight and obesity	139
WHR < 0.85	126
WHR ≥ 0.85	13

The level of physical activity was evaluated in individuals with normal body fat as well as in overweight and obese individuals using data collected from the International Physical Activity Questionnaire [15]. Data on dietary behaviours and knowledge of food and nutrition were obtained from selected questions in the Dietary Habits and Nutrition Beliefs Questionnaire developed by the Polish Academy of Sciences (KomPAN) [16]. The above mentioned questionnaire was used to measure the knowledge of the questioned subjects regarding food and nutrition. This assessment was based on the respondents' answers to 25 questions from the KomPAN questionnaire. Each accurate response was assigned a score of 1 point, whilst incorrect answers or responses marked as 'difficult to determine' received no points. The mean and standard deviation of the sum of properly answered questions were computed for both the group with normal body fat and the overweight or obese subjects. Calculations of a similar nature were conducted on groups of females who were divided based on their WHR values. The level of nutritional knowledge was calculated based on the overall score of each subject, using the technique of the KomPAN questionnaire. A score of 17-25 points was considered good, 9-16 points were considered sufficient, and 0-8 points were considered insufficient.

The study was conducted following the principles of the Declaration of Helsinki. The Scientific Research Ethics Committee of Józef Piłsudski University of Physical Education in Warsaw provided ethical approval (SKE 01-24/2017).

Statistical analysis

Statistical significance of differences in quantitative features was assessed using the Welch test (when a normal distribution of the measurement data was found), or the Mann-Whitney U test, assuming a non-normal distribution of data. The $\chi 2$ test was used to evaluate the significance of differences in qualitative parameters. The calculations were performed using STATISTICA 13.3 software.

Results

When evaluating the body composition of overweight and obese females in comparison to individuals with normal body fat, it was noted that overweight and obese subjects had elevated values for all examined physical characteristics and measurements. The differences between the cohort of females with normal body fat and the cohort with overweight or obesity were found to be extremely significant in all of the assessed characteristics and indicators of body composition. When considering the above mentioned indicators in overweight and obese females, who were categorised based on the distribution of fat tissue (abdominal or peripheral fatness), it was shown that females with fat tissue in the abdomen region had higher values for all physical characteristics. The statistical analysis revealed significant differences between the values of the PBF (percent body fat) and MBF (mass of body fat) indices, as shown in Table 2.

The study proceeded to examine physical activity levels of the female participants, considering their overall, vigorous and moderate activity, as well as physical activity related to walking and the duration of sitting. There were no significant differences in overall and moderate physical activity levels between individuals with normal body fat and overweight and obese females. Overweight and obese females exhibited greater levels of vigorous physical activity, while simultaneously spending more time

Table 2. Characteristics of somatic features of the subjects in groups selected on the basis of body fat percentage and WHR

Characteristics	Normal body fat		Overweight and obesity		Statistical test		WHR < 0.85		WHR ≥ 0.85		Statistical test	
	x	SD	x	SD	Z/t	p	x	SD	x	SD	Z/t	p
PBF	25.27	2.89	34.62	3.84	Z = -16.126	**0.000***	34.21	3.48	38.66	4.91	Z = -3.389	**0.001***
MBF	15.20	2.67	25.90	6.44	Z = -15.767	**0.000***	25.15	5.35	33.17	10.73	Z = -3.548	**0.000***
LBM	44.60	2.82	48.03	4.04	Z = -8.926	**0.000***	47.70	3.61	51.22	6.28	t = -1.988	0.069
TBW	31.40	2.18	34.40	3.06	Z = -9.917	**0.000***	34.14	2.71	36.94	4.79	t = -2.080	0.058
SLM	42.18	2.64	45.11	4.01	Z = -7.836	**0.000***	44.85	3.66	47.56	6.18	t = -1.551	0.145

* – statistically significant differences at $p < 0.05$; Z – Mann-Whitney U test; t – Welch test; PBF – Percent Body Fat; MBF – Mass of Body Fat; LBM – Lean Body Mass; TBW – Total Body Water; SLM – Soft Lean Mass.

Table 3. Physical activity of subjects in groups selected on the basis of body fat percentage and WHR

Type of activity	Normal body fat		Overweight and obesity		Mann-Whitney U test		WHR < 0.85		WHR ≥ 0.85		Mann-Whitney U test	
	x	SD	x	SD	Z	p	x	SD	x	SD	Z	p
Total activity (MET-min/week)	2374.91	2576.35	2349.73	3484.31	0.7986	0.4245	2515.44	3629.15	858.36	734.50	2.446	**0.014***
Vigorous activity (MET-min/week)	1043.45	1164.42	1420.57	1778.84	-1.6776	0.0934	1483.08	1828.81	608.00	454.24	1.289	0.198
Moderate activity (MET-min/week)	664.54	871.00	665.44	867.34	0.0820	0.9347	694.73	897.73	343.33	263.64	1.121	0.263
Walking	31.40	2.18	34.40	3.06	Z = -9.917	0.000*	34.14	2.71	36.94	4.79	t = -2.080	0.058
(MET-min/week)	1368.26	1896.14	1235.91	1774.60	0.4968	0.6194	1326.91	1850.38	450.00	352.20	2.165	**0.030***
Sitting (min/day)	268.74	238.03	293.04	230.42	-1.0674	0.2858	283.74	228.31	381.82	242.69	-1.404	0.160

* – statistically significant differences at p < 0.05.

engaged in sedentary behaviour compared to individuals with a normal body fat percentage. Subjects with normal body fat had a greater level of physical exertion when walking, with a difference of 132.35 MET-min/week. There were no significant changes in any of the measured physical activity markers, based on statistical analysis. When categorising overweight or obese individuals based on their waist-to-hip ratio (WHR), it was shown that participants with abdominal fat had lower levels of physical activity (significant differences were noted in overall activity and walking). Individuals in this particular group spent a little more time in a sedentary position compared to females who have a fat distribution that is more concentrated in the periphery (Tab. 3).

The current study additionally evaluated dietary habits of the females included in the study considering factors such as the quantity and consistency of meals consumed, the frequency of consuming specific food categories, the frequency of snacking between meals, and the frequency of dining out (Tab. 4-8). There were no discernible differences in eating behaviours across the groups. The majority of individuals, regardless of their body fat distribution, who had normal body fat as well as those who were overweight or obese, reported consuming four or more meals each day. However, only a small number of individuals consistently followed this eating pattern. Moreover, most participants consumed food outside of regular meal times. The prevailing patterns indicated that they engaged in between-meal eating either on a daily basis or between 1 to 6 times per week. It was observed that females with abdominal fatness had a lower frequency of snacking between main meals, which was statistically significant when compared to those with peripheral fatness.

Table 4. Number of meals consumed per day by subjects with varying levels of body fat and WHR

Groups	2 meals		3 meals		4 and more meals		Mann-Whitney U test	
	n	%	n	%	n	%	Z	p
Normal body fat	11	6.2	59	33.1	108	60.7	-0.265	0.791
Overweight and obesity	8	6.9	35	30.2	73	62.9		
WHR < 0.85	6	5.7	31	29.5	68	64.8	1.225	0.221
WHR ≥ 0.85	2	18.2	4	36.4	5	45.5		

Table 5. Regularity of meal consumption by subjects with varying levels of body fat and WHR

Groups	No		Yes, but only some		Yes, all		Mann-Whitney U test	
	n	%	n	%	n	%	Z	p
Normal body fat	73	41.0	96	53.9	9	5.1	-1.080	0.280
Overweight and obesity	55	47.4	54	46.6	7	6.0		
WHR < 0.85	48	45.7	51	48.6	6	5.7	-1.183	0.237
WHR ≥ 0.85	7	63.6	3	27.3	1	9.1		

Table 6. Snacking between meals by subjects with varying levels of body fat and WHR

Groups	Up to 3 times a month		1-6 times a week		Every day		Mann-Whitney U test	
	n	%	n	%	n	%	Z	p
Normal body fat	16	9.0	81	45.5	81	45.5	1.310	0.190
Overweight and obesity	15	12.9	57	49.1	44	37.9		
WHR < 0.85	12	11.4	50	47.6	43	41.0	2.040	**0.041***
WHR ≥ 0.85	3	27.3	7	63.6	1	9.1		

Table 7. Frequency of consumption of selected food groups by subjects with varying levels of body fat and WHR

	Groups	Rarely		At least once a week		Once a day		Several times a day		Mann-Whitney U test	
		n	%	n	%	n	%	n	%	Z	p
Fried dishes	Normal body fat	40	22.5	133	74.7	4	2.2	1	0.6	0.504	0.614
	Overweight and obesity	30	25.9	83	71.6	3	2.6	0	0.0		
	WHR < 0.85	26	24.8	77	73.3	2	1.9	0	0.0	0.320	0.749
	WHR ≥ 0.85	4	36.4	6	54.5	1	9.1	0	0.0		
Fruit	Normal body fat	7	3.9	107	60.1	38	21.3	26	14.6	-1.205	0.228
	Overweight and obesity	4	3.4	62	53.4	26	22.4	24	20.7		
	WHR < 0.85	4	3.8	57	54.3	24	22.9	20	19.0	-1.041	0.298
	WHR ≥ 0.85	0	0.0	5	45.5	2	18.2	4	36.4		
Vegetables	Normal body fat	7	3.9	98	55.1	38	21.3	35	19.7	-0.889	0.374
	Overweight and obesity	9	7.8	50	43.1	28	24.1	29	25.0		
	WHR < 0.85	9	8.6	46	43.8	24	22.9	26	24.8	-0.886	0.376
	WHR ≥ 0.85	0	0.0	4	36.4	4	36.4	3	27.3		
Sweets	Normal body fat	29	16.3	109	61.2	21	11.8	19	10.7	0.856	0.392
	Overweight and obesity	23	19.8	70	60.3	17	14.7	6	5.2		
	WHR < 0.85	21	20.0	62	59.0	16	15.2	6	5.7	0.462	0.644
	WHR ≥ 0.85	2	18.2	8	72.7	1	9.1	0	0.0		

Table 8. Frequency of eating out by subjects with varying levels of body fat and WHR

Groups	Up to 3 times a month		1-6 times a week		Every day		Mann-Whitney U test	
	n	%	n	%	n	%	Z	p
Normal body fat	113	63.5	40	22.5	25	14.0	0.266	0.790
Overweight and obesity	76	65.5	24	20.7	16	13.8		
WHR < 0.85	67	63.8	23	21.9	15	14.3	0.938	0.348
WHR ≥ 0.85	9	81.8	1	9.1	1	9.1		

When examining the frequency of consumption of specific food groups, there were no discernible differences between overweight or obese females and subjects with normal body fat. When evaluating the frequency of consuming fried meals, fruit, vegetables, and sweets, most participants reported consuming these items at least once per week. When evaluating the frequency of intake of products typically seen as healthy, such as fruit and vegetables, it was observed that overweight and obese females more frequently selected the responses 'once a day' and 'many times a day'. Conversely, individuals who were overweight or obese were more inclined to report consuming fried meals and sweets occasionally, compared to those with a normal body fat percentage. This is particularly relevant for products that are known to potentially lead to excessive body weight. A similar situation occurred when overweight and obese women were divided into groups according to WHR values. Women with higher WHR values (indicating accumulation of fat in the abdominal region) were more likely to consume fruit and vegetables and less likely to consume fried foods than women with WHR values less than 0.85, as shown in Table 7.

The women surveyed rarely ate meals outside the home. No discernible differences were observed between overweight and obese females and females with normal body fat. No statistically significant differences were found when dividing the overweight and obese subjects into groups based on the value of the WHR index. However, a trend was observed indicating that females with a WHR index lower than 0.85, indicating a peripheral distribution of body fat, had a higher frequency of consuming meals away from home (Tab. 8).

No significant differences were found in the food and nutrition knowledge between overweight and obese females and individuals with normal body fat. The majority of respondents had a satisfactory degree of nutritional awareness, while a slightly higher percentage in the group with normal body fat scored less than 9 points on the quiz, indicating insufficient understanding. When the participants with excessive body fat were divided into groups based on their waist-to-hip ratio (WHR) values, it was shown that ladies with WHR values ≥ 0.85, indicating abdominal fat distribution, had a higher level of knowledge. Within this group, there were no individuals who lacked sufficient nutritional awareness, and a greater percentage of individuals had a strong degree of understanding, as shown in Figure 1.

Discussion

Sufficient body fat is a crucial factor in preserving optimal health during the later stages of life. Based on a study conducted by the World Health Organisation (WHO), it is projected that by 2022, almost 2.5 billion people globally will be classified as overweight, and one out of every eight individuals worldwide

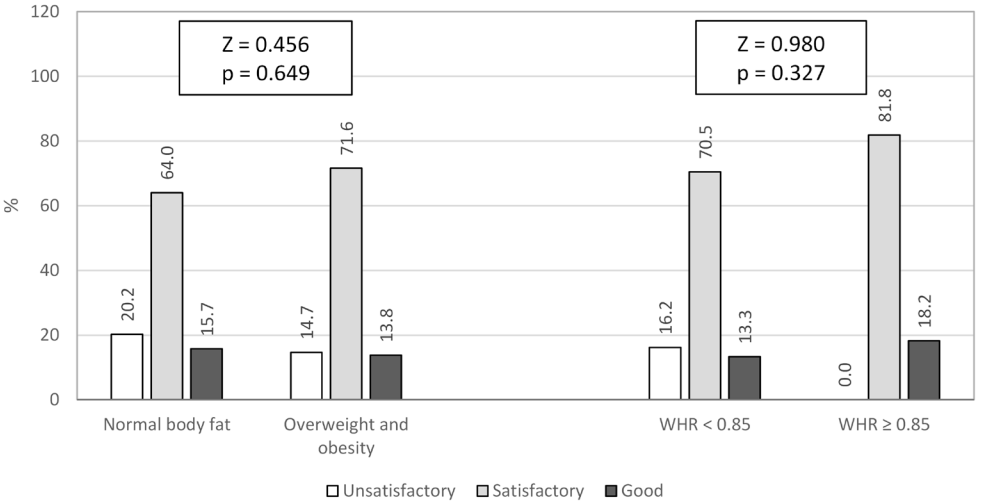

Figure 1. Level of knowledge on food and nutrition of subjects in groups selected on the basis of body fat percentage and WHR

will face the challenge of obesity [17]. This issue is impacting individuals of ever younger ages, as our own investigation also confirms. As many as 33% of female respondents between the ages of 20 and 35 had a high amount of body fat. In 9.4% of subjects, adipose tissue was situated in the abdominal area. This particular kind of obesity is highly associated with metabolic abnormalities and serves as an indicator for cardiovascular disease [18].

Environmental elements that can positively impact the reduction of fatness levels include physical exercise and good nutrition. In our study, we evaluated the level of physical activity between overweight and obese females and normal participants [19, 20]. Surprisingly, we found no significant differences between the groups. In fact, overweight and obese females engaged in more rigorous physical activity than normal subjects. These females may have been attempting to decrease their body weight by engaging in rigorous training or other forms of high-intensity physical exercise. This is corroborated by a study conducted by Suryadinata et al [21], which found that obese individuals had elevated levels of vigorous and moderate physical activity. Regrettably, it is also plausible that obese participants may have exaggerated or deliberately underestimated their level of physical activity, as is known to occur in survey studies [22].

Upon categorising the individuals based on their WHR values, it was noted that there were statistically significant differences in physical activity between the groups. Specifically, females with lower WHR values, indicating a distribution of body fat towards the periphery, exhibited higher levels of physical activity. Obese individuals sometimes view their excess body weight, particularly in the stomach area, as a hindrance to their physical activity [22].

No significant differences were observed in the dietary behaviours of the female participants between the group with normal body fat and the group with excess body fat. Interestingly, it was found that those with excess body fat reported consuming products that are generally considered healthy and recommended for weight loss due to their high fibre and vitamin content and low energy density, such as vegetables and fruit. Individuals with higher body weight also reported a lower frequency of consuming items that are known to lead to weight gain, such as fried foods and sweets. The study conducted by Huk-Wieliczuk et al. [23] revealed that there were differences in the diets of overweight adolescents compared to their peers with normal weight and height proportions, as measured by BMI values. BMI is commonly used in population studies to determine the prevalence of overweight and obesity. Nevertheless, the study observed that overweight adolescents exhibited reduced calorie intake and consumed lower amounts of fat, protein, and carbs in comparison to their counterparts with normal BMI values. The authors hypothesised that the unexpected findings may be attributed to the possibility that the surveyed teens either failed to acknowledge their consumption of sweets and other high-calorie snacks between meals, or underestimated the amount they consumed.

When evaluating the knowledge level of female participants regarding food and nutrition, there were minor variations between the group with normal body fat and the group with excessive body fat. However, these differences were not statistically significant. The individuals who had an excessive amount of body fat were more likely to have an adequate level of knowledge, and the highest percentage of these individuals was found in the group with abdominal obesity. According to Wyleżoł et al. [24], when evaluating the extent of knowledge on obesity among Polish individuals, they observed that there were adverse associations between knowledge about nutrition and BMI measurements. Consequently, individuals with a normal BMI had a greater understanding of obesity, whereas those with a high BMI demonstrated a poorer degree of knowledge on nutrition. This association was observed in females aged 60 and above, and in males aged below 40. Platta and Martul [25], however, found that parental awareness of the influence of unhealthy eating habits on the development of childhood obesity was insufficient. They concluded that further health education in this domain was necessary. Having a more comprehensive understanding of obesity-related matters could potentially have a beneficial influence on their children's ability to manage their weight. Widespread lack of information has been documented among medical professionals and students in health-related fields of study [26, 27], indicating insufficient levels of understanding in these areas.

Conclusion

1. Overweight and obese subjects were characterised by higher values of the analysed somatic traits compared to subjects with normal body fat.

2. No statistically significant differences in the level of physical activity were observed between subjects with normal body fat and overweight and obese subjects, whereas when dividing the subjects in the second group into those with abdominal and peripheral fatness, it was noted that physical activity (both total as well as vigorous and moderate) was lower in subjects with abdominal fatness.
3. No significant differences in eating habits were found between the groups.
4. Adipose tissue content and distribution in young females is more strongly associated with physical activity than eating habits and knowledge on food and nutrition.

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