

Nutritional status and food choices among first year medical students

Research Article

Emilia Kolarzyk^{1*}, Andrei Shpakou², Ewa Kleszczewska³,
Ludmila Klimackaya⁴, Skaiste Laskiene⁵

*1 Department of Hygiene and Dietetics, Jagiellonian University, Medical College,
7 Kopernika Street, 31-034 Krakow, Poland*

*2 Department of Sport Medicine and Rehabilitation Yanka Kupala, State University
of Grodno, Belarus 22 E. Ozheshko str, Grodno 230023, Belarus*

*3 Department of Physiotherapy, The Institute of Cosmetology and Health Care,
Krakowska 9 str, Bialystok, Poland*

*4 Department of Hygiene, Krasnoyarsk State Medical University,
1 Partizana Zheleznyak str., Krasnoyarsk, Russia*

*5 Department of Philosophy and Social Sciences, Lithuanian University of Health Sciences,
9 A. Mickevičiaus str., 44307 Kaunas, Lithuania*

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Abstract: Purpose: To examine the food choices and estimate the prevalence of underweight, overweight and obesity among medical students from four Central Eastern European countries. Methods: We examined 1517 students from Poland, Belarus, Russia and Lithuania aged 20.9 ± 1.97 years. Body weight, height, the thickness of 3 skinfolds and body-fat% were measured and BMI was calculated. The consumption frequency of 39 food products was determined and the differences were estimated by Tukey's procedure. The food products connected with obesity risk were identified by multivariable logistic regression. Results: In 985 female students, underweight was observed more frequently than overweight and obesity, particularly in Belarusian women (16.9% vs 7.2%). In 532 male students, overweight and obesity were observed more frequently than underweight. Body-fat% and skinfold thicknesses were the highest in Russian men. The students ate sweets, light bread, butter and red meat too frequently and except for Belarusians, poultry meat, fish and whole grain dark bread too rarely. Conclusion: The nutritional program was implemented and the suggestion was addressed to the university governments to support the canteens with inexpensive, but well balanced, meals. Noodles, sweet drinks, butter, pork fat, cream, light bread and bread rolls should be limited in the students' dietary scheme.

Keywords: BMI • Food products • Consumption frequency • Skinfolds • University students

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1. Introduction

Political, economic and social changes that occurred in the 1990s in Eastern and Central Europe caused huge changes in the life style as well as in the area of health awareness [1,2]. A nutritional revolution is presently being observed, with the tendency moving from under-nutrition to over-nutrition. At the same time, there are many nutritional restrictions (mainly in females) connected with the desire for a slim figure, especially among young women [3].

Many investigations have shown that among young people in Poland and other countries of Eastern and Central Europe there is a high and widespread prevalence of risk factors of cardiovascular system diseases and metabolic diseases. The main reasons for these disturbances are inadequate food intake and improper dietary habits [4,5], which then lead to obesity or overweight [6-8]. It should also be mentioned that insufficient social health awareness, loss of personal discipline necessary for healthy behaviours and low access to nutrition specialists

* E-mail: mykolarz@cyf-kr.edu.pl

are commonplace [5,9]. Our previous studies indicated that university students are one of the social groups in which the various nutritional faults, such as avoiding main meals, consumption of snacks between meals, fast food consumption, night snacking, weight loss diets on one hand, but also high-energetic and unbalanced diet usage on the other hand, are often reported [10,11]. According to social expectations, it would seem obvious that young people after graduation from university should play a leading role in health promotion. It should be added that graduation from the higher education system does not always mean that students received proper knowledge to maintain optimal healthy behaviours [12] and proper diet-related attitudes [3].

The aim of the study was to evaluate the prevalence of underweight, overweight and obesity among medical university students living in different social and economic conditions in Poland, Belarus, Russia and Lithuania, to assess the potential differences in the consumption frequency of 39 food products and to identify the products that are connected with obesity risk.

2. Materials and methods

In all, 1517 medical university students (mean aged 20.9 ± 1.97 years) from four countries were included in the study: Poland (PL) from Universities in Krakow and Białystok, 614 (421 women and 193 men); Belarus (BY) from University in Grodno, 303 (183 women and 120 men); Russia (RUS) from University in Krasnojarsk, 284 (222 women and 62 men); Lithuania (LT) from the University in Kaunas, 316 (159 women and 157 men). All subjects gave informed consent prior to their recruitment in the study. The study received approval from the Ethics Committee for Human Research of Jagiellonian University, Medical College. The initial project was conceived by authors from Poland and Belarus. The pilot study, including 100 students from

these countries, was carried out to check the common methods and instruments. Next, the authors from Russia and Lithuania were invited to cooperate. We contacted them personally or by telephone and email to explain the study and to translate the necessary materials and questionnaires. In spring 2009, the examination in its present form was carried out, with identical methods being used in all four countries. The study was conducted with first-year university students from the Medical Faculty and Health Protection Faculty. The students voluntarily participated in the study; the number of students in each country and of each sex was in proportion to the total number of students in particular University.

For every person studied, basic measurements were done: body weight (students were on an empty bladder, not having exercise, food or drink for at least three hours before having the measurements) and height (students were asked to take off their shoes), and on the basis of these measurements, Body Mass Index (BMI) was calculated. The following ranges of BMI were specified: $<18.5 \text{ kg/m}^2$, underweight; $18.5\text{--}24.9 \text{ kg/m}^2$, proper weight; $25.0\text{--}29.9 \text{ kg/m}^2$, overweight; $>30.0 \text{ kg/m}^2$, obesity.

Body fat mass was measured by infrared interactance method using Futrex 6100/ZL (FUTREX INC., Western Maryland Parkway, Hagerstown, MD). The thickness (mm) of triceps skin fold, subscapular skin fold and suprailiac skin fold were measured using the Lange Skinfold Calliper (Cambridge Scientific Instruments, Cambridge, MD). The circumference of arm muscles (cm) was measured according to the following formula: arm circumference $-(\pi \times \text{triceps skinfold})$ [13].

The consumption frequency of 39 food products during the previous month before the examination period was estimated using the Questionnaire of Food Products Frequency Intake as validated and recommended by the National Food and Nutrition Institute in Warsaw, Poland. The examined food products were classified to 12 groups (Table 1).

Table 1. The groups of food products examined.

No	GROUP	PRODUCTS
1	dairy products	milk and milk soups, yoghurt and kefir, cottage cheese
2	eggs	eggs
3	meat	pork, beef and veal, ham and sausages, pork-butcher's products, poultry, fish
4	fast food	for different availability to this kind of food in particular countries, hamburgers, cheeseburgers, fish-burgers, casserole were considered together
5	animal fats	pork fat and lard, butter, cream
6	vegetables fats	olive oil, sunflower and soya-bean oil, margarine
7	fruits and vegetables	fresh fruit and fruit juice, fresh vegetables and vegetable juice, potatoes
8	pulse	bean, peas, soya, lentil
9	cereal products	dark and light bread, bread rolls, rice and cereals, noodles
10	sweets	sugar, sweets and honey, jams and candied fruits, chocolate products, cakes and layer cake, sweets drinks
11	alcohol drinks	vodka, beer, wine
12	coffee, tea	coffee, tea

Table 2. Anthropometric characteristics of female and male students.

Parameter	*	Poland (1)		Belarus (2)		Russia (3)		Lithuania (4)		Tukey's test p<0,05
		X	SD	X	SD	X	SD	X	SD	
Height [m]	W	1.66	0.07	1.68	0.05	1.66	0.06	1.70	0.06	4:1;4:3
	M	1.80	0.07	1.81	0.06	1.79	0.08	1.84	0.07	4:1;4:3
Body weight (kg)	W	59.3	0.57	58.1	7.85	61.9	10.91	62.6	10.64	4:2;4:1
	M	75.7	10.80	74.8	10.40	76.5	13.78	77.1	11.17	4:2;3:2
BMI (kg/m ²)	W	21.6	2.98	20.6	2.51	22.5	4.16	21.6	3.27	3:2
	M	23.4	2.76	22.8	2.84	23.9	3.55	22.9	2.83	ns
Body fat (%)	W	24.1	5.50	20.6	5.64	23.1	6.43	22.6	6.95	1:2;3:2
	M	15.2	5.31	14.2	6.60	19.5	5.56	10.8	5.17	1:4;3:4
Triceps skinfold (mm)	W	13.4	5.63	13.4	3.61	17.0	9.87	8.9	4.31	1:4;2:4;3:4
	M	9.5	4.95	9.1	3.21	13.8	8.90	6.6	2.63	3:1;3:2;3:4
Subscapular skinfold (mm)	W	14.7	6.31	12.2	3.34	14.9	9.4	13.5	6.02	1:2;3:2
	M	11.7	5.13	10.7	3.03	13.1	7.94	10.7	4.26	3:2;3:4
Suprailiac skinfold (mm)	W	18.8	7.45	16.6	4.87	20.9	11.93	20.1	9.03	3:2
	M	15.0	8.16	14.1	4.84	18.9	11.24	13.4	6.97	3:1;3:2;3:4
Arm circumference (cm)	W	26.5	3.10	25.6	2.47	25.8	4.5	26.4	3.20	n.s.
	M	31.3	3.91	29.6	3.40	28.1	4.94	30.8	3.25	1:3;4:3
Circumference of arm muscles (cm)	W	22.3	3.03	21.4	2.30	20.4	4.40	23.9	2.65	4:3
	M	28.4	3.59	27.9	3.19	23.6	4.95	29.1	3.18	1:3;2:3;4:3

*W, women; M, men; X, arithmetic mean; SD, standard deviation. Interpretation of Tukey's procedure: e.g. 1:2 means that there is statistically significant difference (p<0,05) between Polish and Belarusian students; 4:3, between Lithuanians and Russians

Table 3. The distribution of BMI classes by country in women and men.

Nutritional status (according to BMI)	Poland		Belarus		Russia		Lithuania	
	women N=421	men N=193	women N=183	men N=120	women N=222	men N=62	women N=159	men N=157
Underweight (%)	10.0	0.5	16.9	0.9	13.5	4.8	11.9	3.4
Proper weight (%)	78.9	75.7	75.9	80.8	69.8	71.0	78.0	77.2
Overweight (%)	9.7	19.7	6.7	15.8	11.7	17.7	5.7	16.9
Obesity (%)	1.4	4.1	0.5	2.5	5.0	6.5	4.4	2.5

The consumption frequency of examined products was determined in 7 categories (ranks). For proper interpretation of obtained means of ranks the following ranges were approved: 1–1.49, not eaten at all; 1.5<X<2.49, eaten once a month; 2.5<X<3.49, 2 to 3 times a month; 3.5<X<4.49, eaten once a week; 4.5<X<5.49, 3 times a week; 5.5<X<6.49, eaten 4 to 6 times a week; 6.5<X<7.0, eaten every day.

The anthropometric and nutritional parameters were compared in female and male groups using Tukey's procedure; differences were considered to be significant for p<0.05.

For all populations of young adult students (N=1517), a linear multivariable regression model was applied. BMI and body-fat% were used as the continuous variable, with gender taken into consideration. The food products connected with obesity risk were identified by multivariable logistic regression.

The statistical package STATISTICA for Windows (version 9.0) was used for the data analysis.

3. Results

3.1 Anthropometric measurements in four examined countries

Anthropometric characteristics of 985 examined women and 532 men are shown in Table 2 and the distribution of BMI classes by country is presented in Table 3.

In all countries, both in the groups of women and men, the overall means of BMI were within the normal range according to the WHO definition, whereas in the group of women, a statistically significant difference was observed between Russian and Belarusian women (see Table 2).

Most of examined students had proper height-weight proportions. In all female groups (985 persons) underweight was observed more frequently (13.2%) than overweight (8.5%) or obesity (2.8%). It was particularly visible in case of Belarusian women: underweight (16.9%), overweight (6.7%) and obesity (0.5%). In all male groups (532 persons), overweight and/ or obe-

sity were more frequently observed than underweight (18.9%, 3.4% and 1.7%, respectively). The higher percentage of overweight together with obesity was observed in Russian (24.2%) and Polish men (23.8%) more than in Lithuanians (19.4%) and in Belarusians (18.3%) (Table 3).

Both in the groups of women and in the groups of men from individual countries, the average values of the percentage of fatty tissue in total body mass were within the range of proper values according to the WHO recommendation (World Health Organization, 1998). However, the comparison of results among female students from particular countries revealed that body fat% was statistically higher in Poland and Russia than in Belarus, and that the deposition of fatty tissue was differentiated.

The thickness of triceps skin fold was the highest in Russian and the lowest in Lithuanian women. The thickness of subscapular skin fold was higher in Polish and Russian women than Belarusian, whereas the suprailiac skin fold was the highest in Russian and the lowest in Belarusian women. The circumference of arm muscles was statistically significantly higher in Lithuanian than Russian women (Table 2).

Among male students, the highest contribution of fatty tissue in total body mass was observed in Russia (average 19.5%), statistically higher than in Poland (15.2%), in Belarus (14.2%) or in Lithuania (10.8%). The thickness of all measured skin folds was the highest among Russian men, whereas the circumference of arm muscles was the highest among Lithuanians (Table 2).

3.2 Anthropometric measurements in four examined countries

Polish women consumed yogurt and kefir significantly more often than did Russian women and more olive oil than Belarusian and Russian women. For the category "ham and sausages", the most frequent consumption was found in Polish students. The women in Belarus ate milk, milks soups and vegetable oils significantly more frequently than women in Lithuania. Dark bread was eaten more often in Belarus than in Russia and Lithuania. Fast-food dishes were eaten more rarely in Belarus than in Poland and Russia. Russian women consumed meat (pork, beef, veal), sweets and honey more often than Polish women. In comparison to Belarusian women, they ate the following food products more frequently: pork fat and lard, potatoes, light bread and sugar. Lithuanian women drank more vegetable juices than Russian women and ate bread rolls more rarely than Polish women. Vodka was drunk more often by Polish than Russian and Belarusian women. Polish women drank more beer than Lithuanian and Russian women (Table 4).

Polish men consumed yoghurt and fish more frequently than Russian men and fast-food dishes more often than Belarusians. Olive oil and fruit juice were consumed more often by Polish men than by students from the three other nations studied. Belarusian men consumed more frequently pork, beef and veal than Polish men, more rice and cereals than Russian and Lithuanian men and more plant oils than Lithuanian men. In comparison with other countries, dark bread was eaten most frequently in Belarus. Russian men consumed more pork, beef and veal than Polish (similar to Belarusian men) and more pork-butcher's products and sugar than Belarusian and Lithuanian men. They also ate more pork fat and lard than Polish and Lithuanian men, more fast-food meals than Belarusian and more potatoes than Lithuanian men. In the group of Lithuanian men, only margarine was consumed more often than in Russian men. Additionally, Polish men drank more vodka than students from all the other nations examined, and more beer than Russian and Lithuanian men. Wine, and also tea, is rarely drunk in Lithuania (see Table 5).

Food products in the ranks of the consumption frequency in the group of women are shown in Table 6 and in the group of men in the Table 7. The results are discussed together.

In the group of dairy products, milk, milk soups and yoghurt were reported as the most frequently consumed in each group examined (the mode was differentiated but higher than in case of cottage cheese). In the group of meats, ham and sausages were consumed the most frequently in Poland (mode: 4–6 times a week) but in Belarus, Russia and Lithuania- pork, beef and veal (mode: 4–6 times a week, all women and Lithuanian men; everyday, Russian and Lithuanian men). In the group of animal fats mode was connected to butter. In the group of vegetables fats there was no preferred product; in each country, with different frequency, olive oil and/or vegetables oils and/or margarines were consumed. In the group of the cereal products, in Poland bread rolls were found to be the most frequently consumed (mode: 4–6 times a week) and in Belarus, whole grain dark bread (mode: 4–6 times a week for women and everyday for men). Russian women reported that noodles, bread rolls and light bread were eaten with the same frequency (2–3 times a week), and Russian men consumed noodles and bread 4 to 6 times a week. In Lithuania, all products from this group were eaten with similar frequency. In the group of sweets, sugar was declared as the most frequently consumed in Poland and Belarus (mode: 4–6 times a week for all women and Belarusian men; everyday for Russian men). Sugar, jams and candied fruits were preferred by women and men in Lithuania (Table 6,7).

Table 4. The consumption frequency of examined food products in the group of women.

Group*	FOOD	POLAND (1) N= 421			BELARUS (2) N= 183			RUSSIA (3) N= 222			LITHUANIA (4) N= 159			Tukey's test
		X	SD	M	X	SD	M	X	SD	M	X	SD	M	P<0,05
1	Milk, milk soups	4.3	2.1	5 ₂₈	5.1	1.9	5 ₃₃	5.0	2.0	5 ₃₁	3.6	2.0	3 ₁₇	2:4, 3:4
	Yoghurt, kefir	5.1	1.6	5 ₃₃	4.7	2.1	4 ₂₈	4.3	2.2	4 ₂₁	4.5	1.5	5 ₃₁	1:3
	Cottage cheese	3.7	1.7	4 ₁₃	4.2	2.0	4 ₂₃	3.8	1.9	4 ₁₃	3.8	1.6	4 ₂₁	ns
2	Eggs	4.2	1.4	4 ₂₆	3.9	1.7	4 ₁₉	4.0	1.7	4 ₁₇	3.6	1.4	3 ₁₆	ns
3	Pork, beef, veal	4.2	1.8	5 ₂₇	5.2	1.4	6 ₃₄	6.1	1.4	6 ₃₇	5.4	1.3	6 ₃₅	3:1
	Ham, sausages	5.5	1.8	6 ₃₅	3.8	2.0	4 ₁₈	4.6	1.8	3 ₂₄	3.2	1.5	4 ₁₃	1:4; 1:3; 1:2
	Pork-butcher's prod	4.1	2.1	5 ₂₅	3.7	1.9	4 ₁₇	4.3	1.7	4 ₂₀	3.6	1.5	4 ₁₅	ns
	Poultry	3.9	1.4	4 ₂₁	3.1	1.4	3 ₁₁	3.8	1.6	3 ₁₂	3.2	1.2	3 ₁₂	ns
	Fish	3.6	1.4	4 ₁₁	3.5	1.4	4 ₁₆	3.5	1.1	4 ₁₀	3.2	1.1	3 ₁₁	ns
4	Fast-food	3.9	1.9	4 ₂₂	1.8	1.2	2 ₄	4.6	2.0	5 ₂₅	3.1	1.6	4 ₁₀	1:2;3:2
5	Pork fat, lard	1.3	0.9	1 ₁	1.2	1.4	1 ₁	2.3	1.5	2 ₇	1.9	1.1	2 ₃	3:2
	Butter	5.6	2.2	6 ₃₆	4.0	2.3	4 ₂₁	4.8	2.2	5 ₂₈	3.7	2.1	4 ₁₉	1:4
	Cream	3.6	1.8	4 ₁₂	3.1	1.8	4 ₁₂	3.8	1.9	4 ₁₄	3.9	1.5	3 ₂₂	ns
6	Olive oil	3.5	2.2	4 ₁₀	2.0	1.6	2 ₅	2.2	1.7	2 ₆	2.6	1.7	2 ₈	1:2;1:3
	Sunflower, soya oil	4.5	2.0	4 ₂₉	5.3	2.0	6 ₃₅	4.9	1.9	5 ₃₀	4.4	1.7	3 ₃₀	2:4
	Margarine	2.5	2.2	2 ₆	2.9	1.2	3 ₉	1.7	1.0	2 ₂	2.1	1.9	2 ₆	2:3
7	Vegetables	5.8	1.5	6 ₃₇	5.6	1.9	6 ₃₇	5.4	1.8	6 ₃₂	5.7	1.3	6 ₃₈	ns
	Fruit	6.0	1.5	7 ₃₉	5.9	1.7	6 ₃₈	5.9	1.6	6 ₃₅	5.6	1.3	6 ₃₆	ns
	Fruit juice	4.0	2.3	5 ₂₄	4.8	2.2	4 ₂₉	4.6	2.0	4 ₂₆	4.0	1.7	4 ₂₃	ns
	Vegetable juice	3.8	2.5	4 ₁₉	3.9	1.8	4 ₂₀	2.8	1.8	3 ₉	4.1	1.7	5 ₂₄	4:3
	Potatoes	5.9	1.7	6 ₃₈	5.1	1.6	5 ₃₂	6.4	1.8	6 ₃₈	5.6	1.5	5 ₃₇	3:2
8	Beans, peas	2.2	1.4	2 ₄	2.1	1.2	2 ₆	2.6	1.6	2 ₈	2.4	1.1	2 ₇	ns
	Soya, lentil	1.4	1.1	1 ₂	1.5	0.9	1 ₃	1.7	1.2	1 ₃	1.6	1.1	1 ₁	ns
9	Dark bread	4.6	2.3	5 ₃₁	5.5	2.2	6 ₃₆	3.9	2.3	4 ₁₆	4.1	1.8	4 ₂₅	2:3; 2:4
	Rice and cereals	3.8	1.7	4 ₁₇	4.4	1.8	4 ₂₅	4.2	1.7	4 ₁₉	3.8	1.5	4 ₂₀	ns
	Noodles	3.9	1.5	4 ₂₀	4.3	1.7	4 ₂₄	4.6	1.5	5 ₂₃	4.2	1.3	4 ₂₇	ns
	Bread rolls	5.3	2.1	6 ₃₄	4.9	2.3	5 ₃₁	4.5	2.4	5 ₂₂	4.1	1.8	4 ₂₆	1:4
	Light bread	3.7	2.4	4 ₁₄	3.4	2.1	4 ₁₅	4.7	2.2	5 ₂₇	4.3	1.8	4 ₂₉	3:2
	Sugar	5.2	2.5	6 ₃₃	4.9	2.6	6 ₃₀	5.9	2.6	6 ₃₆	5.0	2.4	5 ₃₄	3:2
10	Sweets, honey	4.0	2.2	5 ₂₃	4.5	1.9	4 ₂₆	5.5	1.9	6 ₃₄	4.7	1.5	5 ₃₂	3:1
	Jams, candied fruits	3.5	1.8	4 ₉	3.4	2.0	3 ₁₄	3.5	1.9	4 ₁₁	3.1	1.3	3 ₉	ns
	Chocolate products	4.6	1.8	5 ₃₀	4.2	1.8	4 ₂₂	5.4	1.8	6 ₃₃	4.6	1.5	5 ₃₃	ns
	Cakes, layer cake	3.2	1.8	3 ₈	3.0	1.5	3 ₁₀	3.9	1.8	4 ₁₅	3.3	1.4	3 ₁₄	ns
	Sweet drinks	3.8	2.2	4 ₁₈	3.3	2.1	3 ₁₃	4.0	2.1	4 ₁₈	4.2	2.1	5 ₂₈	4:2
11	Vodka	1.9	1.1	1 ₃	1.5	0.7	1 ₂	1.4	0.6	1 ₁	1.7	1.0	1 ₂	1:2; 1:3
	Beer	2.9	1.5	3 ₇	2.2	1.3	2 ₈	2.0	1.1	2 ₅	2.0	1.2	2 ₅	1:3; 1:4
	Wine	2.2	1.3	2 ₅	2.2	1.2	2 ₇	1.9	0.9	2 ₄	2.0	0.9	2 ₄	ns
12	Coffee	4.7	2.7	5 ₃₂	4.6	2.5	5 ₂₇	4.8	2.3	5 ₂₉	3.6	2.5	3 ₁₈	ns
	Tee	6.6	1.2	7 ₃₉	6.6	1.2	7 ₃₉	6.6	1.2	7 ₃₉	6.2	1.4	7 ₃₉	ns

X- arithmetic mean of consumption frequency ; SD-standard deviation; M-mode (in bottom index- the consumption frequency from the most rarely to the most often consumed); Interpretation of Tukey's test: e.g. 1:2 means that there is statistically significant difference ($p < 0,05$) between Polish and Belarusian women;

Group*-name of group is explained in the "Materials and methods"

Table 5. The consumption frequency of examined food products in the group of men.

Group*	FOOD	POLAND (1) N= 421			BELARUS (2) N= 183			RUSSIA (3) N= 222			LITHUANIA (4) N= 159			Tukey's test
		X	SD	M	X	SD	M	X	SD	M	X	SD	M	P<0,05
1	Milk, milk soups	4.7	2.1	5 ₂₅	5.2	2.0	6 ₃₁	5.2	1.8	5 ₃₀	4.5	1.6	5 ₃₀	ns
	Yoghurt, kefir	5.2	1.7	5 ₃	4.7	1.9	4 ₂₄	4.0	2.1	4 ₁₇	4.5	1.4	5 ₂₉	1:3
	Cottage cheese	4.0	1.8	4 ₁₄	4.2	2.0	4 ₁₇	3.3	1.8	3 ₁₀	4.1	1.6	4 ₂₇	2:3
2	Eggs	4.8	1.2	5 ₂₇	4.9	1.9	5 ₂₅	4.1	1.7	4 ₁₈	4.0	1.4	4 ₂₁	ns
3	Pork, beef, veal	5.0	1.6	5 ₃₀	6.5	1.2	7 ₃₇	6.4	1.1	7 ₃₇	5.9	1.3	6 ₃₉	2:1; 3:1
	Ham, sausages	5.1	1.3	6 ₃₁	4.5	2.0	4 ₂₂	4.5	1.9	4 ₂₂	4.1	1.4	4 ₂₆	ns
	Pork-butcher's prod	4.9	1.8	5 ₂₉	4.2	1.9	4 ₁₆	5.9	1.8	6 ₃₅	4.0	1.5	4 ₂₂	3:2;3:4
	Poultry	4.2	1.5	4 ₁₆	4.6	1.7	4 ₂₃	4.0	1.8	3 ₁₆	4.1	1.3	4 ₂₅	ns
	Fish	3.9	1.3	4 ₁₂	3.8	1.7	4 ₁₄	2.7	1.5	3 ₇	3.0	1.3	3 ₉	1:3;2:3
4	Fast-food	4.3	1.8	4 ₁₈	1.9	1.4	2 ₁	4.9	2.2	5 ₂₇	3.3	1.6	4 ₁₂	1:2;3:2
5	Pork fat, lard	1.9	1.4	1 ₂	2.7	1.9	2 ₇	3.5	1.5	3 ₁₁	2.3	1.3	2 ₅	3:1;3:4
	Butter	5.7	2.2	6 ₃₃	5.0	1.8	6 ₂₆	5.5	2.0	5 ₃₂	4.6	1.9	5 ₃₂	ns
	Cream	3.9	2.1	4 ₁₃	3.7	1.6	4 ₁₃	4.2	1.6	4 ₁₉	3.9	1.4	4 ₁₈	ns
6	Olive oil	3.4	2.2	3 ₇	2.2	1.5	2 ₅	2.0	1.3	2 ₄	2.2	1.5	2 ₄	1:4; 1:3; 1:2
	Sunflower, soya oil	4.4	2.1	5 ₂₁	5.0	2.1	5 ₂₉	4.2	1.9	5 ₂₀	3.7	1.8	4 ₁₇	2:4
	Margarine	3.0	2.4	2 ₆	2.3	1.5	2 ₅	1.8	1.1	2 ₂	3.3	2.1	4 ₁₃	4:3
7	Vegetables	5.9	1.3	6 ₃₆	5.4	1.7	6 ₃₅	5.1	2.0	5 ₂₉	5.2	1.4	5 ₃₅	ns
	Fruit	5.8	1.5	6 ₃₅	5.4	1.5	5 ₃₄	5.5	1.6	6 ₃₁	5.2	1.3	5 ₃₆	ns
	Fruit juice	4.5	2.2	5 ₂₃	3.4	2.0	4 ₉	2.8	1.9	2 ₈	2.7	1.8	2 ₇	1:2;1:3;1:4
	Vegetable juice	3.8	2.4	3 ₁₁	3.6	1.8	4 ₁₂	3.9	1.8	4 ₁₄	4.0	1.8	4 ₂₃	ns
	Potatoes	5.9	1.6	6 ₃₇	5.7	1.5	6 ₃₆	6.0	1.6	7 ₃₆	4.9	1.5	5 ₃₃	3:4
8	Beans, peas	3.0	1.6	3 ₅	3.1	1.6	3 ₈	2.4	1.4	2 ₆	2.4	1.3	2 ₆	ns
	Soya, lentil	1.7	1.5	1 ₁	2.1	1.5	1 ₄	2.1	1.4	2 ₅	1.7	1.1	1 ₂	ns
9	Dark bread	4.0	2.2	5 ₁₅	6.4	1.5	7 ₃₈	4.2	2.3	4 ₂₁	3.9	1.8	4 ₂₀	2:1; 2:3;2:4;
	Rice and cereals	4.4	1.6	5 ₁₉	5.2	1.6	5 ₃₀	3.9	1.9	4 ₁₅	3.7	1.5	4 ₁₆	2:3;2:4
	Noodles	4.5	1.2	5 ₂₂	5.3	1.4	5 ₃₃	5.9	1.8	6 ₃₄	3.9	1.4	4 ₁₉	3:4
	Bread rolls	5.8	1.9	6 ₃₄	5.3	1.3	6 ₃₂	5.8	1.9	6 ₃₃	4.9	1.8	5 ₃₄	ns
	Light bread	4.6	2.5	5 ₂₄	4.2	2.0	4 ₁₈	4.9	1.9	5 ₂₆	3.6	1.6	4 ₁₄	3:4
	Sugar	5.9	2.1	6 ₃₈	5.0	1.7	6 ₂₇	6.4	2.1	7 ₃₈	5.2	1.8	6 ₃₇	3:2; 3:4
10	Sweets, honey	4.2	2.2	5 ₁₇	5.0	1.8	5 ₂₈	4.8	2.0	5 ₂₅	4.5	1.6	5 ₃₁	ns
	Jams, candied fruits	3.8	1.8	4 ₁₀	4.2	2.0	4 ₁₉	3.8	1.9	4 ₁₂	3.7	1.5	4 ₁₅	ns
	Chocolate products	4.8	1.9	5 ₂₈	4.2	1.6	4 ₂₀	4.8	1.8	5 ₂₄	4.1	1.4	4 ₂₈	ns
	Cakes, layer cake	3.5	1.9	3 ₈	3.6	1.7	4 ₁₁	3.9	1.6	4 ₁₃	3.3	1.4	3 ₁₁	ns
	Sweet drinks	4.7	2.0	5 ₂₆	4.4	2.3	4 ₂₁	4.9	2.3	5 ₂₈	4.0	1.8	4 ₂₄	ns
11	Vodka	2.9	1.4	3 ₄	2.1	1.2	2 ₂	1.7	0.9	2 ₁	2.1	1.2	2 ₃	1:4; 1:3; 1:2
	Beer	4.4	1.8	5 ₂₀	3.5	1.7	4 ₁₀	2.9	1.6	3 ₉	2.8	1.4	3 ₈	1:4; 1:3
	Wine	2.1	1.4	1 ₃	2.1	1.2	2 ₃	1.9	1.0	2 ₃	1.4	0.8	1 ₁	1:4; 2:4
12	Coffee	3.7	2.5	4 ₉	3.8	2.4	4 ₁₅	4.6	2.3	5 ₂₃	3.0	2.1	2 ₁₀	ns
	Tee	6.1	1.8	7 ₃₉	6.8	0.8	7 ₃₉	6.8	0.7	7 ₃₉	5.7	1.8	6 ₃₈	2:4; 3:4

X- arithmetic mean of ranks of consumption frequency; SD-standard deviation; M-mode (in bottom index- the consumption frequency from the most rarely to the most often consumed); Interpretation of Tukey's test: e.g. 1:2 means that there is statistically significant difference ($p<0,05$) between Polish and Belarusian men;

Group*-name of group is explained in the "Materials and methods"

Table 6. Food products in the ranks of the consumption frequency in women.

POLAND	BELARUS	RUSSIA	LITHUANIA
1,5 < X < 2,5 eaten once a month			
Pork fat, lard	Pork fat, lard	Pork fat, lard	Pork fat, lard
Margarine	Fast-food	Margarine	Margarine
Beans, peas	Olive oil	Soya, lentil	Soya, lentil
Soya, lentil	Beans, peas, soya, lentil	Vodka, beer, wine	Vodka, beer, wine
Vodka, Wine	Vodka, Beer, Wine		
2,5 < X < 3,5 2-3 times a month			
Olive oil	Poultry, Fish	Fish	Ham, sausages
Jams, candied fruits	Cream, Margarine	Vegetable juice	Poultry, Fish
Cakes, layer cake	Light bread	Beans, peas	Fast-food
Beer	Jams, candied fruits	Jams, candied fruits	Jams, candied fruits
	Cakes, layer cake		Cakes, layer cake
	Sweet drinks		
3,5 < X < 4,5 eaten once a week			
Cottage cheese	Cottage cheese	Yoghurt, kefir	Milk, milk soups
Eggs	Eggs	Cottage cheese	Yoghurt, kefir
Pork, beef, veal	Ham, sausages	Eggs	Cottage cheese, Eggs
Pork-butcher's products	Pork-butcher's products	Pork-butcher's products	Pork-butcher's products
Poultry, Fish	Butter	Poultry	Butter, Cream
Fast-food	Vegetable juice	Cream	Sunflower, soya-bean oil
Sunflower, soya-bean oil	Rice and cereals	Rice and cereals	Fruit and vegetable juices
Fruit and vegetable juice	Noodles	Bread rolls	Dark bread, Noodles
Rice and cereals	Sweets, honey	Sweet drinks	Bread rolls
Noodles, Light bread	Jams, candied fruits		Light bread
Sweets, honey	Chocolate products		Sweet drinks, Coffee
Sweet drinks			
4,5 < X < 5,5 2-3 times a week			
Yoghurt, kefir	Milk, milk soups	Milk, milk soups	
Ham, sausages	Yoghurt, kefir	Ham, sausages	
Bread rolls	Pork, beef, veal	Fast-food	
Sugar	Sunflower, soya-bean oil	Butter	
Coffee	Potatoes	Sunflower, soya-bean oil	Pork, beef, veal
	Dark bread	Vegetables, Fruit juice	Sugar
	Rice and cereals	Rice and cereals	Chocolate products
	Noodles	Noodles, Bread rolls	
	Sweets, honey	Light bread	
	Chocolate products	Sweets, honey	
	Coffee	Chocolate products	
5,5 < X < 6,5 eaten 4-6 times a week			
Butter	Vegetables	Pork, beef, veal	Fruit
Fruit	Fruit	Fruit	Tea
Potatoes		Potatoes	
		Sugar	
6,5 < X < 7,0 eaten every day			
Tea	Tea	Tea	Tea

Table 7. Food products in the ranks of the consumption frequency in men.

POLAND (1)	BELARUS (2)	RUSSIA (3)	LITHUANIA (4)
1,5 < X < 2,5 eaten once a month			
Pork fat, lard	Fast food	Cream	Pork fat, lard
Wine	Cream	Margarine	Cream
	Margarine	Soya, lentil	Beans, peas
	Soya, lentil	Vodka	Soya, lentil
	Vodka, Wine	Wine	Vodka, Wine
2,5 < X < 3,5 2-3 times a month			
Margarine	Pork fat, lard	Cottage cheese	Fish
Beans, peas	Beans, peas	Pork fat, lard	Fast-food
Cakes, layer cake	Beer	Beer	Margarine
Vodka			Fruit juice
			Cakes, layer cake
			Beer, Coffee
3,5 < X < 4,5 eaten once a week			
Cottage cheese	Cottage cheese	Yoghurt, kefir	Milk, milk soups
Poultry	Ham. Sausages	Eggs	Yoghurt, kefir
Fast-food	Pork-butcher's products	Ham. sausages	Cottage cheese
Sunflower, soya-bean oil	Light bread	Poultry	Eggs, Poultry
Fruit juice	Jams, candied fruits	Cream	Ham. sausages
Rice and cereals	Chocolate products	Sunflower, soya-bean oil	Pork-butcher's products
Light bread	Sweet drinks	Vegetable juice	Vegetable juice
Sweets, honey		Dark bread	Dark bread Noodles
Beer			Rice and cereals
Coffee			Light bread
			Sweets, honey
			Jams, candied fruits
			Chocolate products
			Sweet drinks
4,5 < X < 5,5 2-3 times a week			
Milk, milk soups	Milk, milk soups	Milk, milk soups	Butter
Yoghurt, kefir	Yoghurt, kefir	Fast-food	Vegetables
Eggs	Eggs, Poultry	Butter	Fruits
Pork, beef, veal	Butter	Vegetables	Bread rolls
Ham. sausages	Sunflower, soya-bean oil	Fruits	Sugar
Rice and cereals	Vegetables, Fruits	Sweets, honey	
Noodles	Rice and cereals	Chocolate products	
Sweets, honey	Noodles, Bread rolls	Sweet drinks	
Chocolate products	Sugar, Sweets, honey	Coffee	
5,5 < X < 6,5 eaten 4-6 times a week			
Butter	Pork, beef, veal	Pork, beef, veal	Pork, beef, veal
Vegetables, Fruits	Potatoes	Pork-butcher's products	Tea
Potatoes	Dark bread	Potatoes,	
Bread rolls		Noodles,	
Sugar, Tea		Bread rolls, Sugar	
6,5 < X < 7,0 eaten every day			
		Tea	

3.3 The results of statistical analysis for the combined population of young adult students

Underweight was recorded more frequently for female students but overweight and obesity were observed more frequently in male than in female students (Figure 1).

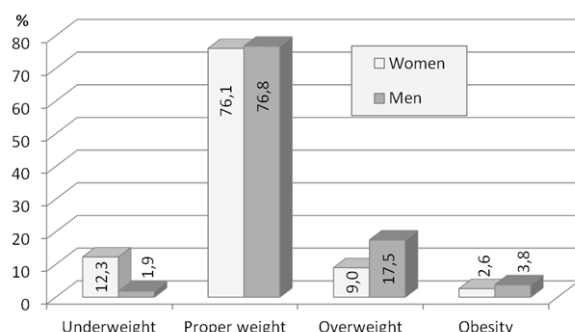


Figure 1. The distribution of BMI classes in males and females (N=1517).

Tea, fruits, vegetables, red meat and sugar were consumed the most frequently, and pork fat, pulse and vodka were consumed the most rarely in all populations examined (Figure 2).

In the linear multivariable regression model for BMI, women had significantly lower BMI in comparison with men. More frequent consumption of pork fat and lard as well as noodles, sweet drinks, light bread and butter was significantly associated with higher values of BMI. Pork fat and lard showed the greatest influence on BMI, followed by noodles and sweet drinks (Table 8).

Table 8. Linear multivariable regression model for BMI depending on gender and frequency of consumed food ($R^2=0.269$).

	b	standard error	standardized b	p
Women	-0.79	0.157	-0.12	<0.001
Pork fat and lard	0.48	0.053	0.22	<0.001
Noodles	0.33	0.047	0.17	<0.001
Sweet drinks	0.26	0.035	0.17	<0.001
Light bread	0.12	0.035	0.08	0.001
Butter	0.11	0.033	0.07	0.001
constant	18.25	0.282		<0.001

p- significance level

In the linear multivariable regression model for percentage of fat in total body mass, women had a 10% higher percentage of body fat than men. More frequent consumption of pork fat and lard, noodles, sweet drinks, butter, light bread and bread rolls was associated with higher percentage of body fat (Table 9).

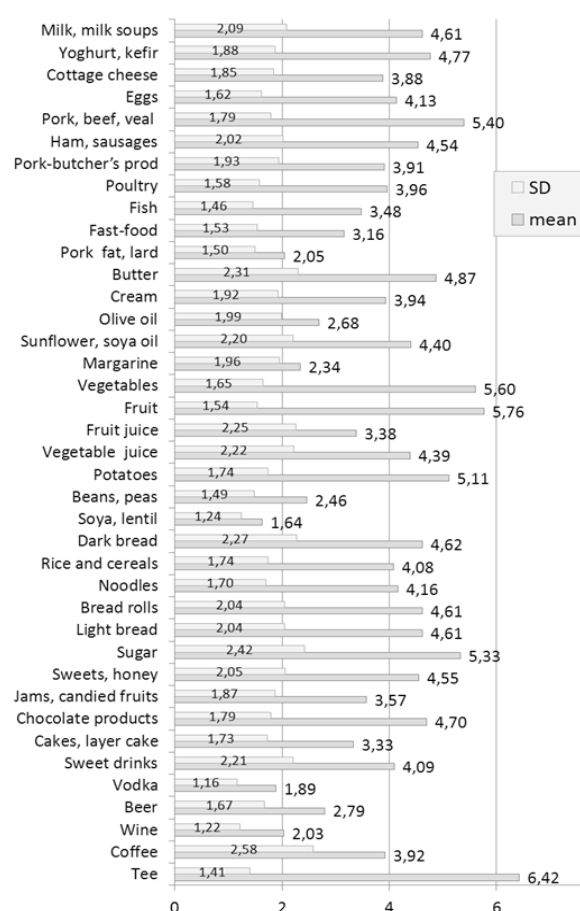


Figure 2. The consumption frequency of examined food products in all national groups studied (N=1517).

Table 9. Linear multivariable regression model for percentage of fat depending on gender and frequency of consumed food. ($R^2=0.424$).

	b	standard error	standardized b	p
Women	10.28	0.321	0.66	<0.001
Pork fat and lard	0.60	0.107	0.12	<0.001
Noodles	0.57	0.097	0.13	<0.001
Sweet drinks	0.34	0.071	0.10	<0.001
Butter	0.23	0.068	0.07	0.001
Light bread	0.21	0.074	0.06	0.004
Bread rolls	0.17	0.079	0.05	0.030
constant	5.35	0.607		<0.001

p- significance level

The multivariable logistic regression model gender did not show significant differences in the risk of obesity. The highest risk was observed for more frequent consumption of noodles (OR=3.38). About a 2-fold higher risk was connected with more frequently (difference of 1 rank) drinking sweet drinks and using butter (OR=2.13 and OR=1.95, respectively).

More often consuming pork fat and lard, cream, light bread and bred rolls also significantly increased the risk of obesity (Figure 3).

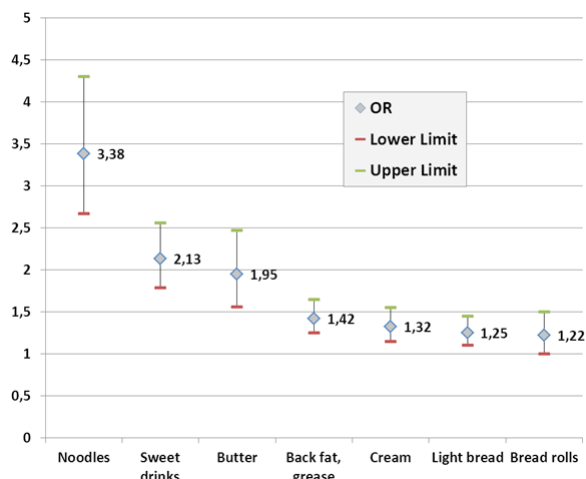


Figure 3. Estimated obesity risk and frequency of consumed food. Multivariable logistic regression.

4. Discussion

The consumption and the kind of food chosen by students in this study may be determined not only by contemporary conditions such as availability and the price of the products, but also by food preferences connected with established national traditions (the recipes are handed down from generation to generation and thus still survive), culture and the way of life. Apart from this, the contemporary nutritional recommendations are created and disseminated in each country examined. It is similar to countries where nutritional advice plays an important role in health promotion and reduction of the risk for the majority of chronic diseases. In the United States, the Dietary Guidelines to Americans (DGA) are updated every 5 years by the US Department of Agriculture and the US Department of Health and Human Services. The 2005 DGA [14] were updated and 2010 DGA [15] were supported and created by Dietary Guidelines Advisory Committee [16]. In most European countries, the Food-Based Dietary Guidelines (FBDG) are in force [17]. According to WHO recommendation, in Poland the FBDG created by the National Nutrition Institute in Warsaw and Polish Ministry of Health and are disseminated in the form of 10 guidelines on healthy diet, healthy nutrition pyramid and general directives (www.izz.waw.pl). The most important directives are as follows: eat at least five portions of cereal products every day (starch contained in them supplies muscles with energy and dietary fibre will regulate the function of intestines; consume four

portions of vegetables and three portions of fruit (sufficient amounts of minerals, vitamins and dietary fibre); drink two glasses of milk a day (adequate amount of calcium and a lot of proteins); one portion of fish, poultry, peas, beans or meat (they provide remaining amount of needed proteins); vegetable oils and soft margarines are recommended. The comparison of these guidelines to Russian, Belarusian and Lithuanian national nutrition advice showed no significant differences, therefore the obtained results will be referred to Polish FBDG.

In this study, food consumption is limited only for qualitative analysis, but on the basis of the obtained results it may be postulated that nutritional habits of the students studied deviated from the recommended nutrition guidelines. Admittedly, the significant distinctions in consumption of food and alcohol among men and women of these four nations were shown, but it is possible to establish the overall mistakes. It is obvious in Table 5 and 6 that students used to eat red meat too frequently and poultry meat too seldom. They also consumed fish, which are good source of protein, too seldom (it is recommended to eat fish twice a week) and pulse. In all nations, the butter was used too frequently, as was the too frequent consumption of light bread and bread rolls, and too rarely, whole grain dark bread (except Belarusian men and women). All students ate sweets too often and drank sweet drinks too often.

Regardless of these observations, the differences in diet between students from particular countries were clearly visible, and it seems to be possible to connect the underweight in Belarusian women and overweight and obesity in Russian women with their diet. Belarusian women ate whole grain dark bread most frequently but more rarely used sugar than Russian women and drank sweet drinks more rarely than Lithuanian women. It is also worthwhile to point out that they consumed fewer fast food meals than other women, which may be explained by a low access to fast food restaurants in this country. Russian men ate fat-building products such as pork, beef, pork-butcher's products, potatoes, noodles, bread rolls, sugar too frequently (4 to 6 times a week). Similar observations have been reported by Sedik & Wiseman [18].

It is worth emphasizing that all examined nations frequently consumed potatoes: among 39 products in the female students group, potatoes were in position 32–38 and position 33–37 in male group, when counting from the most rarely consumed products to the most frequently consumed products. Potatoes are specific to the national cuisine in each country analyzed and are eaten extensively as a number of dishes are prepared of them; e.g. in Belarus, *draniki* from grated potatoes; potato pancakes; *babka* (potato cereal with meat and potato);

kliotskas (a kind of dumpling with meat); in Lithuania, potato pudding (*kugelis*) and potato sausages (*vėdarai*), as well as the baroque tree cake known as *šakotis*.

The diet history in Poland, Belarus, Russia and Lithuania is based on crops that can thrive in cold climate, such as grains (rye, barley, buckwheat, and wheat), root vegetables (beets, turnips, potatoes, onions), and cabbage, but each country has its most famous national dishes.

In Polish cuisine, meat plays a significant role. The most famous Polish meat known is the the Polish sausage (*kielbasa*), pork knuckles cooked with vegetables (*golonka*), breaded pork cutlet (*kotlet schabowy*), stuffed slices of beef, tripe (*flaki*), a cabbage dish (*bigos*). Among soups Scotch broth, tomato soup, beetroot soup or sour rye meal mash are very popular. Pickled vegetables are consumed very often. The most popular fish is herring. Sour cream, curd cheese and soured milk have become important constituents of the Polish kitchen.

In Belarus, vegetables, especially potatoes, are eaten extensively. *Zatirka* is a traditional flour dish. Pancakes with mushrooms prepared with ingredients like boiled eggs, flour and mushrooms make an innovative recipe in Belarus, which is loved by most people. The most famous meat dish is sausage made from raw pork. Traditional Russian dishes include roasted meats, vegetables, soups and stews. *Bliny* (thin pancakes) and a variety of savory and sweet pies called either *piroghi* (large pies) or *pirozhki* (small pies) are very popular. Sturgeon is the favorite fish among Russians, from which black caviar (fish eggs) is collected. Favourite soups include *borscht* (beet soup traditionally served with sour cream), *shchye* (cabbage soup), and *solyanka* (a tomato-based chowder). *Kissel*, a piece of stewed fruit thickened with cornstarch with milk poured over it is a traditional dessert. Tea is served from the samovar, the special ornate urn.

Lithuanians share many dishes and beverages with Poles because of their long common history. There are similar Lithuanian and Polish versions of dumplings (*pierogi* or *koldūnai*), doughnuts (*spurgos*), and crepes (*blini* or *blynai*). Specific to Lithuania are such dishes as cabbage and noodles and rolled cabbage. *Cepelinai*, a stuffed potato creation, cold beet soup (*šaltibarščiai*), and *kugelis* (a baked potato pudding) are the most famous national dishes. Typical for all countries of this part of Europe is a dark, rye bread, which was often eaten buttered or spread with cheese. Today, this bread has been changed to light wheat or buckwheat breads and breads rolls.

In recapitulation, students had to modify their nutritional behaviors and partially depart from traditional way of eating; they began to consume fast and junk foods because that food is cheaper and more quickly available in comparison with cooking a full meal.

As a result of the present study, problems connected with using BMI for overweight estimation should be emphasized. BMI provides information about weight-height proportions; however, the anthropometric and body mass components measurements are necessary for estimation of overweight aetiology. In case of young adults, among males, overweight may be caused by excessive fatty tissue development, but it may also be induced by muscular development connected with fitness activity. In our study, the average BMI did not reveal statistically significant differences among male students in the four countries, whereas the body fat% was statistically higher among Belarusian and Russian men than among Lithuanian men. The dispersion of body fat (%) in groups of overweight men (BMI 25.0–29.9 kg/m²) was clearly visible (11.9%–35.0 % in Poland; 20.1%–32.0% in Belarus; 17.0%–34.7% in Russia and 9.8%–27.4% in Lithuania). The lowest body fat as seen in Lithuanian men may be partially explained by national conditions: Lithuanians in the early 20th century were among the thinnest people in the developing countries. In cross-sectional, nationally representative school-based surveys in 1997–1998 [20] among 29,242 boys and girls, aged 13 to 15 years, from Austria, Czech Republic, Denmark, Flemish, Belgium, Finland, France, Germany, Greece, Lithuania, Ireland, Israel, Portugal, Slovakia, Sweden, and the United States, the highest prevalence of overweight was found in the United States and the lowest in Lithuania. Some doubts about BMI were presented by Petersom *et al.* [20], who claimed that one should not overestimate the significance of BMI in nutritional studies, because in 17- to 23-year-old Estonian students BMI did not differ among body types (pyknomorphs and leptomorphs). However, BMI is commonly used for estimation of body weight/body height proportion and plays a significant role in comparison among different populations. The comparison of our results with the results obtained by Yahia [21] produced the observation that differences in the frequency of underweight, overweight and obesity depend on gender. Similarly to our results, it was shown that among Lebanese University students, the prevalence of overweight and obesity was more common among male students compared with females (37.5% and 12.5% vs. 13.5% and 3.2%, respectively); in contrast, 5.4% of female students were underweight as compared with 1% of males. Given that overweight and obesity are becoming more common (especially among men), the proper estimation of aetiology will be very significant. More attention should be also paid to studies to explain the relationship between overweight/obesity and type of food products consumed. In our population of young adult students from four countries, frequent consumption of pork fat and lard, as well as sweet drinks,

noodles, light bread and butter has impact on increasing BMI. In multivariable logistic regression model the highest risk of obesity is evidenced in case of more frequent consumption (difference of 1 rank) of noodles, sweet drinks and butter.

Unfortunately, there are many other risk factors for development of overweight and obesity. Among them, familial history of obesity, living with family or alone, body physical training and school achievements may play special roles [22]. We may assume that physical training is similar in every country we studied because all women and men were students of medicine and that they have similar types of physical activity lessons within the university curriculum. The school achievements are also similar in these countries. Unfortunately, we do not have accurate data about familial history of obesity and if the students live alone or with the family; therefore, we can't produce a complex analysis of overweight and obesity aetiology using the current data.

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5. Conclusions

1. Collective international work became a basis for preparing a new educational program about nutrition and served as an occasion for new proposals in nutritional improvements at universities that were participating in the study. The new educational program has started at those universities.
2. The postulate was addressed to the universities' governments that to support the canteens for students with inexpensive, but well balanced, meals and fresh vegetables and fruit, and to prohibit the vending machines with carbonated sweet drinks would reduce the tendency to overweight and obesity, especially among male students.
3. Noodles, sweet drinks, butter, pork fat and lard, cream, light bread and bread rolls should be limited in the students' dietary scheme to prevent development of overweight and obesity.

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