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ORIGINAL ARTICLE

Leisure time physical activity of young women from the Carpathian Euroregion in relation to the Body Mass Index

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Abstract

The Carpathian Euroregion comprises the population of 5 countries, including Poland, Slovakia, Hungary and Romania – members of the European Union, as well as the Ukraine. Young women are statistically less involved in high-intensity physical activity than young men. The objective of this study was to assess the relationship between physical activity of young women aged 18–21 years and the BMI and conditioning factors. The study was conducted between 2010–2011 among 2,339 women. The Minnesota Leisure Time Physical Activity Questionnaire (MLTPAQ) was applied. It results from the study that 74.2% of young women are considered to have the proper BMI rate (18.5–24.9). As many as 16.2% are considered underweight and almost 10% have a higher BMI rate and are overweight. More than one third of respondents did not achieve the level of physical activity of 1,000 kcal/week, which is the minimum recommended amount of leisure physical activity time per week. In the case of women with low level of physical activity (<1,000 kcal), as many as 52% of the week activity is considered low-intensity activity EEPAlight. The character of changes of the BMI index with reference to the level of physical activity is very similar in women from towns/cities and women from villages. An increase of BMI along with the total physical activity was related to the increase of free fat mass FFM, despite of the level of physical activity.

Key words

physical activity, women, Body Mass Index, MLTPAQ

INTRODUCTION

The presented epidemiology study considered the impact of physical activity and Body Mass Index on the health state of women on their mortality [1, 2]. The epidemic of overweight increase among children and youths is observed worldwide, including Poland, and is followed by a decrease of physical activity [3]. Adult Poles have increasing problems with body mass control, and overweight and obesity are common problems. An increase in body mass is observed in all age groups; however, it usually concerns relatively young men (20–39 yrs) and women (20–49 yrs) [4]. It is stated that a high BMI in women is more related to biomarkers of cardiovascular disease than lack of physical activity [5]. In white Caucasian adults, overweight and obesity (and possibly underweight) are associated with increased all-cause mortality. All-cause mortality is generally lowest with a BMI of 20.0–24.9 [6]. It is emphasized that physical activity during leisure time is beneficial [7]. The low level of physical activity is only given and its minimal amount is related to an energy expenditure below 1,000 kcal during per week. An optimal amount has not yet been given. Regular participation in different forms of activity which require an energy expenditure between 700–2000 kcal per week significantly decreases mortality due to cardiovascular diseases and general mortality [8, 2]. Similar studies [9] show that leisure time physical activity has been hypothesized to protect against cardiovascular mortality. Statistically less young women than men are engage in high-intensity physical activity [10, 11]. Data available on studies conducted with the use of the Minnesota Leisure Time Physical Activity Questionnaire MLTPAQ [12] among people aged 35–74 yrs show that the relationship between the physical activity of women in comparison to men also relate to the further stages of ontogenesis. Physical activity is not required as a preferred form of leisure time and therefore does not favourably distinguish students from among the general population [13]. It was also noticed that the BMI rate does not exactly reflect the increasing problem of overweight among university students as a waist-hip ratio (WHR) measured in the general population [14]. It is interesting that the waist ratio of academic students, regarding metabolic syndrome, was more frequently noticed among women [15]. This suggests that excess body fat among women with normal weight is rather related with low-intensity physical activity than more frequent consumption of fat [16]. The association between physical activity and BMI is weak in non-obese individuals, in contrast to a strong one among obese individuals [17].

OBJECTIVE

The objective of the study was to assess the relation between the physical activity of young women's BMI and conditioning factors. MLTPAQ was used as the research tool.

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MATERIALS AND METHODS

The research was carried out in 2010–2011 in a group of 2,339 female students from various backgrounds, aged 18–21, living in the area of the Carpathian Euroregion, and included 1,607 from Poland (68.7%, University of Rzeszow, Krosno State College), 260 from Ukraine (11.1% University of L'viv), 207 from Slovakia (8.8% University of Presov), 195 from Romania (8.3% University of Oradea) and 70 from Hungary (3% University of Miskolc). The Minnesota Leisure Time Physical Activity Questionnaire (MLTPAQ) was used to assess the total leisure time physical activity [18]. The study considered leisure time physical activity (outside the university), and the observation period of 6 months, and carried between October – March. The questionnaire enables assessment of the energy expenditure per week. Therefore, the total energy expenditure in the leisure time of PA (EEPAtotal) was calculated in kilocalories per week. Moreover, based on the PA intensity code, it was possible to quantify the energy expenditure in physical activity (EEPA) according to the activity's classification as intense, moderate or light intensity, as follows:

- Light PA intensity below 4 METs, such as walking (EEPAlight).
- Moderate PA intensity 4–5.5 METs, such as brisk walking (EEPAmoderate).
- Intense PA intensity greater than or equal to 6 METs, such as jogging (EEPAintense).

Thus, for each particular subject:
EEPAtotal = EEPAlight + EEPAmoderate + EEPAintense

The total energy expenditure in physical activity (EEPAtotal) was categorized into the following levels: < 1,000 (low), 1,000–1,999 (medium), 2,000–2,999 (high), ≥ 3,000 kcal/week (very high). The degree was measured with the use of a Martin's antropometer. The body mass and body components were estimated with the use of the bioelectric impedence method and measured with the use of Tanita TBF 300 (BMI – Body Mass Index kg/m², Fat (%) fat, Fat (kg) fat, FFM (kg) – free fat mass). The waist girth was measured with the use of a measuring tape (centimeter). Waist circumference should be measured at a level midway between the lower rib margin and iliac crest and hip girth measuring at the same time as the Waist to Hip Ratio (WHR).

Descriptive statistics showed the characteristics of features and somatic indicators distribution, as well as the numerical results of the MLTPAQ questionnaire. Due to a majority of distinct asymmetrically distributed somatic features (especially BMI), further statistical analysis was conducted with the use of non-parametric tests. Kruskal-Wallis test was used in particular to assess the significant differences in somatic features distribution among the group of women with different levels of physical activity.

RESULTS

In the researched population there were 989 (42.3%) women living in towns/cities, and 1,350 (57.7%) living in villages. The BMI of the women from towns/cities, on average, was 20.8 (s=2.9; Me=20.4), and that of the village women: 21.2 (s=3.0; Me=20.7). The difference between the BMI level of the women living in towns/cities and that of the women living in villages was statistically significant (p=0.0051**). As far as the level of activity is concerned, among the women living in towns/cities the total activity EEPAtotal, on average, was 1,778 kcal/week (s=1,367; Me=1,398) and among the women from villages – 1,633 kcal/week (s=1,204; Me=1,293). Also, the difference was statistically significant (p=0.0415*). Analysis of the relationship between the level of activity and BMI was carried out separately for the students living in villages and for the students living in towns/cities. The character of changes of the BMI index with reference to the level of physical activity was very similar in the women from towns/cities and the women from villages. In both groups, the people with low or medium activity had a lower BMI than the people with a high or very high level of physical activity (Tab. 3). These conclusions were drawn on the basis of the comparison of the median values, as in the face of the right-skewed distribution of the BMI index, the mean values are slightly inflated and might not accurately show the relation between the two groups. Due to the similar distribution of the results in the two groups, further analysis was carried out for the whole test population of young women; however, without the division into the place of living. The average BMI of women was valued at 21.1. The average level of total physical activity (EEPAtotal) was valued at 1,698 kcal/week, EEPAlight 715 kcal/week, EEPAmoderate 470 kcal/week, EEPAintense 516 kcal/week. At the same time, the median was significantly lower, indicating that every second person did not gain the average level of leisure time physical activity of 1,339 kcal/week. (Tab. 1). It results from the study that 74.2% of young women are considered to have the proper BMI rate in accordance with the WHO recommendations. At the same time, 16.2% were considered underweight and almost 10% had a higher BMI rate and were overweight or obese (Tab. 2). It was found that more than one third of respondents did not achieve the level of physical activity of 1,000 kcal/week, which is the minimum recommended amount of leisure physical activity time per week (Fig. 1). In the case of women with a low level of physical activity (<1,000 kcal), as many as 52% of the week activity was considered as low-intensity activity EEPAlight (Fig. 2). Tables 3 and Graph 3 show the BMI distribution regarding the level of physical activity. It

Table 1. Characteristic of the study group accirding to somatic build features and physical activity

	$\bar{x}$	s	c_{25}	Me	c_{75}	A
Height (cm)	165.3	5.9	161.0	165.0	170.0	0.02
Body mass (kg)	57.9	9.5	51.4	56.1	62.4	1.37
BMI (kg/m²)	21.1	3.1	19.0	20.6	22.6	1.53
FAT %	22.7	6.9	18.0	22.4	26.8	0.28
FFM (kg)	44.0	3.6	41.6	43.6	46.0	1.13
Waist girth (cm)	68.8	7.3	64.0	68.0	72.0	1.50
Hip girth (cm)	93.6	7.0	89.0	93.0	97.0	0.97
WHR	0.73	0.05	0.70	0.73	0.76	0.74
EEPA (kcal/tydz)						
EEPA light	715	695	297	567	958	10.15
EEPA moderate	470	590	103	286	626	4.51
EEPA intense	516	727	91	272	642	3.71
EEPA total	1698	1358	803	1339	2189	3.35

A – Skewness coefficient; s – standard deviation; c – centile; Me – median. x – mean

Table 2. Characteristic of the study group according to national origin and BMI categories

Country	N	%
Poland	1,607	68.7%
Slovakia	207	8.8%
Ukraine	260	11.1%
Romania	195	8.3%
Hungary	70	3.0%
BMI (kg/m²)		
underweight < 18.5	378	16.2%
normal 18.5-24.9	1735	74.2%
overweight ≥ 25-29.9	187	8.0%
obesity ≥ 30	39	1.7%

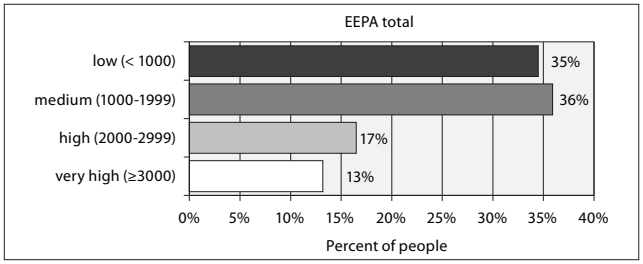

Figure 1. Percentage share of total physical activity (EEPA total) according to different levels of physical activity

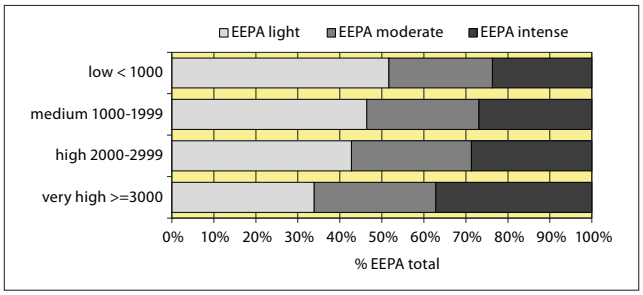

Figure 2. Percentage share of effort EEPA light, moderate, intense in the total physical activity EPA total, according to the particular levels of EEPA

was found out that the increase in total leisure time physical activity, increases BMI of young women. The results showed that there is a statistical difference between the average level BMI among the group of women p=0.0032**. In the group of women with high and very high level of physical activity, the BMI median was valued at approx. 21.0, whereas with low and very low level of physical activity it was valued at 20.3 and 20.5. An additional non-parametric test was used for multi comparison. This showed that there was a statistical difference between the BMI of women with low level of physical activity in comparison to women with high or very high physical activity. There was a relationship between the total physical activity (EEPAtotal) and body composition FFM and FAT% and somatic features, such as hip circumference and waist circumference and waist-hip-ratio WHR. There were no statistical differences between FAT% and waist circumference and waist-hip-ratio WHR, along with the increase of the level of physical activity. Statistical differences were indicated in hip circumference and fat free mass FFM. Those values were higher among women with higher total physical activity EEPAtotal (Tab. 4). In order to find a relationship between

Table 3. BMI distribution according to total physical activity (EEPA total)

EEPA (total)	BMI				
	$\bar{x}$	s	c_{25}	Me	c_{75}
All					
low (<1,000 Kcal)	21.0	3.3	18.8	20.3	22.3
moderate (1,000–1,999 Kcal)	21.1	3.0	19.1	20.5	22.6
high (2,000–2,999 Kcal)	21.4	3.3	19.2	20.9	22.7
very high (≥3,000 Kcal)	21.3	2.6	19.5	21.0	22.7
P			**0.0032****		
Rural area					
low (<1,000 Kcal)	21.1	20.5	3.2	18.9	22.4
moderate (1,000–1,999 Kcal)	21.1	20.5	2.9	19.1	22.7
high (2,000–2,999 Kcal)	21.6	21.0	3.2	19.6	22.8
very high (≥3,000 Kcal)	21.5	21.3	2.7	19.8	23.0
P			**0.0119***		
Urban area					
low (<1,000 Kcal)	20.5	20.0	2.8	18.5	21.7
moderate (1,000–1,999 Kcal)	21.0	20.5	3.1	19.0	22.4
high (2,000–2,999 Kcal)	21.1	20.8	3.0	18.9	22.5
very high (≥3,000 Kcal)	20.9	20.6	2.4	19.4	22.3
P			**0.0335***		

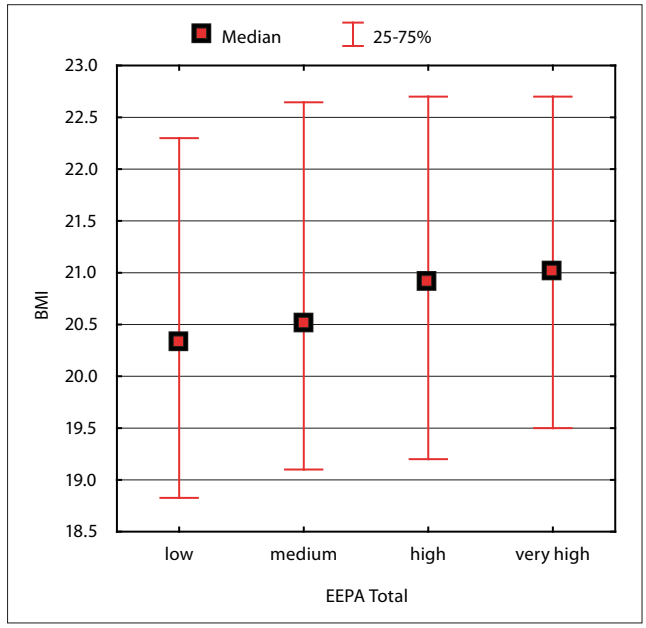

Figure 3. BMI median and quartile according to total leisure time physical activity (EEPA total)

different levels of physical activity and BMI, the study population was divided into four groups, depending on the type of activity: EEPAlight, EPAmoderate and EEPAintense. The relationship between the level of physical activity and BMI was best seen for low level physical activity. It was found that there is a statistical difference between hip circumference and waist circumference and FAT% and fat free mass FFM, depending on the level of low physical activity. In general, all those indicators increase along with the level of physical activity EEPAlight, gaining the highest average values in the group of people with very high physical activity EEPAlight. In the case of average intensity of EEPAmoderate, there is

Table 4. Somatic build features according to total physical activity (EEPA total)

EEPA (total)	Waist girth		Hip girth		WHR		FAT %		FFM	
	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
low (<1,000 Kcal)	68.6	7.5	93.3	7.3	0.74	0.05	22.4	7.0	43.7	3.7
moderate (1,000–1,999 Kcal)	68.8	6.9	93.5	6.7	0.73	0.05	22.6	7.0	43.9	3.3
high (2,000–2,999 Kcal)	69.2	7.9	94.1	7.2	0.73	0.05	23.1	6.9	44.4	3.8
very high (≥3,000 Kcal)	69.3	6.7	94.3	6.7	0.73	0.05	22.8	6.6	45.0	3.5
p	0.1440		0.0204*		0.9671		0.2426		0.0000***	

Table 5. BMI distribution according to physical activity (EEPA light. moderate. intense)

	BMI				
	$\bar{x}$	Me	*s*	c_{25}	c_{75}
EEPA Light (below 4 Mets)					
low (<c_{25})	21.1	20.6	3.1	19.0	22.3
medium (c_{25}-c_{50})	20.8	20.1	2.9	18.8	22.1
high (c_{50}-c_{75})	21.3	20.8	3.3	19.1	22.8
very high (≥c_{75})	21.4	21.0	3.0	19.3	22.8
p	**0.0001*** **				
EEPA Moderate (4-6 Mets)					
low (<c_{25})	21.1	20.2	3.5	18.8	22.5
medium (c_{25}-c_{50})	21.1	20.6	2.9	19.1	22.5
high (c_{50}-c_{75})	21.2	20.6	3.2	19.1	22.7
very high (≥c_{75})	21.2	20.8	2.6	19.4	22.6
p	**0.0470***				
EEPA Intense (above 6 Mets)					
low (<c_{25})	21.1	20.5	3.4	18.9	22.6
medium (c_{25}-c_{50})	21.1	20.5	3.1	18.9	22.6
high (c_{50}-c_{75})	21.0	20.5	3.0	19.1	22.4
very high (≥c_{75})	21.3	20.8	2.9	19.3	22.7
p	**0.1416 (low+moderate+high vs. very high: *p* = 0.0225*)**				

no evident relationship with the level of BMI. However, the mean value in the group with very high physical activity EEPAmoderate was significantly higher – Me = 20.2, than in the group with low physical activity EEPAlight (Tab. 5). Among those with high physical activity EEPAintense there was no statistical significant relationship with BMI. BMI was significant only in the group with very high physical activity. Therefore a dichotomy comparison in the two groups was carried out: physical activity type high below 75. centile (low, medium, high) and above 75. centile (very high). Such a comparison showed that the BMI in women with the highest values of EEPAintense was significantly higher than the others ($p = 0.0225$*). The level of medium physical EEPAmoderate only slightly had an impact on FFM, which was slightly higher in the group of women with high and very high physical activity EPAmoderate than in the other two groups – low and medium. It was found that waist-to-hip ratio (WHR) was lower in the group of women with high and very high physical activity, in comparison to women with low physical activity EEPAintense (Tab. 6).

Table 6. Somatic build features distribution according to physical activity (EEPA light, moderate, intense)

	Waist girth		Hip girth		WHR		FAT %		FFM	
	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
EEPA Light (below 4 Mets)										
low (<c_{25})	68.6	7.5	93.3	6.9	0.74	0.05	22.5	6.9	43.9	3.6
moderate (c_{25}-c_{50})	68.1	6.6	93.0	6.6	0.73	0.04	22.0	6.6	43.7	3.2
high (c_{50}-c_{75})	69.2	7.5	94.2	7.3	0.74	0.05	23.1	7.1	44.0	3.6
very high (≥c_{75})	69.4	7.4	94.2	7.0	0.74	0.05	23.0	7.0	44.6	3.8
p	0.0014**		0.0010**		0.4374		0.0107*		0.0000***	
EEPA Moderate (4-6 Mets)										
low (<c_{25})	68.8	8.2	93.7	7.7	0.73	0.05	22.3	7.4	43.8	3.8
moderate (c_{25}-c_{50})	68.6	6.8	93.2	6.8	0.74	0.05	22.4	6.7	43.9	3.6
high (c_{50}-c_{75})	69.1	7.5	94.0	7.2	0.73	0.05	23.1	7.2	44.3	3.6
very high (≥c_{75})	68.9	6.5	93.7	6.1	0.73	0.05	22.8	6.4	44.1	3.1
p	0.3327		0.2080		0.4389		0.1531		0.0104*	
EEPA Intense (above 6 Mets)										
low (<c_{25})	69.1	7.6	93.4	7.5	0.74	0.05	22.7	7.3	43.7	3.5
moderate (c_{25}-c_{50})	69.0	7.1	93.7	6.7	0.74	0.05	22.8	6.8	43.9	3.6
high (c_{50}-c_{75})	68.4	7.1	93.5	6.7	0.73	0.05	22.3	6.8	44.0	3.6
very high (≥c_{75})	68.9	7.2	93.9	6.9	0.73	0.05	22.8	6.8	44.6	3.5
p	0.2440		0.5221		0.0067**		0.7243		0.0001***	

DISCUSSION

The results show that 74.2% of young women aged 18–21 yrs form the Carpathian Euroregion, 74.2% were considered to have the proper BMI rate in accordance with the WHO recommendations As many as 16.2% were considered to be underweight, and almost 10% had a higher BMI rate and were overweight or obese. This is similar to other authors who indicate the same BMI distribution in young women [19]. Underweight in Poland concerns every sixth girl aged 15–19 yrs, and every tenth 20-year-old women [4]. Women were classified into four categories depending on the declared level of physical activity measured with the use of the MLTPAQ questionnaire. Based on that, it was showed that one third of respondents did not achieve the level of physical activity of 1,000 kcal/week, which is the minimum recommended amount of leisure physical activity time per week. This too is similar to other cross-sectional papers considering leisure time physical activity of students from 23 countries. Among young Poles, 35% were classified as inactive [20].

In the studies carried out among a large population of men and women with different BMIs it was found that a high BMI was related to low and not high physical activity, both in leisure time and during work [21]. In the group of women studied it was noted that together with the increase in the level of physical activity, the thickness of skinfolds deceased, as well as total fat in the body mass [22]. The difference between fat tissue distribution (assessed based on the WHR) was not noticed among women with different levels of physical activity. In the presented study, a statistically significant increase in the BMI depending on the total physical activity (EEPAtotal) was noticed. There were no statistical relationships between the total physical activity (EEPAtotal) and fat FAT% among young women.

Similar results indicating no relationships between physical activity of young women and the level of fat were found in other studies [23]. At the same time, there was a statistically significant increase in fat free mass and hip circumference, together with an increase in the declared level of total physical activity EEPAtotal. In the case of people with low total physical activity EEPAtotal (<1,000 kcal), as much as 52% of week physical activity was considered as low intensity physical activity EEPAlight. Whereas the percentage of per week physical activity decreased in the following groups – 1,000–1,999, 2,000–2,999 and above 3,000 kcal/week, it increased in the group of EEPAmoderate and EEPAintense physical activity. With the use of separate quartile division, the following types of physical activity's intensity: low EEPAlight, average EEPAmoderate, high EEPAintense, were analysed depending on the BMI. The study results showed that physical activity based in total of both low EEPAlight and average EEPAmoderate or high EPAintense, had an impact on the BMI increase among young women. It was noticed that at the same time the physical activity based on each level of intensity was statistically significantly related to the fat free mass FFM increase. An increase in the physical activity, including the average EEPAmoderate and high EEPAintense, was not related to the FAT% change. Only in the case of low physical activity EEPAlight there was a relationship between FAT% change, together with the increase in physical activity. Therefore, even a small part of daily high physical activity appears to be an important factor for the prevention of overweight and obesity [24], and an increase in cardiorespiratory Fitness CRF [25]. It was noticed that fat distribution WHR among the studied young women decreased, along with an increase in the intensity of activity EEPAintense. Further analysis should focus on determining a relationship between the BMI and the level of physical activity in two extreme groups – with low and high BMI (below 25. and above 75. Centile, respectively), because in those groups the relationship between BMI and physical activity could have a different character.

CONCLUSIONS

1. Regardless of the place of residence, urban or rural, an increase in the total leisure time physical activity of young women increases their BMI.
2. An increase in BMI, together with the total physical activity, is related above all to the increase of free fat mass FFM, despite the level of physical activity.

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