Assessment of dietary intake in a sample of Polish population – baseline assessment from the prospective cohort 'PONS' study

Rafał Ilow[1], Bożena Regulska-Ilow[2], Dorota Różańska[2], Katarzyna Zatońska[3], Mahshid Dehghan[4], Xiaohe Zhang[4], Andrzej Szuba[5], Lars Vatten[6], Kinga Janik-Koncewicz[7], Marta Mańczuk[7], Witold A. Zatoński[7,8]

[1] Department of Food Science and Dietetics, Wrocław Medical University, Wroclaw, Poland
[2] Department of Dietetics, Wrocław Medical University, Wroclaw, Poland
[3] Department of Social Medicine, Wrocław Medical University, Wroclaw, Poland
[4] Population Health Research Institute, Department of Medicine, McMaster University, Hamilton, Canada
[5] Department of Internal Medicine, Wrocław Medical University, Wroclaw, Poland
[6] Norwegian University of Science and Technology, Department of Public Health, Faculty of Medicine, University Medical Centre, Trondheim, Norway
[7] Department of Cancer Epidemiology and Prevention, the Maria Skłodowska-Curie Cancer Centre and Institute of Oncology, Warsaw, Poland
[8] European Health Inequalities Observatory, Institute of Rural Health, Lublin, Poland

▊ **Abstract**

Objective: The aim of this study was to assess the dietary intake of participants in the Polish-Norwegian Study (PONS).

Methods: The presented study comprised 3,862 inhabitants of Świętokrzyskie Province aged 45-64 (2,572 females and 1,290 males). Daily intakes of energy, protein, carbohydrate, fat and fatty acid were estimated using the Food Frequency Questionnaire (FFQ).

Results: Energy intake was significantly higher in males than females (1,461.4 vs 1,320.7 kcal/day), and in participants aged 45-54 than in those aged 55-64 (1,409.5 vs 1,338.5 kcal/day). The percentage of energy from saturated fatty acids was higher than dietary recommendations. Protein, fat and carbohydrate intakes were significantly higher in males compared to females, and in younger than in older group. Daily cholesterol intake was significantly higher in males compared to females and in younger than in older group. People with a higher level of education had a higher energy, protein and fat intake.

Conclusion: Under-reporting of energy intake was observed in a significant percentage of participants, especially in males. Gender, age and education status had statistically significant impact on dietary intake. Increase in the intake of dietary fibre, mono- and polyunsaturated fatty acids with diet by the studied participants will make the diets more healthy.

▊ **Keywords**

prospective study, macronutrient intake, Food Frequency Questionnaire

INTRODUCTION

Many studies have indicated the strong association between diet as an important modifiable risk factor and chronic diseases, such as cardiovascular diseases and cancer [1-3]. Some dietary components have been found to be protective (fruits, vegetable, fish and whole grain) and some found to be predictive (red meat, refined starches and saturated fat) of cardiovascular diseases and cancers [4].

A Seven Countries study indicated the importance of healthy eating [5]. The study showed that in Greece and Italy, people consumed less animal fat (saturated fatty acids) than in Finland, USA and the Netherlands, and the incidence of coronary heart disease was lower than the latter countries. The study also showed a positive correlation between saturated fat intake and blood cholesterol, and an inverse correlation

with monounsaturated fatty acid intake. It was observed that with an increased intake of monounsaturated fatty acids, the incidences of ischemic heart disease and mortality associated with them decreased [5]. A negative relationship between mortality due to coronary heart disease has been also found in relation to vegetable, fish and legume consumption [4].

The beneficial effects of the Mediterranean diet has been demonstrated in the Lyon Diet Heart Study, which included patients after myocardial infarction. About 2 years after the study, there was observed a 70% decrease in relapse of heart attacks, and a 70% reduction in all deaths in people using the Mediterranean diet compared with the control group [6].

The cardioprotective effect of omega-3 and reduced risk of thrombotic infarction was also observed [7-9]. In addition, researchers showed that a healthy diet rich in fruits and vegetables had a positive impact on human health. Low fruit and vegetable consumption was significantly related to acute myocardial infarction in the INTERHEART study [3]. The protective role of fruit and vegetable consumption against coronary heart disease was observed in the Nurses' Health Study and the Health Professionals' Follow-Up Study [1].

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Many studies have also demonstrated the protective effect of fruit and vegetables against cancer [2, 10, 11].

The impact of dietary factors on cardiovascular disease has likewise been observed in Poland. A decreasing saturated fatty acid intake and increasing vegetable oils (rapeseed and soybean) consumption as a source of unsaturated fatty acids, between the years 1991 - 2002 was associated with decreasing cardiovascular disease mortality in Poland. During this time, increasing fruit and vegetable consumption and decreasing tobacco smoking was also observed [12]. The implementation of the EU regulations after 2009 [13] and opening of the food market to the European trends concerning health-promoting life style also contributed to this situation [14].

According to Hu and Willett [15], the optimal diet for heart protection should be abundant in fruits, vegetable, whole grain, non-hydrogenated unsaturated fatty acids, and omega-3 fatty acids.

The aim of this study was to assess energy, protein, carbohydrate, total fat and fatty acid dietary intake of the Polish-Norwegian Study (PONS) participants.

MATERIALS AND METHODS

This study presents preliminary analysis data from the first wave of participants of the PONS of chronic diseases in the Świętokrzyskie Province of Poland. The PONS study is a big, open-ended prospective study with very broad research aims. The ultimate aim of the study is to advance our understanding of important causes of morbidity and mortality in Poland, and to establish a solid knowledge base for the prevention of these major causes of premature morbidity and mortality.

Sample and data collection. Recruitment units were established in urban and rural areas of Świętokrzyskie Province. Eligibility criteria for the project population were place of residence (city of Kielce and Świętokrzyskie Province) and age (45-64). The results presented in this paper are based on data from the first 3,862 participants (2,572 females and 1,290 males aged between 45-64) recruited between 2010-2011. 1,182 were rural inhabitants (396 males and 786 females) and 2,680 urban inhabitants (894 males and 1,786 females). Mean age, BMI and waist circumference among rural inhabitants was: 55.0±5.5 y.o., 29.0±3.9 kg/m^2 and 100.7±9.8 cm in males, and 53.9±5.1 y.o., 29.1±5.2 kg/m^2 and 90.7±11.8 cm in females. Among urban inhabitants, these parameters were, respectively, 56.1±5.3 y.o., 28.3±3.8 kg/m^2 and 99.0±10.4 cm in males, and 56.2±5.2 y.o., 27.8±4.8 kg/m^2 and 87.3±11.5 cm in females.

All participants were examined in accordance with the PONS project protocol. Questionnaire information was collected as a systematic interview, and the responses were entered on an electronic form, and after completion of the interview the data were sent directly to a data server for processing and further management.

Measurements. Participants' habitual food intake in past year was measured using the Food Frequency Questionnaire (FFQ). PONS FFQ was constructed based on a previously developed and validated FFQ for the Poland branch of the PURE study [16]. Development and validation methods for FFQ were based on previous studies conducted in the United Arab Emirates and Kuwait [17], and in Colombia [18].

The questionnaire contained 55 questions. Portion sizes were described as typical portions used at home (e.g. a glass, a slice, a teaspoon, a plate). Each question was divided into 2 parts. In the first part, participants were asked if they were eating/drinking each item (e.g. a slice of cheese or a glass of semi-skimmed/low fat milk) at least once a month. The possible answers were: 'Yes', 'No', 'Don't know' and refusal. In the second part of the questionnaire, participants were asked about consumption frequency of each item in the last year (e.g. 'How often in the past 12 months did you eat a slice of cheese?' or 'How often in the past 12 months did you drink one glass of semi-skimmed/low fat milk?'). The frequencies of consumption were classified as: 1-3 times a month, once a week, 2-4 times a week, 5-6 times a week, once a day, 2-3 times a day, 4-5 times a day, 6 times a day or more, don't know and refusal. Individual sugar intake was assess by an open-ended question – participants were asked 'How many teaspoons of sugar do you add to tea or coffee and other drinks?'

The FFQ included an additional section about oils consumption and daily intake of canola oil, soybean oil, sunflower oil, olive oil, and other oils (e.g. grape seed oil) during the previous year, which were recorded.

The PONS questionnaire also included a question about alcohol consumption in a different section of the FFQ. Taking into account that alcohol is source of energy in the diet, the consumption of beer, grape wine, fruit wine and vodka was included for daily energy calculations.

Recorded frequencies of consumption were converted into daily intake, and daily foods and nutrients intake were calculated. To compute the daily nutrient intake, the reported frequency of consumption for each food item was multiplied by the portion size, and then the total food intake was converted into nutrient intake, based on the food's nutrient profile. Daily intake of foods and nutrients was computed at the Population Health Research Institute (PHRI) at McMaster University, Hamilton, Canada. Based on the US Department and Agricultural (USDA) [19] and Poland's Food Composition Table [20], a special nutrient food database which includes food products and dishes commonly eaten in Poland, was constructed. Merchant and Dehghan [21] described previously the procedure to compile a food composition database from USDA and local food composition tables.

Statistical analysis. Mean (SD) and median were calculated to summarize continuous variables. For all analysis, the criterion for statistical significance was set at p=0.05. Statistical analysis were performed using computer programme STATISTICA v 9.1 PL StatSoft Inc., USA.

Ethics. The study was approved by the Ethics Committee of the Cancer Centre and the Institute of Oncology in Warsaw, Poland.

RESULTS

Mean daily energy and macro-nutrients intake by gender, age, place of residence and level of education is presented in Tables 1-3. It was found that the short FFQ under-estimated participants' daily energy and nutrients intake. However, energy intake was significantly higher in males than in

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Table 1. Mean (SD) daily energy and nutrient intake in the PONS study group, by gender and place of residence

Nutrient	Unit	Urban		Rural		Overall	
		Males (n=894)	Females (n=1786)	Males (n=396)	Females (n=786)	Males (n=1290)	Females (n=2572)
		1	2	3	4	5	6
Energy	kcal	1465.6 (442.1) [a,c]	1322.7 (454.8) [d]	1452.1 (419.8) [b]	1316.0 (362.0)	1461.4 (435.3) [g]	1320.7 (428.5)
Protein	g	62.2 (19.0) [c]	60.4 (22.1)	59.7 (16.5)	58.1 (16.5)	61.4 (18.3) [g]	59.7 (20.6)
Fat total	g	51.8 (19.3) [a,c]	46.3 (19.1) [d]	50.6 (16.7) [b]	46.4 (15.7)	51.4 (18.5) [g]	46.3 (18.1)
SFA	g	16.9 (6.4) [a,c]	15.6 (6.4) [d]	16.8 (5.8) [b]	15.6 (5.5)	16.9 (6.2) [g]	15.6 (6.1)
MUFA	g	19.1 (7.8) [a,c]	16.6 (7.4) [d]	18.7 (6.4) [b]	16.6 (5.9)	18.9 (7.4) [g]	16.6 (7.0)
PUFA	g	9.5 (4.0) [a,c]	8.1 (3.8) [d]	9.1 (3.4) [b]	8.1 (3.0)	9.4 (3.8) [g]	8.1 (3.6)
P/S	-	0.6 (0.2) [a,e]	0.5 (0.2)	0.6 (0.2)	0.5 (0.2)	0.6 (0.2) [g]	0.5 (0.2)
Cholesterol	mg	226.7 (99.7) [a,c]	204.7 (99.8) [d]	224.6 (80.8) [b]	200.3 (75.1)	226.0 (94.3) [g]	203.3 (93.0)
Carbohydrates	g	176.6 (56.2) [a,c]	168.3 (61.5)	175.3 (57.4)	168.5 (50.4)	176.2 (56.5) [g]	156.8 (47.0)
Fibre	g	16.3 (5.8)	16.3 (7.2)	16.2 (5.6)	16.1 (5.2)	16.3 (5.7)	16.3 (6.6)
Protein	% E	17.2 (2.6) [a,c,e]	18.4 (2.8) [d,f]	16.7 (2.6) [b]	17.8 (2.8)	17.0 (2.6) [g]	18.2 (2.8)
Fat total	% E	31.6 (5.2)	31.3 (5.1)	31.4 (4.9)	31.5 (4.8)	31.5 (5.1)	31.4 (5.0)
SFA	% E	10.3 (2.0) [a,c]	10.5 (2.0)	10.4 (2.0)	10.6 (2.0)	10.4 (2.0) [g]	10.6 (2.0)
MUFA	% E	11.6 (2.5) [a,c]	11.2 (2.4) [d]	11.6 (2.2) [b]	11.3 (2.3)	11.6 (2.4) [g]	11.2 (2.4)
PUFA	% E	5.8 (1.5) [a,c]	5.5 (1.4) [d]	5.6 (1.3)	5.5 (1.3)	5.8 (1.4) [g]	5.5 (1.4)
Carbohydrates	% E	43.9 (6.6) [a,c]	45.9 (6.4) [d]	43.8 (6.6) [b]	46.4 (6.4)	43.9 (6.6) [g]	46.0 (6.4)
Alcohol	% E	4.3 (5.3) [a,c]	1.2 (2.1) [d]	5.0 (6.3) [b]	1.1 (2.2)	4.5 (5.6) [g]	1.2 (2.1)

SD – standard deviation
% E – percentage of energy
[a] – 1 vs 2; [b] – 3 vs 4; [c] - 1 vs 4; [d] – 2 vs 3; [e] – 1 vs 3; [f] – 2 vs 4; [g] – 5 vs 6 – statistically significant differences, p<0.05.

females (1,461.4 vs 1,320.7 kcal/day), and in participants aged 45-54 than in those aged 55-64 (1,409.5 vs 1,338.5 kcal/day) (Tab. 1, 2). Comparing urban and rural participants, no significant differences in daily energy intake were observed. People with primary education had a significantly lower daily energy intake (1,281.5 kcal/day) than those with vocational, secondary and university education (1,392.2, 1,361.1 and 1,379.2 kcal/day, respectively) (Tab. 3). The percentage of energy from protein, fats and carbohydrates in the rural area were 16.7%, 31.4% and 43.8% in males, and 17.8%, 31.5% and 46.4% in females, respectively. In urban areas, males had 17.2%, 31.6%, 43.9%, and females had 18.4%, 31.3% and 45.9% of energy from protein, fats and carbohydrates, respectively (Tab. 1).

Protein intake was higher in males than in females (61.4 vs 59.7 g/day, p<0.05), and in participants aged 45-54 than older participants (61.2 vs 59.6 g) (Tab. 1, 2). People with

primary education had a lower protein intake than those with a higher level of education (Tab. 3).

Daily fat intake was higher in males compared to females (51.4 vs 46.3 g, p<0.05), and in younger than in the older age group (49.9 vs 46.7 g). The percentage of energy from saturated fatty acid (SFA), monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) were higher among males than females. Statistical differences between the younger and older age groups were found according to percentage of energy from MUFA (11.5 vs 11.3 of energy). People in urban and rural areas had similar amounts of fat intake (Tab. 1, 2). People with primary education had a lower fat intake (45.4 g/day) than those with vocational (48.9 g/day) and university education (48.6 g/day). People with higher education had a higher percentage of energy from

Table 2. Mean (SD) daily energy and nutrient intake in the PONS study group by age

Nutrient	Unit	Study group	
		45-54 y.o. (n=1586)	55-64 y.o. (n=2276)
Energy	kcal	1409.5 (471.6) [a]	1338.5 (406.5)
Protein	g	61.2 (21.4) [a]	59.6 (18.7)
Fat total	g	49.9 (20.2) [a]	46.7 (17.0)
SFA	g	16.6 (6.6) [a]	15.6 (5.9)
MUFA	g	18.1 (8.0) [a]	16.9 (6.6)
PUFA	g	8.9 (4.1) [a]	8.3 (3.4)
P/S	-	0.6 (0.2)	0.6 (0.2)
Cholesterol	mg	217.0 (103.8) [a]	206.7 (86.3)
Carbohydrates	g	175.2 (61.7) [a]	168.0 (54.8)
Fibre	g	16.3 (6.9)	16.3 (5.9)
Protein	% E	17.6 (2.8) [a]	18.0 (2.8)
Fat total	% E	31.7 (5.0) [a]	31.2 (5.0)
SFA	% E	10.5 (2.0)	10.5 (2.0)
MUFA	% E	11.5 (2.4) [a]	11.3 (2.4)
PUFA	% E	5.6 (1.4)	5.6 (1.4)
Carbohydrates	% E	45.1 (6.5)	45.4 (6.6)
Alcohol	% E	2.5 (4.0) [a]	2.1 (4.0)

SD – standard deviation
% E – percentage of energy
[a] – statistically significant differences between age groups, p<0.05.

Table 3. Mean (SD) daily energy and nutrient intake in PONS study group by level of education

Nutrient	Unit	Primary education (n=230)	Vocational education (n=687)	Secondary education (n=1710)	University education (n=1235)
		1	2	3	4
Energy	kcal	1281.5 (401.0) [a,b,c]	1392.2 (426.6)	1361.1 (446.0)	1379.2 (431.1)
Protein	g	55.7 (17.0) [a,b,c]	59.4 (18.5)	60.5 (20.9)	61.3 (19.5)
Fat total	g	45.4 (17.2) [a,c]	48.9 (18.5)	47.7 (18.8)	48.6 (18.1)
SFA	g	15.2 (6.0) [c]	16.1 (6.3)	15.9 (6.2)	16.3 (6.1)
MUFA	g	16.5 (6.5) [a]	17.9 (7.1) [d]	17.2 (7.4)	17.6 (7.0)
PUFA	g	8.3 (3.4) [a]	8.9 (3.5) [d,e]	8.5 (3.9)	8.5 (3.7)
P/S	-	0.6 (0.2) [c]	0.6 (0.2) [d,e]	0.6 (0.2)	0.5 (0.2)
Cholesterol	mg	196.1 (75.2)	212.4 (89.5)	211.6 (102.4)	211.8 (87.0)
Carbohydrates	g	163.0 (54.0) [a]	173.4 (54.1)	170.7 (59.4)	171.5 (58.3)
Fibre	g	15.3 (4.8) [c]	16.3 (5.7)	16.3 (6.8)	16.5 (6.3)
Protein	% E	17.6 (2.8)	17.3 (2.9)	18.0 (2.8)	18.0 (2.9)
Fat total	% E	31.7 (5.1)	31.3 (5.1)	31.3 (5.0)	31.6 (5.0)
SFA	% E	10.6 (2.1)	10.3 (2.0) [e]	10.5 (2.0)	10.6 (2.0)
MUFA	% E	11.5 (2.3)	11.5 (2.4)	11.3 (2.4)	11.4 (2.4)
PUFA	% E	5.8 (1.4) [c]	5.7 (1.3) [d,e]	5.6 (1.4)	5.5 (1.4)
Carbohydrates	% E	46.1 (6.4)	45.5 (6.9)	45.4 (6.5)	44.9 (6.4)
Alcohol	% E	1.3 (3.3) [a,b,c]	2.8 (5.3) [e]	2.1 (3.7) [f]	2.4 (3.6)

SD – standard deviation
% E – percentage of energy
[a] – 1 vs 2; [b] – 1 vs 3; [c] – 1 vs 4; [d] – 2 vs 3; [e] – 2 vs 4; [f] – 3 vs 4 – statistically significant differences, p<0.05.

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SFA than those with vocational education. The percentage of energy from PUFA was significantly higher in participants with vocational education than in those with secondary and university education. People with primary education had a higher percentage of energy from PUFA than those with university education (Tab. 3).

We also assessed PUFA to SFA (P/S) ratio, which was significantly higher in males than in females (0.6 vs 0.5, respectively), but significant differences were not found between urban and rural settings (Tab. 1). Taking into account the level of education, it was observed that participants with university education had a significantly lower P/S ratio (0.5) than those with primary and vocational education (0.6 and 0.6, respectively). There was a higher P/S ratio among participants with vocational than secondary education (Tab. 3).

Mean daily cholesterol intake was higher among males than females, and among younger than older participants (Tab. 1, 2).

Males and younger participants had higher carbohydrate intakes than the others (Tab. 1, 2). Carbohydrate intake was higher in participants with vocational education than in those with primary education (Tab. 3).

The percentage of energy from alcohol in males was 4.5%, and was significantly higher than in females (1.2%) (Tab. 1). The percentage of energy from alcohol was significantly higher in participants aged 45-54 than in those age 55-64 (2.5% vs 2.1%) (Tab. 2). Alcohol intake was positively associated with level of education, and percent energy from alcohol was lower among those with primary education than others (Tab. 3).

The relationship between blood lipid profiles and nutrients intake was assessed. It was found that those with a higher percentage of energy from PUFA and higher ratio of PUFA/SFA, had lower blood cholesterol (<190mg/100ml). Similar correlations were found for LDL cholesterol level. Participants with blood LDL level <115 mg/100ml had a significantly higher percentage of energy from PUFA, and better P/S ratio (5.7% and 0.56, respectively) than those with blood LDL level ≥115 mg/100ml (5.6% and 0.55, respectively). Individuals with a high percentage of energy from alcohol had blood cholesterol ≥190 mg/100ml.

DISCUSSION

The dietary intake of PONS participants was measured using a short FFQ and, as expected, males had a higher daily energy and macro-nutrients intake. Participants with a higher ratio of PUFA/SFA had lower blood cholesterol and LDL levels. The overall diet was similar between urban and rural participants.

Among energetic dietary compounds, insufficient intake was observed mainly in carbohydrates. Protein intake among males was in accordance with Polish recommendations [22], and among females slightly exceeded recommendations. Total fat intake in both groups was in the lower level of Polish recommendations [22]. Other authors have also observed underreporting in dietary intake [23, 24]. Włodarek and Gurtatowska [23] found that energy intake estimated by 24-hour dietary recall was about 600 kcal lower than assessed daily energy expenditure. It is worth noting that 80% of the study group were overweight and obese. Waśkiewicz and Sygnowska [24] assessed that the diet of persons with overweight or obesity was characterized by lower energy and carbohydrates intake than in those with normal weight.

Daily energy intake in Polish population assessed by 24-hours dietary recall in the WOBASZ study [25] was higher than our results. Among participants aged 45-54, energy intake in the WOBASZ study amounted to 1,629 kcal/day in males and 1,687 kcal/day in females, and respectively, 1,634 kcal/day and 1,619 kcal/day among participants aged 55-64. Daily energy intake observed in Świętokrzyskie Province in the WOBASZ study amounted to 2,526 kcal/day in males and 1,750 kcal/day in females [26]. Energy intake assessed in the POL-MONICA BIS study [27, 28] was also higher than in the presented study, both in Warsaw and the former Tarnobrzeg Province. Daily energy intake among participants aged 45-54 in Warsaw was 2,314 kcal in males, and 1,657 kcal in females, while in Tarnobrzeg Province it was 2,341 kcal and 1,765 kcal, respectively. Among participants aged 55-64, the daily energy intake amounted in Warsaw inhabitants to 2,216 kcal in males and 1,495 kcal in females, while in Tarnobrzeg Province – 1,998 kcal and 1,549 kcal, respectively [27, 28]. A higher daily energy intake than in the presented study was also observed among 40-year-olds (2,574 kcal in males, 1,769 kcal in females), and 50-year-olds, (2,341 kcal in males, 1,677 kcal in females) Wroclaw inhabitants [29, 30].

The percentage of energy from macronutrients in the PONS study group was incorrect. We observed excessive percentage of energy from protein and insufficient from carbohydrates. The percentage of total fat was similar in males and females and in both groups was above recommendations (>30%). The percentage of energy from total fat observed in other Polish studies was higher than in PONS study [25-30].

The percentage of energy from SFA in the PONS study was higher than recommendations. Percentage of energy from SFA observed in the WOBASZ studied group (aged 20-74 years), both in males and in females, was also higher than recommendations (13.6% and 13.1% of energy from SFA, respectively) [25]. In Świętokrzyskie Province [26] the percentage of energy from SFA was lower than in the whole WOBASZ population, and amounted respectively to 12.2% in males and 12.5% in females. The percentage of energy from SFA in the POL-MONICA BIS Warsaw study [28] was similar to Świętokrzyskie Province, and amounted 12.4% in males and 12.1% in females. In the POL-MONICA BIS Tarnobrzeg study [27], the percentage of energy from SFA was, respectively, 11.4% and 11.1%. An excessive percentage of energy from total fat and SFA was also observed in the diet of Americans in the National Health and Nutrition Examination Survey (NHANES) [31].

In the Guidelines for the Management of Dyslipidaemias, published by the European Society of Cardiology (ESC) and the European Atherosclerosis Society (EAS) [32], the authors emphasize that SFA have the strongest impact on LDL cholesterol level and, in the presence of hypercholesterolaemia, their intake should be reduced below 7% of energy. According to the authors, trans fats have a similar effect on LDL cholesterol level as on SFA, but this fraction also decreased HDL cholesterol level. In searching for a correlation between SFA intake and HDL cholesterol level, it was observed that SFA intake reduces the anti-inflammatory potential of HDL, and impairs arterial endothelial function [33].

The percentage of energy from MUFA and PUFA in this study was too low, compared with recommendations. A better percentage of energy from MUFA, especially in

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males, compared with recommendations, was observed in the WOBASZ and POL-MONICA BIS studies [25, 27, 28]. The percentage of energy from PUFA in WOBASZ [25] and POL-MONICA BIS Tarnobrzeg [27] studies was similar to the presented study. In the POL-MONICA BIS Warsaw study [28], a higher percentage of energy from PUFA was observed (6.4% in males and 6.5% in females).

P/S ratio to express the correct proportion between the content of PUFA to SFA should be between 0.7 - 1.0. The P/S ratio observed both in the presented and previous studies was lower than 0.7 [27-30].

Mean daily cholesterol intake assessed in the presented study was in accordance with recommendations (266.0 mg in males and 203.3 mg in females). Cholesterol intake assessed in other Polish studies was above 300 mg/day in males, while among females – between 232 - 289 mg/day [25-30]. Among the American population, males aged 40-59 consumed daily 353 mg of cholesterol, while females consumed daily 241 mg [31].

According to the ESC/EAS Guidelines for the Management of Dyslipidaemias [32], dietary fibre present in fruit, vegetables and whole meal cereals has a direct hypocholesterolaemic effect. Dietary fibre intake assessed in the presented study was very low compared with Polish recommendations [22], according to which the daily fibre intake should be above 25 g/day. In the WOBASZ study [25], POL-MONICA BIS Warsaw [28] and Tarnobrzeg studies [27], dietary fibre intake was also insufficient compared with recommendations. In both studies it was found that dietary fibre intake was higher in males than in females. Dietary fibre intake among 40-year-old males from Wrocław was close to recommendations (24.2 g/day), while in females it was insufficient (19.1 g/day) [29]. 50-year-old Wrocław inhabitants consumed less dietary fibre (22.6 mg and 18.5 mg, respectively), than 40-year-old inhabitants [30].

The main strength of the presented study are in the large number of participants and standardized method of data collection. However, the short FFQ under-estimated the daily nutrient intake, and the result of the study may slightly differ from previous studies conducted in Poland. The short FFQs have been used to measure individual dietary patterns in large international studies [3] and proved to be a valuable tool for assessing diet-disease correlation.

CONCLUSIONS

Under-reporting of energy intake was observed in a significant percentage of participants, especially in males. It seems reasonable to include some additional questions in the FFQ in further studies. Gender, age, and education status had a statistically significant impact on dietary intake. The analyzed diets were not well balanced. Increasing the intake of dietary fibre, mono- and polyunsaturated fatty acids in the diet of the studied participants will make their diets more healthy.

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