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Nutrition and somatic traits of women with different physical activity and various menstrual status

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Abstract

Background. There are publications which indicate a relationship between dietary pattern and somatic traits. Others report on link between somatic traits and physical activity. However, sparse studies discuss relationship between these three factors, i.e. nutrition, somatic traits and physical activity.

Objectives. This survey aimed to analyze relationships between nutrition (amount and source of energy in food) and somatic traits (body height, body mass, fat content of the body) of women with different physical activity and various menstrual status.

Material and methods. Investigations covered 312 women who were assessed for: somatic traits, average daily energy consumption and percentage contribution of proteins, fats and carbohydrates in providing energy. The physical activity was assessed by computing the physical activity index (PAI) being a ratio of daily energy expenditure (DEE) to basal metabolic rate (BMR). Among the women two groups were distinguished based on centile charts of the PAI developed for a given population, i.e.: women with a low ($PAI \leq 10$ cpts) and women with a high ($PAI \geq 90$ cpts) level of physical activity.

Results. The highly physically active women were characterized by a lower body fat content, lower BMI values, and higher percentage of lean body mass compared to the women with a low level of physical activity. The highly active women showed a tendency for an increased consumption of whole-meal bread, milk and dairy products, vegetables (including potatoes), fruits, and sweets as well as a tendency for a reduced consumption of meat and processed meat products, both types of butter, and lard, compared to the little active women.

Conclusions. It seems that the physical activity of the women had a direct impact on their nutrition. In turn, by affecting the somatic traits (body mass and composition), their eating habits could influence their physical activity.

Key words: women, menstrual status, low and high level of physical activity, nutrition, body composition

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Introduction

The menopause falls between the reproductive period and the aging of woman's body. The main criterion of its diagnosis is no menstrual bleedings within a 12-month period. A study conducted by Kaczmarek [1] has demonstrated that the mean age at the natural menopause determined for the population of Polish women with the Kaplan-Meier's method was 49.5 years. Symptoms of the menopause associated with the cessation of the reproductive functions, which directly precede the menopause and may sustain even for a year post menopause, are typical of the so-called perimenopausal period (perimenopause), also referred to as the menopausal transitory period. This period is characterized by, e.g., decreased concentration of estrogen, ovarian androgens, progesterone, and growth hormone [2]. These hormonal changes result in irregular menstrual cycles being initially shortened and then elongated as well with excessively profuse or very scanty menstruations [3]. In that period, ca. 85% of the women suffer from: hot flushes, night sweats, palpitations, dizziness and headaches, fatigue, mood changes, and trouble sleeping [4-6]. The Report of the World Health Organization additionally

distinguishes the premenopause, i.e. a period of around two years before the last menstruation or the entire fertility period preceding the menopause, as well as the postmenopause which means the post-menopausal period [7].

The time the menopause appears in is highly significant to woman's health. The progressing dysfunction of the hormonal activity of the ovaries causes a number of metabolic disorders which may contribute to an increase in the incidence of many diseases hazardous to both their health and life. In this period, women are significantly more likely to develop osteoporosis, obesity, type II diabetes, and cardiovascular diseases [6,8]. Equally frequent causes of the deterioration of woman health in that period include wrong eating habits and low physical activity [9].

The menopausal period entails also changes in the body composition of women. Endocrinal changes typical of this period cause an increase in the fatty tissue content and a change in the fat body mass to the lean body mass ratio, to the disadvantage of the latter [10-11]. Contrary to expectations, the increase in women body adiposity during the menopause is not accompanied by an increased energy intake, but most of all by a drastic reduction in the physical activity [12]. Even moderately intense but regular physical activity has a positive impact on cardiorespiratory performance and muscle strength, and by affecting the nervous systems – also on the mental health. Moderate physical activity strengthens bone structure and reduces the risk of obesity development [9, 13-15]. Also deficient or excessive feed intake compared to the physiological demand, may lead to deviation from the normal health status [16-18].

There are ample literature works which indicate a relationship between dietary pattern and somatic traits, while some others report on links between somatic traits and physical activity [19-21]. In contrast, only sparse studies have discussed relationship between these three factors, i.e. nutrition, somatic traits, and physical activity [22], and even these have failed to answer the question about the co-effect of these factors on women health.

Study aim

The aim of this study was to analyze relationships between the physical activity (of various intensity), nutrition (amount and source of energy in food), and somatic traits (body height, body mass, fat content of the body) of women with various menstrual status.

Material and methods

Characteristics of the surveyed women

In this work, we use data collected during surveys conducted in 2018 and 2019 in the Bialski Powiat (Lublin Voivodeship) and Siedlecki Powiat (Mazowieckie Province), which covered 323 women who participated in the so-called bridging studies at the Collegium Mazovia of the Innovative Higher School in Siedlce and attended the University of the Third Age. Participation in the survey was voluntary and anonymous. The analysis was conducted for results obtained from 312 women. Eleven (3.4%) women were excluded from the study as they suffered from artificial menopause induced by radiotherapy or by hysterectomy/ovariectomy.

Socio-demographic data and other information necessary to establish the menstrual status of the women were collected with a questionnaire-based method. The women provided information on, i.a., date and place of birth, and were asked to answer the following questions: "Do you still menstruate?" and "Are your menstrual cycles regular?". The non-menstruating women were asked to establish the date of the last menstruation. Based on answers received, the menstrual status of the women was determined acc. to WHO guidelines⁷. The first group included regularly menstruating women (premenopausal period). The second group included women with irregular menstruations in the case of whom the time between the last menstruation and the survey was shorter than 12 months. In turn, women who did not menstruate for longer than 12 months were included into the third group (postmenopausal period).

Anthropometric measurements and body composition analysis

The following measurements were performed: body height (BH) and thickness of skinfolds at: arm triceps (TRC), under the scapula (SSC), and at the abdomen (ABD). BH measurements were made exact to 0.1cm using an anthropometer (Sieber Hegner & Co. AG, Switzerland), whereas skinfold thickness measurements exact to 0.1mm, on the left side of the body, using a Harpenden skinfold caliper (Sieber Hegner & Co. AG, Switzerland). Body mass (BM), body fat percentage (BFP), and lean body mass (LBM) were evaluated with an IOI 353 body composition analyzer (Jawon Medical, Korea). Results achieved were used to compute the BMI value and the total thickness of three skinfolds: TRC, SSC, and ABD (mm).

Nutritional pattern assessment

The nutritional patterns of the surveyed women were assessed with the triple 24-h recall method [23]. The interviews were performed by trained pollsters in two working days and in one day free of work (Sunday). The size of food rations was evaluated using the Photo Album of Food Products and Dishes [24]. The frequency of consumption of selected food products within a week was evaluated using a 5-point scale: every day, 3-4 times a week, 1-2 times a week, less frequently, or never. Each category from the scale was ranked with values from 5 to 1, next mean ranks of the frequency of consumption of the analyzed food products and their standard deviations

were computed. Afterwards, mean daily energy intake (EI) as well as percentage contents of proteins, fats, and carbohydrates in providing energy from everyday food rations were computed using the DIETA 5.0 software, based on national nutritional tables [25].

Physical activity assessment

Daily energy expenditure (DEE) was determined with the Bouchard et al. method, which consists in the retrospective collection of data from the surveyed women about the types of activities performed within the last 24 hours [26]. All activities were ascribed a certain energy expenditure which when summed up gave a total energy expenditure (TEE) expressed in kcal/24h. The collected data served to compute the physical activity index (PAI), being a ratio of total energy expenditure to basal metabolic rate (TEE/BMR) [27], and energy balance expressed as EI/TEE. Interviews concerning the physical activity were performed by trained pollsters on the same days as the 24-h recalls. Having considered the age of the women, the PAI computed for each group of women with various menstrual status was used to plot percentile charts which served as the basis for discriminating sub-groups of women with different levels of physical activity. Afterwards, from all hierarchically ordered PAI values in each group a certain number of the surveyed women was selected which corresponded to 10% of the highest and the lowest PAI values. It allowed distinguishing groups of women with low ($PAI \leq 10$ pts) and high ($PAI \geq 90$ pts) level of physical activity.

The significance of differences between the variables in the distinguished groups of women was evaluated with Student's t-test for independent variables. Correlations between the somatic traits, nutrition, and physical activity were determined by calculating coefficients of simple correlations. Differences were found statistically significant at the significance level of $p \leq 0.05$ or higher.

Results

The number and age of the women with various menstrual status were presented in Table 1. The first group (premenopausal period) included 69 women (22.1%) aged 41.32.3 years. The second (perimenopausal period) and the third (postmenopausal period) group were represented by 45 (14.4%) and 198 (63.5%) women aged 48.01.5 and 66.77.7 years, respectively.

Table 1: Number and age of women (mean \pm SD) in groups distinguished based on their menstrual status

Menstrual status		Number		Age	
		n	%	\bar{x}	SD
Premenopausal	Group 1	69	22.1	41.3	2.3
Perimenopausal	Group 2	45	14.4	48.0	1.5
Postmenopausal	Group 3	198	63.5	66.7	7.7

Values of the physical activity index (PAI) in percentile ranges and in groups of women with various menstrual status were collated in Table 2. In the ≤ 10 pts and ≥ 90 pts ranges of the first group, the PAI values were 1.440.06 and 2.040.17, respectively. In the ≤ 10 pts range of the second and the third group, the PAI values accounted for 1.410.09 and 1.390.08, whereas in the ≥ 90 pts range – for 1.880.11 and 1.760.15, respectively.

Table 2: Values of the physical activity index (PAI) in particular percentile ranges (mean \pm SD) in groups of women with various menstrual status

Menstrual cycle	Percentile ranges of physical activity index (PAI)				
	≤ 10	10–25	25–75	75–90	≥ 90
Group 1 (n=69)	1.44 \pm 0.06 n=7	1.52 \pm 0.04 n=10	1.68 \pm 0.09 n=35	1.85 \pm 0.08 n=10	2.04 \pm 0.17 n=7
Group 2 (n=45)	1.41 \pm 0.09 n=5	1.48 \pm 0.04 n=6	1.61 \pm 0.07 n=23	1.78 \pm 0.06 n=6	1.88 \pm 0.11 n=5
Group 3 (n=198)	1.39 \pm 0.08 n=21	1.43 \pm 0.02 n=30	1.59 \pm 0.13 n=99	1.65 \pm 0.07 n=30	1.76 \pm 0.15 n=20

The somatic characteristics of women with high and low level of physical activity in groups distinguished in terms of their menstrual status was provided in Table 3. Data shown therein demonstrate that the women with a high level of physical activity (PAI \geq 90cpts) had lower values of the somatic traits (except for BH and LBM) compared to the women with a low level of physical activity (PAI \leq 10cpts). Significant differences ($p\leq 0.05$) in the first and the second group concerned the total thickness of three skinfolds: 64.314.3mm vs. 79.511.2mm and 68.610.8mm vs. 85.312.1mm, and in the second group – the thickness of ABD skinfold (26.65.6mm vs. 34.95.8mm). Similar tendencies were observed in the third group, however significant ($p\leq 0.05$) differences were not observed for the thickness of ABD skinfold ABD (24.75.7mm vs. 29.96.3mm) and for the sum of three skinfolds (64.813.1mm vs. 72.710.1mm), as well as for BMI value BMI (27.33.6kg \cdot m⁻² vs. 30.12.6kg \cdot m⁻²), PBF (35.95.4% vs. 39.75.5%), and LBM (64.15.3% vs. 60.36.4%).

Table 3: Values of somatic traits and body composition of women with various menstrual status and different level of physical activity (mean \pm SD)

Variable	Group 1		Group 2		Group 3	
	Physical activity level					
	low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts
	(n=7)	(n=7)	(n=5)	(n=5)	(n=21)	(n=20)
BH (cm)	159.95.7	163.16.1	158.24.8	161.65.8	157.64.9	159.86.3
BM (kg)	76.413.5	74.212.2	79.010.6	76.811.4	74.612.6	70.211.2
BMI (kg \cdot m ⁻²)	29.23.1	27.93.4	31.22.8	29.43.4	30.12.6	27.33.6 *
TRC (mm)	23.64.9	18.55.5	24.15.7	19.56.5	22.66.2	20.95.3
SSC (mm)	25.15.6	20.26.3	26.65.1	22.46.6	21.28.1	19.27.3
ABD (mm)	30.67.3	25.66.8	34.95.8	26.65.6 *	28.96.3	24.75.7 *
Sum of TRC, SSC, and ABD (mm)	79.511.2	64.314.3 *	85.312.1	68.610.8 *	72.710.1	64.813.1 *
PBF (%)	35.55.8	32.16.4	37.35.7	33.74.5	39.75.5	35.95.4 *
LBM (%)	64.54.8	67.95.2	62.75.5	66.35.4	60.36.4	64.15.3 *

Explanations: PAI – physical activity index, cpts – centile points, * $p\leq 0.05$ – value significantly different from the respective value determined for the women with a low level of physical activity (Student's t-test)

Table 4 presents results of the analysis of a correlation between values of the somatic traits and physical activity index (PAI) in the groups of women with various menstrual status. In all groups of women with a high level of physical activity (PAI \geq 90cpts), regardless of their menstrual status, insignificant negative correlations were determined between values of BH, BM, BMI, TRC, SSC, ABD, PBF, the sum of thickness of three skinfolds (TRC, SSC, and ABD) and the values of PAI as well as insignificant positive correlations between LBM and PAU values. In the groups of women with a low level of physical activity (PAI \leq 10cpts), most of the analyzed correlations were negative but statistically insignificant.

Table 4: Correlation (Pearson's correlation coefficient) between values of somatic traits and physical activity index (PAI) in groups of women with various menstrual status and different level of physical activity

Variable	Group 1		Group 2		Group 3	
	Physical activity level					
	low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts
	(n=7)	(n=7)	(n=5)	(n=5)	(n=21)	(n=20)
BH (cm)	-0.104	-0.106	-0.098	-0.087	-0.108	-0.126
BM (kg)	0.021	-0.019	0.039	-0.046	0.098	-0.120
BMI (kg·m ⁻²)	0.029	-0.034	0.078	-0.076	0.065	-0.087
TRC (mm)	-0.036	-0.046	-0.028	-0.036	-0.026	-0.035
SSC (mm)	-0.043	-0.056	-0.035	-0.045	0.025	-0.055
ABD (mm)	0.025	-0.029	0.029	-0.046	-0.035	-0.045
Sum of TRC, SSC, and ABD (mm)	-0.107	-0.110	-0.109	-0.106	0.106	-0.099
PBF (%)	-0.024	-0.038	-0.018	-0.021	-0.018	-0.035
LBM (%)	0.035	0.049	0.029	0.039	-0.112	0.119

Explanations: PAI – physical activity index, cpts – centile points, BH – body height, BM – body mass, BMI – body mass index, TRC – arm triceps skinfold, SSC – skinfold under the scapula, ABD – skinfold at the abdomen, PBF – percentage of body fat, LBM – lean body mass

Table 5 provides results of the analysis of a correlation between the frequency of consumption of selected nutrients and PAI values in the groups of women with various menstrual status. Regardless of their menstrual status, the women declaring intensive physical activity tended for more frequent consumption of whole meal bread, milk and dairy products, fruits and vegetables, and sweets, and for less frequent consumption of meat, delicatessen meat products, both types of butter, and lard (except for these in the premenopausal period) than the little active women. The highest number of statistically significant differences was observed in the third group. They concerned the consumption of whole meal bread ($p\leq 0.001$); milk, kefir, and yoghurt ($p\leq 0.001$); white cheese ($p\leq 0.05$); delicatessen meat products ($p\leq 0.05$); cream butter ($p\leq 0.05$); vegetables ($p\leq 0.001$); and fruits ($p\leq 0.001$). In the first groups, significant differences were determined only for white cheese ($p\leq 0.01$) and vegetables ($p\leq 0.05$), whereas in the second group they concerned whole meal bread ($p\leq 0.05$), delicatessen meat products ($p\leq 0.05$), potatoes ($p\leq 0.05$), and sweets ($p\leq 0.05$).

Table 5: Usual frequency of consumption of selected food products by women with various menstrual status and different level of physical activity (mean ± SD)

Variable	Group 1		Group 2		Group 3	
	Physical activity level					
	low PAI≤10cpts	high PAI≥90cpts	low PAI≤10cpts	high PAI≥90cpts	low PAI≤10cpts	high PAI≥90cpts
	(n=7)	(n=7)	(n=5)	(n=5)	(n=21)	(n=20)
Whole meal bread	2.6 1.3	3.2 1.3	1.6 1.2	3.6 1.4 *	1.6 1.4	3.6 1.4 ***
Milk, kefir, yoghurt	3.7 1.1	4.1 1.2	3.0 1.1	4.3 1.3	3.0 1.0	4.3 1.3 ***
White cheese	1.7 1.3	3.8 1.2 **	2.8 1.1	3.2 1.2	2.3 1.1	3.2 1.2 *
Hard cheese	3.5 1.4	3.8 1.2	3.1 1.0	3.4 1.0	3.1 1.1	3.4 1.0
Meat	4.0 1.2	3.7 1.1	4.1 0.9	3.8 1.0	4.1 1.2	3.6 1.4
Delicatessen meat products	3.7 1.2	3.6 1.2	4.1 1.0	3.5 1.1 *	4.0 1.2	3.2 1.1 *
Sausages	2.9 1.5	3.0 1.2	3.1 1.0	3.3 1.0	3.6 1.0	3.5 0.9
Eggs	2.6 1.1	3.1 0.9	2.9 0.9	3.3 0.9	3.2 0.9	3.3 1.3
Cream butter	4.2 1.2	4.1 1.4	4.3 1.2	2.9 1.6	4.2 1.3	2.9 1.5 *
Vegetable margarine	4.0 1.4	4.0 1.6	3.8 1.5	2.0 1.6	3.8 1.5	3.4 1.6
Lard	1.4 0.8	1.2 0.7	1.6 0.9	1.4 0.8	1.6 0.9	1.4 0.8
Potatoes	4.2 0.9	4.5 0.6	2.7 1.0	4.1 0.6 *	3.7 1.0	4.2 0.7
Vegetables	2.2 1.2	3.6 1.1 *	2.2 1.3	3.3 1.1	2.2 1.4	4.3 1.2 ***
Fruits	4.1 1.0	4.6 0.6	4.2 1.0	4.4 0.8	3.3 1.0	4.6 0.8 ***
Sweets	3.2 1.2	3.4 1.1	2.2 1.0	3.9 1.2 *	3.3 1.1	3.9 1.2

Explanations: PAI – physical activity index, cpts – centile points, * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.01$ – value significantly different from the respective value determined for the women with low level of physical activity (Student's t-test)

The intake of energy and major nutrients in groups of women with a low and high level of physical activity and various menstrual status was provided in Table 6. The intake of energy was lower in the group of women with a low level of physical activity compared to the women with a high level of physical activity and reached: 29.315.4 kcal·kg⁻¹·d⁻¹ vs. 31.813.3 kcal·kg⁻¹·d⁻¹ in the first group; 30.213.3 kcal·kg⁻¹·d⁻¹ vs. 32.516.1 kcal·kg⁻¹·d⁻¹ in the second group; and 22.514.4 kcal·kg⁻¹·d⁻¹ vs. 24.613.2 kcal·kg⁻¹·d⁻¹ in the third group. In addition, in the case of the women with a high level of physical activity from group three (postmenopausal period), compared to the women with a low level of physical activity, analyses showed a significantly ($p \leq 0.01$) higher intake of energy from carbohydrates (53.95.4 cal% vs. 46.25.5 cal%), and a lesser intake from fats (29.25.5 cal% vs. 38.15.56 cal%; $p \leq 0.01$). Similar but statistically insignificant tendencies were observed for the women from the two other groups.

Table 6 provides also data concerning the energy balance (EI/TEE) which was lower in the groups of highly active women compared to the groups of women with a low level of physical activity. In the third group, differences between the mean values turned out statistically significant ($p \leq 0.05$), i.e. 1.190.32 vs. 1.310.28. This result was affected by a significantly ($p \leq 0.01$) higher value of the total energy expenditure in women with a high level of physical activity compared to the less active women (20.73.4 kcal·kg⁻¹·d⁻¹ vs. 15.92.6 kcal·kg⁻¹·d⁻¹).

Table 6: The intake of energy and major nutrients, energy expenditure, and energy balance in groups of women with various menstrual status and different level of physical activity (mean \pm SD)

Variables		Group 1		Group 2		Group 3	
		Physical activity level					
		low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts
		(n=7)	(n=7)	(n=5)	(n=5)	(n=21)	(n=20)
Total energy expenditure	(kcal \cdot kg $^{-1}\cdot$ d $^{-1}$)	20.5 1.9	23.2 2.1*	18.6 1.6	21.7 2.2 *	15.9 2.6	20.7 3.4**
Energy balance (energy intake/total energy expenditure)		1.43 0.48	1.37 0.29	1.62 0.38	1.49 0.37	1.42 0.28	1.19 0.32*
Energy	(kcal \cdot kg $^{-1}\cdot$ d $^{-1}$)	29.3 15.4	31.8 13.3	30.2 13.3	32.5 16.1	22.5 14.4	24.6 13.2
Protein	(g \cdot kg $^{-1}\cdot$ d $^{-1}$)	0.9 0.5	0.9 0.5	0.9 0.3	1.1 0.6	0.9 0.4	1.1 0.5
	(cal%)	11.3 1.9	11.9 1.8	12.5 2.3	13.3 2.5	15.7 1.6	16.9 1.8
Fats	(g \cdot kg $^{-1}\cdot$ d $^{-1}$)	1.3 0.6	1.2 0.7	1.2 0.4	1.1 0.7	1.0 0.4	0.8 0.5
	(cal%)	38.3 5.3	33.1 5.4	35.1 3.2	29.9 3.9	38.1 5.6	29.2 5.5**
Carbohydrates	(g \cdot kg $^{-1}\cdot$ d $^{-1}$)	3.7 2.4	4.4 1.8	3.9 2.5	4.6 2.7	2.6 1.7	3.3 1.6*
	(cal%)	50.4 5.4	55.0 5.3	52.4 7.5	56.8 6.1	46.2 5.5	53.9 5.4**

Explanations: PAI – physical activity index, cpts – centile points, * $p\leq 0.05$; *** $p\leq 0.01$ – value significantly different from the respective value determined for the women with low level of physical activity (Student's t-test)

Table 7 presents results of analysis of relationship between intakes of energy and major nutrients and values of the physical activity index (PAI) in the groups of women differing in their menstrual status. Worthy of notice are positive, though insignificant, correlations in groups of women with a high level of physical activity as well as negative correlations in the groups of less active women.

Table 7: Correlation (Pearson's correlation coefficient) between intakes of energy and selected nutrients, and values of the physical activity index (PAI) in groups of women with various menstrual status and different level of physical activity

Variable	Group 1		Group 2		Group 3	
	Physical activity level					
	low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts	low PAI \leq 10cpts	high PAI \geq 90cpts
	(n=7)	(n=7)	(n=5)	(n=5)	(n=21)	(n=20)
Energy (kcal)	-0.022	0.039	-0.019	0.021	-0.093	0.115
Protein (g)	-0.037	0.035	0.014	0.018	-0.087	0.099
Fats (g)	-0.031	0.014	-0.021	0.015	-0.108	0.098
Carbohydrates (g)	-0.018	0.026	0.016	0.026	-0.121	0.117

Explanations: PAI – physical activity index, cpts – centile points

Discussion

This survey confirmed earlier observations made by other authors regarding the positive influence of the physical activity on body composition [12, 28-30]. The women with a high level of physical activity had lower body fat contents and BMI values, and a higher lean body mass compared to the less active women. These differences were especially tangible in the postmenopausal women (Group 3), though similar tendencies occurred also in the groups of pre- (Group 1) and perimenopausal (Group 2) women. To compensate for a higher energy expenditure, the highly active women consumed more energy compared to the women with a low level of physical activity (Table 6). Hence, the lower percentage of body fat (PBF) determined in their case may be explained by a greater energy expenditure, which was also indicated by negative correlations between percentage of body fat and PAI value in this group of women. Compared to the women with a low level of physical activity, the ratio of energy intake to total energy expenditure in the highly active women was closer to the unit, which indicates a compensated energy balance in their case (Table 6).

In turn, the increased energy demand observed in the case of women with a high level of physical activity was to a greater extent compensated for by carbohydrates and to a lesser extent by fats, compared to the little active women (Table 6). This finding may be confirmed by positive, though insignificant, correlations between PAI values and carbohydrates intake observed in all groups, especially in the postmenopausal women, as well as by a lack of a correlation between PAI values and fats intake (Table 7). The relatively higher percentage contribution of carbohydrates than of fats in providing energy to the women with a high level of physical activity could be due to the food choices they made. It turned out that the highly physically active women consumed more whole meal bread, milk and dairy products, vegetables (including potatoes), fruits, and sweets as well as less meat and meat products, butter, and other fats (Table 5). It seems that the low percentage of their body fat may be explained not only by the increased energy expenditure, as it is commonly believed, but also by the choice of food products having a positive impact on energy balance in the body. Our results are thus consistent with findings from earlier surveys conducted by, i.a. Al-Hurani and Atoum [31], who demonstrated that the Jordan women consumed proportionally more energy provided from fats ($34.2 \pm 5.3\%$ vs. $32.8 \pm 6.7\%$) during the Ramadan when their physical activity was reduced, than before the Ramadan when their activity was higher. In contrast, a survey conducted in Indonesia has shown that good performance of the cardiovascular system of the surveyed was associated with a higher intake of carbohydrates and a lower intake of fats [32]. A similar observation was made by Erlenbusch et al. [33] who have claimed that the endurance of non-trained persons was more positively influenced by the high-carbohydrate than by the high-fat diet. Interesting findings were reported by Brodney et al. [34] who have demonstrated that the nutritional patterns of persons with a higher circulatory and respiratory performance (a positive correlation with physical activity) was more similar to the recommended intakes of fat, cholesterol, and dietary fiber, compared to the nutritional patterns of moderately fit persons.

Conclusions:

1. Regardless of the menstrual status, the physically very active women were characterized by a lower body fat content, lower BMI values, and higher percentage of lean body mass compared to the women with a low level of physical activity.
2. The increased energy demand observed in the women from the high physical activity groups was associated with both a relatively higher intake of carbohydrates and a lower intake of fats compared to the women from low physical activity group as well as with the choice of food products.
3. The highly active women showed a tendency for an increased consumption of whole-meal bread, milk and dairy products, vegetables (including potatoes), fruits, and sweets as well as for a reduced consumption of meat, delicatessen meat products, both types of butter, and lard (except for the women in the premenopausal period), compared to the little active women.
4. Apart from the intake of energy, the physical activity may be affected by its source, i.e. by food composition. It seems that the physical activity of the women had a direct impact on their nutrition. In turn, by affecting the somatic traits (body mass and composition), their eating habits could influence their physical activity.

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