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ORIGINAL ARTICLE

NUTRITION AND NOURISHMENT STATUS OF POLISH STUDENTS IN COMPARISON WITH STUDENTS FROM OTHER COUNTRIES

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ABSTRACT

Background. Although Poland belongs to the economically developed countries, social transformations affect people's incomes and, consequently, their diets, what in many cases caused development of diet-related diseases. Results of epidemiological studies among students show symptoms of certain civilization diseases.

Objective. The aim of this study was to compare the intake of nutrients by Polish students in our study with the nutrients intake by students from other university centres abroad and the determination of the direct impact on health parameters of educated people.

Material and Methods. The study involved 329 Polish students. The dietary information was collected by interview on food intake during the last 24 hours. The index of BMI and WHR were calculated using anthropometric method. 27 nutrients, dietary fibre and daily total cholesterol intake with the computer program „Dietetyk 2" (National Food and Nutrition Institute, Warsaw, Poland).

Results. Both women and men consume inadequate amounts of milk and dairy products, fruits, vegetables, vitamin C and iron. The average daily intake of vitamin C and iron was below the standard of nutrition. Diets in men was characterized by excessive content of meat and in women sucrose. 35% of the students surveyed were overweight or obese. There was a lot of irregularities in the diet of both women and men, but men's diet was more balanced in terms of nutrient content than the diet of women.

Conclusions. The delivery of thiamine, riboflavin, calcium, and vitamin C is less in Polish students than in other populations compared. Nutritional mistakes and dietary habits during studies can influence the development of disease in young educated people.

Key words*: malnutrition, nourishment status, diet, students, vitamins, minerals*

STRESZCZENIE

Wprowadzenie. Chociaż Polska należy do krajów rozwiniętych gospodarczo, zachodzące przemiany społeczne po wejściu do UE wpływają na dochody ludności i w konsekwencji na ich nieprawidłową dietę. Wyniki badań epidemiologicznych wśród studentów wskazują możliwość wystąpienia wielu chorób dietozależnych.

Cel. Celem badań było porównanie sposobu żywienia polskich studentów ze sposobem żywienia studentów z innych krajów.

Materiał i metody. W badaniu wzięło udział 329 polskich studentów. Informacje na temat żywienia zbierano metodą wywiadu o spożyciu żywności z ostatnich 24 godzin. Obliczono średnie wartości wskaźników antropometrycznych BMI i WHR badanych osób z podziałem na płeć. Wyliczono zawartość 27 składników pokarmowych, błonnika oraz całodziennie spożycie cholesterolu przy użyciu programu komputerowego „Dietetyk 2" (Instytut Żywności i Żywienia, Warszawa, Polska).

Wyniki. Zarówno kobiety, jak i mężczyźni spożywali niedostateczne ilości mleka i jego przetworów, warzyw i owoców oraz witaminy C i żelaza. Średnia dziennego spożycia witaminy C i żelaza była poniżej normy żywienia. Diety mężczyzn charakteryzowały się nadmierną zawartością mięsa, a kobiet sacharozy. 35% badanych studentów miało nadwagę lub otyłość. Obserwowano wiele nieprawidłowości w sposobie żywienia zarówno kobiet jak i mężczyzn, jednak dieta mężczyzn była lepiej zbilansowana pod względem zawartości składników pokarmowych niż dieta kobiet.

Wnioski. Zagrożeniem dla zdrowia studentów płci męskiej jest wyższe spożycie cholesterolu i sodu. Polscy studenci spożywali mniej tiaminy, ryboflawiny, wapnia i witaminy C, niż porównywane populacje. Błędy i nawyki żywieniowe nabyte w okresie studiów mogą wpływać na rozwój chorób u młodych wykształconych osób.

Słowa kluczowe*: niedożywienie, stan odżywienia, dieta, studenci, witaminy, składniki mineralne*

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INTRODUCTION

Rational nutrition is the one of the major determinant of human health and wellbeing. The food ingested is a source of many nutrients essential for tissue regeneration and growth, and for the formation of the so-called body reserves controlling vital functions. During adolescence, anabolic processes dominate over catabolic ones, therefore an increased supply of energy-rich and body building substances in the form of complete protein is indispensable. Mind activity associated with learning processes involves substantial energy expenditure necessary to cover the demand resulting from muscle tension and emotions experienced. In Poland, approximately 20% of the population suffer from health disorders caused by diet-related diseases [29]. It should be noted that diseases which were responsible for most of the deaths in Europe and North America in the 19th century are not the major cause of deaths any more at present on account of improved economic, sanitary, and health condition of human populations which reduced the incidence of contagious and infectious diseases. On the other hand, the incidence of heart diseases, obesity, diabetes, and cancer of the digestive system and lungs is increasing [5]. Recently, a number of young people taking up full-course studies (mainly at institutions offering economy- and technology-related education) have been observed to significantly increase in Poland. Thus, effects of incorrect dietary habits may affect a considerable proportion of young people in Poland. Results of epidemiological studies involving this group of population show symptoms of certain civilisation diseases to occur earlier than expected from the biological age alone.

Our results from the Westpomeranian area (Szczecin, Poland) compared with the results of studies conducted in other academic centres in Poland. Taken into account academic centres of Olsztyn, Krakow, Warsaw, Poznan, Lodz, Wroclaw and Bialystok. In most centres studied depending on the consumption of nutrients and energy were similar [27].

Although Poland belongs to the economically developed countries, social transformations affect people's incomes and, consequently, their diets. Therefore it seemed interesting to compare results of nutrients intake by Polish students with nutritional data concerning students from other countries.

MATERIALS AND METHODS

Study subjects

The data for this study were collected from a total of 329 students (271 women and 58 men), aged 22.9 year on the average, of Food Technology and Human Nutrition (non-random selection) at the West Pomeranian University of Technology (WPUT) in Szczecin (Poland). Participation in these studies was 92%. (8% refused to participate in the study). The uneven sex ratio was a result of the course type, attracting more women than men.

Nutritional interview

The dietary information was collected by asking the subjects to fill a questionnaire related to their dietary history and the double food taken up during the previous 24 h (nutritional interview was carried out in a dozen groups on all the days of the week). Nutritional interview included questions about consumption of fortified foods and dietary supplements. The questionnaire developed for the study contained also questions concerning general socio-demographic characteristics, fortified food intake, diet supplementation, smoking, and the use of drugs and oral hormonal contraceptives (i.e., factors that could have influenced the blood level of certain vitamins). The data on socio-economic factors are presented in another article [28]. The study deliberately involved students whose knowledge concerning rational diets, appropriate nutrition, and healthy food habits would be expected to be higher than average. To determine the portion size, the subjects used "The album of photographs of food products and dishes" [30]. Contents of energy and 27 nutrients (protein, total lipids, saturated fatty acids (SUFA), monounsaturated and polyunsaturated fatty acids (MUFA, PUFA), carbohydrates, saccharose, lactose, vitamins A, D, E, C, cobalamin, pyridoxine, thiamine, riboflavin, niacin, folacin, calcium, phosphorus, magnesium, iron, sodium, potassium, zinc, copper, and manganese), dietary fibre, and cholesterol in students' total daily intake (TDI) were calculated (with a due consideration to culinary losses) with the 'Dietetyk 2' computer software recommended by the Food and Nutrition Institute (IŻŻ) in Warsaw, Poland. In addition, contents of products from each of the food groups were assessed according to *Turlejska et al*. [31].

Anthropometric measurements

Height, weight, waist circumference were assessed according to standardized protocols in the Department of Human Nutrition. For the nourishment status assessment, the *Quetelet* index (BMI) and the visceral obesity factor (WHR) were used. The reference ranges assumed were 18.5–24.9 for BMI [8] and WHR values below 0.8 and 1.0 for women and men, respectively [3].

Statistical analysis

The results were statistically analyzed using the soft-ware package STATISTICA 8.0 (Statsoft, Tulsa, Oklahoma, USA). The arithmetical mean (x) and stan-

dard deviation (SD) and the significance of differences with ANOVA were calculated. Data on nutrients intake were expressed as arithmetical mean to facilitate comparison with other authors. Because most of the distributions differed from the normal distribution (*Shapiro-Wilk* test), further analysis involved nonparametric tests. The data on nutrient and energy contents of the students' diets were subjected to statistical treatment, involving *Tukey's* test (applied at the 5% confidence level) to detect significant differences between the groups examined.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Bioethical Committee of the Pomeranian Medical University in Szczecin (approval No BN-001/12/06).

RESULTS

Most of the students examined (71.2% women and 67.3% men) were non-smokers (Table 1). Drugs use episodes were reported by 3.3% of the population, whereas oral contraceptives were used by 34.3% of the women (Table 1). As shown by the questionnaires, most of the students (48.7% of women and 51.7% of men) and consumed fortified food (66% of women and 50% of men). The decision to supplement the diet was most often taken on a student's own account and was not always informed, for which reason the nutrient being supplemented was not always the necessary one.

The majority of the subjects (84.8% of women and 69% of men) showed their BMI within the appropriate range (Table 2). The visceral obesity factor (WHR) values allowed to assign most of the subjects to the preferred gynoidal type, whereas more than 30% of the population showed the unfavourable adipose tissue distribution of the androidal type (Table 2).

As shown by the data concerning dietary habits, as little as 6% of the population examined took meals at fixed times (Table 1), while 5% of the population consumed less than three meals a day. More than 80% of the students had breakfast before leaving home for school. Hot dinners at least 5 times a week were enjoyed by more than 50% of the population. The questionnaires showed substantial between-gender differences concerning the last meal of the day (supper): while the women took it two hours before bedtime, the men had supper just before going to bed. More than one-third of the population studied ate snacks between meals, the snacks consisting mostly of fruits, juices, and salads (55.6-46.7%), but also sweets (25.7-21.5%).

The data showed the women's TDI to be substantially nutrient-poorer than the men's TDI, the differences being significant in most nutrients except for vitamins C and E and calcium (Table 3a). In terms of energy-supplying macronutrients, both women's and men's diets turned out to contain too much lipids and too little carbohydrates (Table 3b).

Analysis of diets from the standpoint of major food groups consumed revealed the women to eat too little of the major foods, particularly milk and fermented milk products, cottage cheeses, potatoes, bread, vegetables,

Table 1. Anthropometric and demographic characteristic and dietary habit assessment [%] of examined students (n = 329)

Characteristic	Answers	Women (n=271)	Men (n=58)
Age (years)		22.8	22.9
Height (cm)		167	179
Weight (kg)		58.7	76.5
BMI (kg/m^2)		21.2	23.6
WHR		0.79	0.91
Tobacco use (%)	Current smokers	28.8	32.7
	Non-smokers	71.2	77.3
Drug use episodes (%)	Yes	2.9	5.2
	No	87.1	84.6
	No answer	10	10.2
Use of oral contraceptives (%)	Yes	34.3	-
	No	75.7	-
Supplementation (%)	Yes	48.7	51.7
	No	51.3	48.3
Fortified food use (%)	Yes	66	50
	No	34	50
Number of meals:	1-2	5.4	3.2
	3	31.9	42
	4	45	41.6
	5 and more	17.7	13.2
Breakfast before leaving home:	Yes	83.6	80.2
	No	16.4	19.8
Number of cooked dinners per week:	Every day	35.2	28
	5-6	17.6	38
	3-4	29.6	22.5
	1-2	17.6	11.5
Eating between meals:	Yes	34.5	34.5
	No	8	25
	Occasionally	57.5	40.5
Type of snacks:	Sweets: mainly chocolate bars	25.7	21.5
	Crisps, munchies, salty sticks and salted nuts	7	10
	Nuts, sunflower or pumpkin seeds (unsalted)	6.3	3.1
	Fruits, salads, juices	55.6	46.7
	Sandwiches, yoghurts	5.4	18.7
Number of hours between supper and bedtime:	2h and more	61.2	35
	1-2h	18	32
	Less than 1h before bedtime	20.8	43

Table 2. Structure of BMI and WHR indices (a) and proportion of energy from macronutrients in TDI (b) of examined students (n = 329)

Index	% women	% men
BMI		
<16	0	0
16.0-16.9	0	0
17.0-18.4	7.4	6.9
18.5-24.9	84.8	69
25.0-29.9	7.4	17.2
30.0-39.9	0.4	6.9
>40	0	0
WHR type		
Gynoidal type	64.2	67.2
Androidal type	35.8	32.8

legumes and, to a lesser extent, sausages, fish, and fruits. On the other hand, the women's consumption of sugar and sweets was too high. The men turned out to take up too much lipids, especially mixed and animal lipids, eggs, sausages, meat, and poultry, whereas men's uptake of sugar and sweets could be regarded as appropriate [14].

DISCUSSION

The BMI index data showed the proportion of the Polish West Pomeranian University of Technology in Szczecin students with obesity stage I and II to be comparable to that in other regions of the world (Tables 2 and 4). In women, a similar BMI structure was evident among female students in Iran [21] and Hungary [2]. In Turkey, the proportion of obese women was lower [15], but it was higher in female students in North Dakota (USA) [4]. With respect to male students, obesity is a problem that concerns not only the Polish students, but also those in the USA [4], Turkey [15], and Hungary [2]. It seems that the young people a better indicator of obesity than BMI is body fat (BIA) and its distribution in the body (WHR) [11].

Obesity of young adults is linked to low physical activity, which significantly increases the threat of future arterial hypertension and heart disease [1]. The Australian study showed that transport students to school is associated with decreased cardiovascular fitness and respiratory. While active commuting may not be of sufficient energy expenditure to impact upon BMI [19]. It should be noted that in the US, obese are even children suffering from diseases related to poor nutrient assimilation. Obesity was reported to affect 10% of children with *Crohn's* disease and, depending on the institution, from 20 to 30% of patients with ulcerative colitis [16].

In a study involving a group of female medical students, *Gores* [9] observed women who had gained weight during their first year in college to tend to continue gaining weight during their studies. Moreover, the first-year female students who chose slimming diets gained an average of 5 kg, a lower weight gain (an average of 1.6 kg) being observed in those students who did not pursue such diets [6].

Table 3. Diet energy and component contents in TDI of examined students (n = 329).

a)	Mean (SD)			Mean (SD)	
Factor	women n = 271	men n = 58	Factor	women n = 271	men n = 58
Energy [kcal] *	1735.7^{a} (488.6)	2443.8^{b} (615.3)	Mg [mg] *	256^{a} (105.7)	309.9^{b} (126.1)
Protein [g] *	61.64^{a} (19.43)	87.94^{b} (22.28)	Fe [mg] *	9.16^{a} (2.96)	12.6^{b} (3.57)
Lipids [g] *	66.8^{a} (29.03)	101.9^{b} (38.9)	Zn [mg] *	8.43^{a} (2.62)	11.7^{b} (3.12)
SUFA [g] *	24.9^{a} (10.7)	39.9^{b} (16.9)	Cu [mg] *	1.0^{a} (0.48)	1.2^{b} (0.38)
MUFA [g] *	27.1^{a} (13.6)	42.1^{b} (17.8)	Mn [mg] *	4.13^{a} (1.94)	5.17^{b} (2.65)
PUFA [g] *	10.8^{a} (9.13)	14.6^{b} (9.01)	Vitamin A [µg]*	979.6^{a} (731.4)	1199.8^{b} (502)
Cholesterol [mg] *	202.1^{a} (102.2)	461.4^{b} (157.8)	Vitamin D [µg]*	2.13^{a} (1.48)	3.54^{b} (2.63)
Carbohydr.[g] *	238.6^{a} (68.92)	314.1^{b} (83.2)	Vitamin E [mg]	7.8^{a} (6.2)	9.90^{a} (4.68)
Saccharose [g] *	62.7^{a} (32.8)	74.1^{b} (35.7)	VitaminB1[mg]*	0.98^{a} (0.43)	1.43^{b} (0.59)
Lactose[g] *	9.17^{a} (8.41)	12.27^{b} (12.85)	VitaminB2[mg]*	1.30^{a} (0.41)	1.80^{b} (0.69)
Dietary fibre [g] *	16.54^{a} (5.82)	22.14^{b} (6.19)	Niacin [mg]*	12.32^{a} (6.13)	17.93^{b} (6.91)
Na [mg] *	1692.4^{a} (821.4)	2814.8^{b} (1025.4)	VitaminB6[mg]*	1.56^{a} (0.56)	2.13^{b} (0.94)
K [mg] *	2627.4^{a} (815.5)	3220.4^{b} (1186.2)	Folic acid [µg]*	154.05^{a} (44.8)	188.85^{b} (54.7)
Ca [mg]	589.5^{a} (305.3)	622.4^{a} (371.2)	VitaminB12[µg]*	3.50^{a} (2.03)	4.98^{b} (3.01)
P [mg] *	1064.9^{a} (353.8)	1464.7^{b} (416.6)	Vitamin C [mg]	44.80^{a} (28.4)	45.33^{a} (30.1)

a, b; homogenous groups (*Tukey* test), * - statistical differences between women and men ($p<0,05$)

b)

Proportion of	Women n= 271		Men n=58	
energy from	mean	SD	mean	SD
Protein	14.1	3.53	14.0	4.87
Lipids	35.6	7.84	37.2	13.05
Carbohydrates	50.3	8.12	48.8	16.65

The Polish female students (average height of 167 cm) were taller than the Greek [17], Iranian [21], Spanish [22], Hindu [13], Turkish [15], and Nepalese women students [10] examined in the studies referred to, the difference between the Nepalese and Polish women amounting to 18.3 cm.

As shown by Tables 4 and 6, the energy intake by the female WPUT students in 2006-2008 was similar to the values reported for the female student populations in Japan [20], Iran [21], Greece [17], and Spain [22].

The protein intake by different populations was more variable, a higher intake being observed in the women in Spain [22] and in both sexes in the USA [4]. The high animal protein contribution to the diet (74% of the total protein consumed) was an additional unfavourable factor. A lower (by 4.1 g) protein contribution to the diet was reported for the Greek women [17], the protein contribution in the remaining populations compared being similar. The excess protein, particularly the methionine-rich animal protein (methionine being a homocysteine precursor) with the concurrent deficiency of vitamins B (riboflavin, pyridoxine, cobalamin, folic acid, choline) may enhance the development of atherosclerotic changes within the vascular walls. An insufficient intake of arginine, present mainly in plant protein, may reduce the nitrogen oxide concentration and increase the blood pressure [26].

For a fairly long time, the intake of carbohydrates in Poland has been observed to remain too low [23], an effect evident also in the student population examined. A higher intake of carbohydrates by both men and women was reported from China [5]. Saccharose poses a serious health threat as it contributes to increasing the sensitivity [12]. This study demonstrated an excessive intake of the nutrient, which may enhance metabolic disorders and caries.

Intake of saturated fatty acids (SUFA) by the male Polish students was lower (by an average of 7.2 g) than that reported for male students in Athens (Greece) [17]. Among women, the dietary SUFA content was similar to that reported from Greece [17], Spain [22], and Iran [21], and was by 8.1 g higher than the level reported by *Murakami* et al. [20] for the women in Japan. The adverse effects of SUFA include increased blood Unfavourable influence of SUFA is connected with intensified blood clotting as a result of thrombocyte activation and increased fibrinogen concentration.

As shown by the data in Table 3a, the diets of the student group examined contained too little essential unsaturated fatty acids (EUFA) and the diet fatty acid ratios were far from appropriate. A relevant comparison of averaged UFA intakes revealed the diets of Spanish and Iranian female students to be richer in mono- (by an average of 13.7 g) and polyunsaturated acids (by an average of 6.4 g), respectively (Table 5). The fatty acid intake may be associated with certain health risk posed by *trans* isomers. Compared with UFA, they are more likely to produce adverse effects as they reduce the blood plasma HDL cholesterol and increase the LDL fraction concentrations. Moreover, *trans* fatty acid isomers were observed to be human atheromatous plaque components [25].

The Szczecin students examined were found to vary considerably in their cholesterol intake which was very low in the females, but significantly exceeded the standard level in the males. The daily cholesterol intake by individuals with elevated atherosclerosis risk (in the present authors' opinion, the risk is closely associated with smoking and low physical activity) should not exceed 200 mg.

The contribution of dietary fibre to the Szczecin students'(both males and females) diets was lower than that found in the diet of Chinese students [5] and also lower than recommended for a balanced diet. However, the dietary fibre intake by the Polish students was comparable with that recorded in Spanish students [22]. Taking up the recommended dose of dietary fibre, particularly its soluble fraction which reduces the blood cholesterol and glucose levels, is crucial on account of a potential blood pressure reduction. Therefore, it is advisable to intake 30-40 g of dietary fibre a day.

As far as the vitamin intake is concerned, of a great importance are the differences in vitamin E intake among students from various countries. Vitamin E intake reported by female Spanish [22], Greek [17], and Iranian [21] students was considerably lower than that of the Szczecin students (Table 6). Antioxidants (vitamins E, C, A, and β-carotene), taken up in appropriate doses, inhibit lipid peroxidation, enhance arterial blood pressure reduction, increase cell insulin sensitivity, improve the function of cardiac blood vessels, and reduce thrombocyte aggregation [26]. An appropriate contribution of vitamin E to daily diet may be helpful in the *Alzheimer's* disease treatment. However, vitamin E supplementation proved ineffective in the *Parkinson's* disease treatment [7].

Vitamin D deficiency, observed in diets of students is also problem in some populations from the other countries. *Islam* et al. [13] reported vitamin D deficiency in diets of Bangladesh women, regardless of age.

Intake of vitamins B (thiamine and riboflavin) by the Szczecin students was lower than the intake reported from other parts of the world [10]. However, interpretation of the data is hindered by substantial differences in the recommended daily riboflavin uptakes between Poland and other European countries.

The niacin content in female diets was similar in all the countries for which the data were available. On the other hand, the Szczecin male TDI contained less (by an average o 3.8mg) niacin than the TDI of male Greek students [17], as opposed to the pyridoxine intake

Table 4. Comparison of anthropometric characteristics of students from other countries

Determinant	Greece –Crete, Women [20]	Iran – Teheran, Women [9]	Spain – Madrid, Women [21]	Hungary – Budapest, women [10]	India –Bangla-desh, women [22]	Turkey – Ankara, women [11]	Nepal, women [23]	USA - North Dakota, women [12]	Greece –Crete, men [20]	Hungary, men [10]	Turkey –Ankara, men [11]	USA - South Dakota, men [12]
BMI range												
<18.5	-	10.3	-	11.3	-	20.7	-	6.4	-	3.8	4.7	0.8
18.5-24.9	-	77.3	-	77.4	-	72.0	-	71.9	-	69.2	68.7	44.2
25.0-29.9	-	10.8	-	9.1	-	6.7	-	16.4	-	24.4	24	39.7
30.0-39.9	-	1.6	-	2.2	-	0.7	-	5.3	-	2.6	2.7	15.2
BMI average	22.7	21.7	21.2	21.4	22.2	20.7	19.6	-	24.5	23.4	23.4	-
Height [cm]	165.5	166.7	162.5	-	155.5	164.8	148.7	-	176.4	-	178.1	-
Body mass [kg]	62.3	60.4	56.1	-	53.8	56.2	43.4	-	76.4	-	74.3	-

Table 5. Comparison of energy, dietary fibre and cholesterol of students from different countries.

Diet component	Greece– Crete, women [20]	Spain – Madrid, women [21]	Japan, women [24]	Iran – Teheran, women [9]	China, women, men [2]	USA, women, men [2]	Greece – Crete, men [20]
Energy (kcal)	1675	1911	1764	1810	2640	2360	2493
Protein [g]	57.5	79.8	61.3	60.5	64	95	87.5
Carbohydrates [g]	193	201.9	243	226.5	470	240	276.2
Dietary fibre [g]	13.7	16	12.5	13.9	33	12	16.9
Lipids [g]	74.9	91.4	58	76.7	-	-	36.5
SUFA	24.4	28.3	16.8	26	-	-	47.1
MU FA	32.3	40.8	20	28.9	-	-	14.5
PUFA	8.6	9	12.7	17.2	-	-	112.6
Cholesterol [mg]	205.3	322.3	-	215.4	-	-	300.3
Proportion of energy from:							
Protein	14.1	16.7	13.9	-	13	20	14.2
Lipids	39.2	42.1	29.6	-	15	38-40	41
Carbohydrates	46.7	38.8	55.1	-	72	40	44.8

Table 6. Comparison of vitamin and minerals intake of students from different countries

Vitamins & minerals	Greece – Crete, women [20]	Spain – Madrid, women [21]	Japan, women [24]	Iran –Teheran, women [9]	China, women, men [2]	USA, women, men [2]	Greece – Crete, men [20]
vitamin A [µg]	882.5	980.7	888	836	429	909.1	-
vitamin D [µg]	-	-	-	-	-	-	-
vitamin E [mg]	6.2	6.5	6	-	-	8.9	-
vitamin B_1 [mg]	1.3	1.1	1.2	2.3	1.4	2.2	-
vitamin B_2 [mg]	1.5	1.5	1.5	0.8	1.9	2.2	-
niacin [mg]	14	12.8	-	-	-	21.7	-
vitamin B_6 [mg]	1.3	1.41	-	-	1.1	1.9	-
folic acid [µg]	220.7	163.7	-	-	177.8	282.7	-
vitamin B_{12} [µg]	3.8	5.7	-	-	3.7	5.3	-
vitamin C [µg]	144.5	110.9	68.8	140	73	146.1	-
Na [mg]	1660	-	-	1438.5	-	-	2591
K [mg]	2361	-	-	1808.6	-	-	3091
Ca [mg]	744	-	-	642.7	-	-	990.9
P [mg]	986	-	-	936.1	-	-	1389
Mg [mg]	212.7	-	-	210.4	-	-	260.7
Fe [mg]	9.7	-	-	12	-	-	13.7

which was comparable to that reported from the Greek population. The Szczecin female students' dietary cobalamin content was lower than that reported by [22].

The vitamin C content in diets of the Szczecin male and female students was insufficient, as opposed to the data reported from other parts of the world: the ascorbic acid

level in diets of Greek [17], Spanish [22], and Chinese [5] students was almost twice that of the Szczecin students.

Similarly high dietary sodium uptakes by male and female students were reported by various authors from all over the world (Table 6) [21,17]. Sodium chloride intake depresses nitrogen oxide (NO) synthesis and reduces insulin sensitivity, thus resulting in arterial hypertension (AH). Sodium effects on arterial blood pressure are intake to be related to sodium co-occurrence with chlorine [18].

The potassium supply in the Szczecin students' diet did not differ from the average intake levels reported from other countries. Similar was the case with respect to the calcium contribution to the Szczecin female students' TDI. On the other hand, the calcium intake by the male Szczecin students was lower (by ca. 368 mg) than that reported by Mammas et al. [17]. The magnesium contribution to TDI of the Szczecin female students was higher (by an average of ca. 44 mg) than in diets of Greek [17] and Iranian women [21].

Among the minerals contained in the Szczecin students' diets, the intakes of iron, copper, and zinc were the lowest. It has to be borne in mind that those metals are important cofactors of many enzymatic reactions in the body, and that deficiencies of those metals are tightly correlated with anaemia.

Analysis of data on amounts of energy provided by macronutrients in the diets examined showed the proportion of energy derived from protein should be regarded as appropriate and was similar to data reported by other authors (Table 5). A higher (by *ca*. 5.6%) proportion of energy provided by protein was observed in the USA female and male students [4] as well as in female students in Spain (by *ca*. 2%) [22]. This study allowed to conclude that the Polish students should derive a higher proportion of energy from carbohydrates [28]. The female Japanese students' diet [20] was optimal in terms of the amount of energy supplied by carbohydrates [20], whereas in the Chinese students' diets [5], carbohydrates accounted for a too high energy supply (72% of the total energy supplied by the diet). In the present study, the proportion of energy supplied by lipids was far too high in both female and male students. The data reported from Greece [17], Spain [22] and the USA [4] showed lipids to account for a similar or slightly higher proportion of energy. It should be, however, noted that the Greek and Spanish diets are rich in olive oil which contains considerable amounts of oleic acid and polyphenols acting as antioxidants. Moreover, the Mediterranean diet, currently considered as one of the healthiest there are, contains numerous components which are responsible for favourable effects on the endothelium functions and prevent oxidation of plasma lipoproteins [24]. For those reasons, the Mediterranean diet is recommended in ischemic heart disease prevention.

Analysis of the Polish students' diet composition in terms of food product groups confirmed the long-term trend in the Polish adult diet structure. Comparison of the data obtained in this study with the corresponding evidence on the TDI of Greek students (17) revealed certain shared and some differing characteristics. Similar was the consumption of products such as bread, grits, milk and fermented milk products. The largest differences concerned the dietary amounts of fish and shellfish, nuts, fruit juices, legumes, vegetables and fruits, the intake of which was considerably higher among the Greeks whose diet (particularly with respect to that of males) contained less lipids, sugar, potatoes and meat than the diet of the Polish students.

The Szczecin students' diets contained too little milk and milk products, especially fermented milk-based beverages, which may result in dietary calcium and riboflavin deficiency and enhance metabolic disorders and the occurrence of osteoporosis later in life.

CONCLUSIONS

1. According to the measurements of anthropometric indicators (BMI, WHR) Polish student population does not differ from European populations. There is no changes in the range of increase in overweight (BMI of 25-29.9) what is comparable to that occurring in the USA.
2. Percentage of energy from lipids in Poland is comparable to other European countries, but lower than in the US and more than half higher than in China.
3. The higher intake of cholesterol and sodium by Polish male students causes increased health risk.
4. Polish students intake less thiamine, riboflavin, calcium, and vitamin C in comparison to the other analysed populations.
5. The alarmingly low dietary intake of vitamin C and iron by the female students and vitamin C by the male students may be a reason of anaemia and reduced quality of their life.

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Conflict of interest

The authors stated that there are no conflicts of interest regarding the publication of this article.

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