Anthropological Review • Vol. 80(4), 393–404 (2017)

DE GRUYTER OPEN

ANTHROPOLOGICAL REVIEW
Available online at: https://doi.org/10.1515/anre-2017-0028

Somatotype, diet and nutritional status of women

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Abstract: The relationship between energy value and nutrients intake and the body shape and size parameters (weight, height, waist and hip circumferences) has become an interesting research area for nutritionists and dieticians.

The aim of this study was to determine the relationship between the body shape and size parameters (weight, height, waist and hip circumferences), somatotype (according to the Rohrer (RI) index) and energy value and nutrients intake of women.

The study was conducted in 2014 and 2016 on 148 female volunteers aged 57–88 from the Mazovian and Lublin province (Poland). Sample selection was targeted at elderly people with different body types. The exclusion criteria were: multi-organ failure, cancer and disability. Then among the subjects, a survey was conducted, that included demographic data, lifestyle, health status and vitamins and minerals supplements use. Food intake has been assessed using a 3-day dietary food records. The somatotype was determined using the RI with the Curtis key, classifying the subjects as ectomorphic (n=30), mesomorphic (n=31) and endomorphic (n=87).

The somatotype was significantly related to place of residence, physical activity, waist and hip circumference, WHR and BMI index, total protein intake, animal protein intake, vitamin E intake ($p \leq 0.05$) and to fat, phosphorus and thiamine intake ($p \leq 0.1$).

The obtained results showed that the place of residence, physical activity, chronic diseases, the use of specialized diet, body weight fluctuations, BMI and WHR were different depending on the somatotype in the examined group of women. Endomorphic subjects had significantly greater waist and hip circumference and diastolic blood pressure compared to the other somatotypes. The somatotype had only a significant effect on total protein, animal protein and vitamin E intake, and ectomorphic elderly women may be particularly susceptible to nutrient deficiencies. Due to the risk of macronutrient, vitamin and mineral deficiencies in the diets of the examined women, it seems necessary to educate this group as well as caregivers and doctors in the area of nutrition adapted to the needs of the elderly.

Key words: body physique, elderly women, nutrition

Introduction

Somatotype can be defined as the present morphological state of the individual. There are three basic types: ectomorphic, mesomorphic and endomorphic (Carter and Heath 1990). The ectomorphic body type is characterized by slim physique,

Original Research Article Received: August 4, 2017; Accepted for publication: October 31, 2017
DOI: 10.1515/anre-2017-0028

weak bones and muscles, sloping arms, relatively short torso and long limbs. The chest is narrow and flat, arms rounded, thighs and shoulders weak, fingers long and delicate and skin is dry. This body type is characterized by rapid energy expenditure, low fat cell count and as well as slow muscle growth. Ectomorphic physique requires less intensive training, longer interruptions, higher protein intake and adequate resting period (Carter and Heath 1990). Ectomorphs are considered introverted, ill-tempered, irritable, with a tendency to schizophrenia (Maddan 2010), sensitive, susceptible to fatigue and having difficult contact with other people (Wang et al. 2011). Mesomorphic physique is a muscular body type with a strong skeleton, broad shoulders and chest, firm limbs, massive pelvis and a very fast muscle growth (Carter and Heath 1990). Mesomorphic person is regarded to be energetic, active, dynamic and aggressive (Madden 2010; Wang et al. 2011; Funder 2013). In contrast, the endomorphic type is characterized by rounded physique, large number of fat cells, larger waist circumference than the chest, large head, broad face and short neck. Besides endomorphs have rounded shoulders, relatively short and weak limbs and fingers, small feet and hands and strong bones. They also have a great potential for building muscle mass but the difficulty in losing fat. Low physical activity can lead to the risk of obesity and heart disease (Carter and Heath 1990). Endomorphic people are often considered extravert and emotionally instable (Maddan et al. 2010). They are sociable and have a taste for comfort and hedonistic lifestyle (Wang et al. 2011). The division into somatotypes is a mixture of three components: endomorphics, ectomorphics and mesomorphics, and their mutual proportions with assigned numbers from 1 to 7, determining the set of characteristics of the individual (Tóth 2014). Results are presented in a three-digit form. An individual who has only endomorphic features has the assigned symbol 7-1-1, while a person with only mesomorphic characteristics 1-7-1 and ectomorphic one 1-1-7 (Carter and Heat 1990). This means that there are 343 possible combinations (Maddan 2010).

The relationship between somatotype and the risk and incidence of diseases is the subject of numerous studies. Studies show that people with endomorphy somatotype have a higher risk of: diabetes mellitus (Yeung 2010), hypertension (William et al. 2000, Badenhorst et al. 2003, Herrera et al. 2004), metabolic syndrome (Martinez et al. 2012; Galic et al. 2016) and cancer (Bertrand 2013). The first study that investigated the relationship between somatotype and disease was conducted in the 1920s.

With age there are fluctuations occurring within the given somatotype. Due to the higher body fat content, there are more women within the endomorphic somatotype (Buffa et al. 2005). The changes that occur are similar in both sexes with the exception of the mesomorphic somatotype group, which increases in number in women up to 50 years of age and then falls, and in men no changes in this somatotype have occurred after the age of 30. The greatest differences in somatotype components occur in the age group 18–40. The proportion of endomorphs in women increases to 60 and then declines. Number of ectomorphs tend to decline to 50 years of age and then no changes are observed (Kalichman and Kobyliansky 2006). Other researchers show a gradual reduction of the endomorphic component, stability within the mesomorphic one, and a slight increase in the ectomorphic component. It is believed that somatotypes may be important in studies of age-related diseases such as type 2 diabetes and Alzheimer's disease, where large body composition differences are observed (Buffa et al. 2005). The somatotyping technique may be a tool for monitoring and studying physical changes in these diseases (Buffa et al. 2007).

Due to the above mentioned reasons and the existing relationships between body composition and the energy and nutrient demand, in the present study the relationship between somatotype and diet and nutritional status of women aged 57–88 has been examined.

Subjects and Methods

Study design and participants

The study was conducted in 2014 and 2016 on 148 female aged 57–88 from Mazovian and Lublin province (Poland). Sample selection was targeted at elderly people with different body types. The exclusion criteria were: multi-organ failure, cancer and disability.

Dietary assessment

Among the selected women, a survey was conducted that included demographic data, lifestyle, health status, vitamins and minerals supplements use. Food intake data were collected using 3-day-records method. Respondents were trained before participating the survey how to self-report daily food and beverage intake. Data were obtained from two working days and one weekend day. Each questionnaire was carefully reviewed by the research staff to ensure that all reported data about food and beverages, the quantity of food consumed were included. After reviewed food intake data were converted to weights and were processed in the program "Energia" to estimate energy and nutritional values. For food, the nutritional value was reduced by the following losses, resulting from technological processing: macronutrients – 10%, thiamine – 20%, riboflavin and niacin – 15%, folate – 40%, vitamin A – 25%, and vitamin C – 55% (Turlejska et al. 2006). Taking into account losses, energy value was compared with estimated energy requirement (EER) for women with low level of physical activity (PAL=1,4). For protein, fat, vitamins: A, B_1, B_2, B_6, B_{12}, C, niacin, folate and for minerals: calcium, phosphorus, magnesium, iron, zinc, copper and iodine was used the estimated average requirement (EAR) level. The recommended dietary allowances (RDA) level was used for carbohydrates and adequate intake (AI) level for fiber, vitamins: D, E, and for electrolytes: sodium, potassium (Jarosz et al. 2012). Nutritional assessment was carried out with respect to the references values for the three age groups: 51–65, 66–75 and above 75 (Jarosz et al. 2012). For each somatotype, the average intake and standard deviation for macronutrients, vitamins and minerals, were determined. For group, to interpret the obtained data with EAR reference, the cut-off point method has been applied, in which inadequate intakes is computed as the proportion of the group with intakes below the median requirement (EAR). For nutrients with AI reference, adequate intakes was assessed as the proportion of the group with intakes above the AI level (Jarosz et al. 2012).

Anthropometric assessment

Weight was measured to the nearest 0.1 kg on a balance-beam scale. Standing height was measured with a fixed stadiometer calibrated in centimeters. BMI was calculated as weight in kg divided by height in meters squared (kg/m^2). In reference to the Queensland Government 2014 data for the elderly, the BMI of each woman falls into the following categories: underweight: <24 kg/m^2, normal weight: 24–30 kg/m^2, overweight or obesity: >30kg/m^2. Waist and hip circumferences of each participant were measured by the research staff (waist: midway between the lowest rib margin and the iliac crest; hip: horizontally at the level of the greatest lateral extension of the hips). Waist-hip ratio (WHR) index was calculated for determination of fat tissue distribution. In women, it should not exceed 0.8 (WHR <0.8 – normal and WHR ≥0.8 – abdominal type, undesirable) (WHO, 2008).

Based on measured height and body weight, the somatotype was determined using the Rohrer index (RI). RI was calculated as weight in grams multiplied by 100 and divided by height in centimeters cubed (g/cm^3). That allowed to assign the subjects to 3 groups: ectomorphic RI <1.28 kg/m^3 (n = 30), mesomorphic RI = 1.29–1.46kg/m^3 (n = 31), endomorphic RI>1.47 kg/m^3 (n = 87) (Szafraniec et al. 2012).

Blood pressure (BP) was measured using a validated digital automatic blood pressure monitor (Omron M3 Model) in accordance with Parati et al. (2010).

Statistical analysis

The results were analyzed statistically using PS IMAGO 4.0 (IBM SPSS Statistics 24). Data on energy and nutrient intake and anthropometric parameters were presented as mean with standard deviation, and differences between groups with different somatotypes were examined using one-way analysis of variance with Tukey's post hoc test. Chi2 test was used to examine the relationship between somatotype and selected socio-demographic factors, lifestyle, and anthropometric parameters. Statistically significant results were found for $p \leq 0.05$ and the trend was for $p \leq 0.1$.

Results

The mean age of the subjects was 68±6 years. The largest age group among all somatotypes was 66–75 years (Table 1). Most subjects had high-school education, average financial situation and did not use vitamins and minerals supplements (p>0.05) (Table 1).

The majority of the surveyed women lived in the cities of more than 100,000 residents (Table 1). There were found statistically significant differences between somatotypes and the place of residence (p<0.001). Women of ectomorphic physique were the most numerous in the towns of population below 100,000. Mesomorphic and endomorphic subjects lived mainly in the cities of population above 100,000. Among the village residents the most prevailing was endomorphic somatotype.

Statistically significant relationships between somatotype and: physical activity, chronic diseases and the application of a specialized diet were observed (Table 1). All women with ectomorphic physique were engaged in regular physical activity such as recreational activities. Majority of the mesomorphic women were physically active, unlike endomorphic ones, who

Table 1. Characteristics of the study group by somatotype (%)

	Somatotype			p^*
	Ectomorphic n=30	Mesomorphic n=31	Endomorphic n=87	
Age:				
51–65	33.3	38.7	37.9	0.169
66–75	63.3	38.7	49.4	
> 75	3.4	22.6	12.7	
Education				
Primary	6.7	9.7	13.8	0.451
Secondary	53.3	51.6	40.2	
Vocational	26.7	12.9	18.4	
Higher	13.3	25.8	27.6	
Place of residence				
Village	3.4	9.7	17.2	<0.001
Town (<100.000)	63.3	12.9	2.3	
City (>100.000)	33.3	77.4	80.5	
Economic status**				
Bad	3.4	9.7	5.8	0.752
Average	63.3	51.6	65.5	
Good	33.3	38.7	27.6	
Excellent	0.0	0.0	1.1	
Physical activity**				
Yes	100	93.5	82.8	0.023
No	0.0	6.5	17.2	
Chronic diseases**				
Yes	63.3	71.0	85.1	0.028
No	36.7	29.0	14.9	
Specialized diet				
Yes	6.7	29.0	36.8	0.007
No	93.3	71.0	63.2	
Vitamins and minerals supplements use				
Yes	26.7	22.6	29.9	0.730
No	73.3	77.4	70.1	
Body weight fluctuations (in the last 6 months)				
Yes	0.0	0.0	13.8	0.010
No	100	100	86.2	
BMI				
<24	100	93.5	5.7	<0.001
25–30	0.0	6.5	69.0	
>30	0.0	0.0	25.3	
WHR				
< 0.8	53.3	25.8	16.1	0.003
≥ 0.8	46.7	74.2	83.9	

p^* test Chi^2, $p \leq 0.05$, ** self-reported.

Table 2. Selected anthropometric data and blood pressure (BP) values based on somatotype

	Somatotype						p*
	Ectomorphic n=30		Mesomorphic n=31		Endomorphic n=87		
	Mean	SD	Mean	SD	Mean	SD	
Waist	73.2[a]	4.72	80.4[b]	6.01	90.2[c]	9.63	<0.001
Hips	90.0[a]	6.61	95.9[a]	8.83	101.8[b]	11.9	<0.001
Systolic blood pressure (mm Hg)	122.4	14.4	126.4	17.5	130.5	18.0	0.084
Diastolic blood pressure (mm Hg)	73.8[a]	7.82	77.2[ab]	10.9	80.1[b]	13.3	0.046

* post hoc Tukey test
SD – standard deviation
a,b, c – values marked with the different characters differ significantly, $p \leq 0.05$; values marked with the same character do not differ significantly, $p > 0.05$

rarely did any physically activity. Chronic diseases were most frequent among endomorphic subjects. The application of a specialized diet was most popular among endomorphic women, less popular among mesomorphic ones, and the least popular among ectomorphic subjects.

Endomorphic women were significantly more likely to observe body weight fluctuations than those in the other groups (Table 1). All ectomorphic and most mesomorphic subjects were underweight. In contrast, the highest number of overweight or obese women was found in the endomorphic somatotype group (Table 1). They also had a significantly more frequent WHR above 0.8 (predisposition to abdominal obesi-

Table 3. Assessment of energy value and macronutrients intake of groups in dependence on somatotype

Nutrient	Somatotype					
	Ectomorphic n=30		Mesomorphic n=31		Endomorphic n=87	
	Intake*	%**	Intake	%	Intake	%
Energy [kJ]	5605±1258	–	6054±1266	–	6196±1571	
Energy [kcal]	1338±300		1444±302		1479±375	
Total protein [g] (EAR)	60.9[a]±15.6	10.0	62.3[b]±12.2	6.5	68.4[c]±15.8	14.9
Animal protein [g]	41.5[a]±12.1	–	42.7[a]±9.61	–	48.9[b]±13.2	–
Plant protein [g]	19.3±4.98	–	19.5±5.51	–	19.5±7.43	–
Fat [g]	51.9[A]±16.0	33.3	51.7[A]±13.2	45.2	59.1[B]±21.5	35.8
Total carbohydrates [g]	171±40.3		198±50.8		183.5±50.1	
Saturated fatty acids [g]	18.0±6.32	–	21.0±6.94		21.2±8.32	–
Monounsaturated fatty acids [g]	21.8±9.07	–	21.1±7.66		21.9±8.05	–
Polyunsaturated fatty acids [g]	9.16±4.88	–	10.0±4.66		9.48±4.50	–
Cholesterol [mg]	282±125	–	281±116		253±109	–
Sucrose [g]	32.3±16.9	–	32.4±17.5		32.9±20.7	–
Fiber [g] (AI)	18.3±5.48	20.0	17.0±4.58	16,1	16.8±5.68	18,4

* mean ± standard deviation.
** of inadequate (EAR) or adequate intakes (AI) according to Jarosz, 2012.
a,b – values marked with the different characters differ significantly, $p \leq 0.05$; values marked with the same character do not differ significantly, $p > 0.05$; post hoc Tukey test.
A,B – values marked with the different characters differ significantly, $p \leq 0.1$; values marked with the same character do not differ significantly, $p > 0.1$; post hoc Tukey test.

Table 4. Assessment of vitamins intake of groups in dependence on somatotype

Vitamins	Somatotype					
	Ectomorphic n=30		Mesomorphic n=31		Endomorphic n=87	
	Intake*	%**	Intake	%	Intake	%
A (retinol equivalents) [μg] (EAR)	1088±1340	23.3	1110±1335	19.4	1041±1182	28.7
D [μg] (AI)	3.00±3.06	3,3	2.52±1.88	0	3.10±3.08	3,4
E (alpha-tocopherol) [mg] (AI)	8.86^{ab}±3.17	56,7	7.15^{a}±2.40	25,8	9.36^{b}±4.37	50,6
B_1 [mg] (EAR)	0.88^{A}±0.27	43.3	0.84^{A}±0.23	64.5	0.97^{B}±0.32	49.4
B_2 [mg] (EAR)	1.30±0.54	26.7	1.42±0.48	9.7	1.45±0.46	3.4
Niacin [mg] (EAR)	13.2±3.80	30.0	13.1±4.71	35.5	14.5±5.09	27.6
B_6 [mg] (EAR)	1.62±0.44	23.3	1.57±0.47	25.8	1.68±0.45	21.8
Folate [μg] (EAR)	170.3±51.8	100	175.1±51.4	96.8	177.2±50.1	98.9
B_{12} [μg] (EAR)	4.01±3.69	33.3	4.32±3.99	22.6	4.18±3.53	17.2
C [mg] (EAR)	56.7±31.2	56.7	60.9±36.8	54.8	59.6±32.1	55.2

* mean ± standard deviation.
** of inadequate (EAR) or adequate intakes (AI) according to Jarosz, 2012.
a,b – values marked with the different characters differ significantly, $p \leq 0.05$; values marked with the same character do not differ significantly, $p>0.05$; post hoc Tukey test .
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ty) compared to the other somatotypes (Table 1).

Table 2 shows the mean waist and hip circumference values as well as the blood pressure for each somatotype (Table 2). The highest mean waist circumference was found among endomorphic subjects. Differences between individual somatotypes were statistically significant ($p<0.001$). A similar relationship was found in the hip circumference, which was the highest in endomorphic subjects

Table 5. Assessment of minerals intake of groups in dependence on somatotype

Minerals	Somatotype					
	Ectomorphic n=30		Mesomorphic n=31		Endomorphic n=87	
	Intake*	%**	Intake	%	Intake	%
Na [mg] (AI)	1250±362	46,7	1498±547	61,3	1392±493	52,9
K [mg] (AI)	2576±747	0	2590±631	0	2654±736	1,1
Ca [mg] (EAR)	456±220	100	528±181	96.8	520±203	98.9
P [mg] (EAR)	968^{A}±256	6.7	1023^{A}±212	6.5	1088^{B}±273	2.3
Mg [mg] (EAR)	219±56.8	80.0	226±56.2	71.0	234±85.5	74.7
Fe [mg] (EAR)	8.81±3.04	20.0	8.98±3.23	12.9	9.08±3.01	9.2
Zn [mg] (EAR)	7.72±2.22	30.0	7.98±2.03	32.3	8.30±2.10	25.3
Cu [mg] (EAR)	0.91±0.35	20.0	0.96±0.22	19.4	0.98±0.45	19.5
Mn [mg]	3.31±1.22	–	3.83±1.65	–	3.56±1.41	–
I [μg] (EAR)	26.2±19.3	100	25.4±11.2	100	28.4±21.8	98.9

* mean ± standard deviation.
** of inadequate (EAR) or adequate intakes (AI) according to Jarosz, 2012.
A,B – values marked with the different characters differ significantly, $p \leq 0.1$; values marked with the same character do not differ significantly, $p>0.1$; post hoc Tukey test.

and the lowest in ectomorphic ones ($p < 0.001$). Diastolic blood pressure differed significantly within somatotypes and was significantly higher in endomorphic women than in ectomorphic ones ($p = 0.046$).

The average daily energy intake, total protein, animal and vegetable protein, fat, saturated fatty acids, monounsaturated and polyunsaturated fatty acids, cholesterol, sucrose and fiber (Table 3) were estimated based on a 3-day dietary food records. The statistically significantly higher total protein intake was found in the endomorphic subjects, than lower in the mesomorphic ones, and the lowest in the ectomorphic women ($p \leq 0.05$). There was a statistically significant effect of somatotype on animal protein intake. Ectomorphic and mesomorphic women consumed it less than endomorphic ones. In the study group, the tendency to increase total fat intake among endomorphs was also higher in comparison with other types ($p \leq 0.1$). There were no other statistically significant differences in macronutrient intake between somatotypes (Table 3).

The highest intake of vitamin E and the tendency for higher intake of thiamin ($p \leq 0.1$) and phosphorus ($p \leq 0.1$) were observed in women with endomorphic somatotype compared to the other groups. The intake of the other vitamins and minerals was similar in all the subjects regardless of somatotype (Tables 4 and 5).

Discussion

The results presented in this paper for the first time in Poland showed the effects of somatotype on: selected indicators of health status, dietary habits and nutritional status of elderly women. The relationship between somatotype and blood pressure was demonstrated in this study. It was found that endomorphic women had a higher diastolic blood pressure compared to the mesomorphic and ectomorphic ones. A similar correlation has been shown in Kalichman et al. (2004) study, in which the endomorphic subjects were characterized by higher blood pressure than the other types. Similarly, the Herrery et al. (2004) study demonstrated a positive correlation between endomorphic type and higher blood pressure in elderly women. Elevated blood pressure can be a risk factor to the elderly, especially if it coexists with overweight, which may lead to metabolic syndrome. Willett et al. (1995) demonstrated that women with a BMI of 23–24.9 kg/m^2 had a 50% higher risk of coronary heart disease than women with a BMI<21 kg/m^2. BMI> 29 kg/m^2 increased that risk by as much as 350%.

High value of WHR, which correlates positively with excessive fat deposition in the abdominal region, predisposes to many serious diseases. It shows a linear relationship with the incidence of cardiovascular disease including hypertension and dyslipidemia, and diabetes and insulin resistance (Szymoch et al. 2009). Recent studies have shown that central obesity increases the risk of metabolic abnormalities, which are found in 1/3 obese individuals (Suchecka-Rachoń and Rachoń 2007). Studies have also demonstrated that as the waist circumference increases, there is a greater risk of cardiovascular problems and type 2 diabetes. The Heart Outcomes Prevention Evaluation (HOPE) study found that with increased waist circumference there is a higher incidence of hypertension as well as increased cardiovascular death due to myocardial infarction (Chrostowska et al. 2007). The American study also demonstrated that greater waist circumference was associated with an increased risk of metabolic syndrome irrespective of BMI (Ryan et al., 2008). A similar relationship was also found in Williams et al. (2000) study, where the ectomorphic type was negatively correlated with waist circumference. People with endomorphic somatotype are particularly at risk of androgenic obesity, which in elderly people significantly increases the risk of many diseases. The most important recommendation for people with increased WHR is weight reduction, which reduces the risk of cardiovascular disease. An important element of lifestyle is also physical activity, which is recommended for people with abdominal obesity. Essential for the prevention of health problems is the aspect of somatotyping of women, which enables identification of an endomorphic population that could be significantly earlier dealt with for prevention of overweight and obesity, which could in consequence reduce the risk of heart disease and improve blood parameters.

Aging is associated with changes in size, proportions, and composition of the body. There is an increase of fat content in the central part of the body and reduction of growth and muscle mass. In the study participated 148 elderly women: 87 endomorphic, 31 mesomorphic and 30 ectomorphic. This proportion appear to be typical for the population at this age. Buffa et al. (2005), evaluating age-related changes, showed that in elderly men and women (60–89 years), the endomorphic and mesomorphic somatotypes are prevailing in comparison with other age groups, while ectomorphic population is rather low. It can be said that in elderly people endomorphic component develops at the expense of ectomorphic one, which may be a risk factor for the development of metabolic diseases associated with the type and the amount of body fat.

The study was to evaluate the relationship between somatotype and energy along with selected nutrients intake, however significant correlations were observed only between somatotype and the intake of: total protein, animal protein, total fat, vitamin E, thiamine and phosphorus. The highest intake was found in endomorphic women. Raschka and Graczyk (2013) found significant correlation between somatotype and energy as well as carbohydrate intake in men and women aged 40, showing that ectomorphic somatotype correlated positively while endomorphic and mesomorphic ones correlated negative with energy intake. Koleva et al. (2000) observed a strongly developed endomorphic somatotype in the group of people over 40. There was no significant difference in macronutrient intake between different somatotype groups. Most of the subjects showed however exceedingly high intake of vitamin C, sodium and energy. Drywień et al. (2016) study in young females (21–25 years) showed that endomorphs are characterized by the least energy value and macronutrients intake, which indicates that age is an additional factor and implies that further search for other determinants of this tendency are advisable. The observed tendencies draw attention to the nutritional status of the elderly women with ectomorphic somatotype, which may be a factor associated with malnutrition, because their values of BMI indicated the underweight.

There have been no studies conducted so far to evaluate correlation between somatotype and vitamins intake. No studies have explained the reduced vitamin E intake among mesomorphs. The reason for lower intake of this vitamin in women is not known, and this may be due to ignorance about vitamin E rich foods and not eating enough vegetable oils and seeds. This vitamin is an important antioxidant especially for the elderly, and its deficiency may be associated with reduced defense against free oxygen radicals, thus promoting faster cell aging (Piórecka et al. 2010).

Past analyses of somatotype were carried out in groups of young people, usually practicing sports and did not take into account the mineral intake. There are few studies investigating this type of relationship (Bolonchuk et al. 2000; Mendonça et al. 2012).

Somatotype can be a useful and appropriate tool for identifying obesity predispositions. Perhaps this technique will prove to be more accurate and provide more information than ones currently available. This research may be an introduction to further analyses and may serve as a pilot study. There is a need for further study on the relationship between physique and food consumption, eating habits, lifestyle and diseases. Carrying out this type of research in other age groups creates the opportunity to identify negative changes over the years and the enables us to prevent them. Further studies should be done on a larger population of the elderly people using more accurate somatotyping and anthropometric methods.

Conclusions

1. The obtained results showed that the place of residence, physical activity, the incidence of chronic diseases, the application of specialized diet, body weight fluctuations, BMI and WHR were statistically significantly correlated with somatotype in the studied group of women.
2. Endomorphic people were found to have significantly higher waist and hip circumference and higher diastolic blood pressure compared to the other groups of subjects.
3. Somatotype had only a significant effect on total protein, animal protein, and vitamin E intake.
4. Because of the deficiencies of macronutrients, vitamins and minerals in the diets of the examined women, it seems necessary to educate this group, as well as caregivers and doctors in the field of nutrition adapted to the needs of the elderly.
5. There is a need for further, more detailed study on the relationship between somatotype and food intake.

Authors' contributions

MED – main conception and design, statistical analysis and interpretation of data; participation in drafting and revising the article for important intellectual content; JF, MG – analysis and interpretation of data, writing and editing the contents according to journal style; BW, PZ, KW, – data collection, preparation of the output database; SK – participation in drafting and revising the article, preparation of the English version.

Conflict of interest

All authors declare no conflict of interest concerning this manuscript.

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