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EVALUATION OF FATTY ACIDS DAILY INTAKE AND DIETS ATHEROGENICITY OF DIETETICS STUDENTS OF WROCLAW MEDICAL UNIVERSITY

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ABSTRACT

Background. Dietary and lifestyle risk factors play an important role in the pathogenesis of cardiovascular disease (CVD). The excessive intake of products that could affect atherogenic effect and are rich sources of saturated fatty acids (SFA) and cholesterol conductive the occurrence of lipid metabolism disturbances in the body.

Objective. Evaluation of fatty acids dietary intake and assessment of the students' diets atherogenicity in the aspect of the CVD risk.

Material and methods. The study was conducted in 2011-2012. The study group included 100 females, dietetic students of the Wroclaw Medical University. The average age of the students was 21 years. Dietary habits were evaluated by the 3-day diet record method including one weekend day.

Results. Average energy intake was 1673.9 kcal per day. The average daily total fat intake was 65.4 g and provided 34.5% of total energy intake. The percentage of energy from SFA in the diets of 82% students exceeded the recommended 10% and averaged 13.1%. The average percentage of energy from monounsaturated fatty acids (MUFA) in the students diets was 12.9% and in the diets of 5% students did not exceeded recommended 10%. The average percentage of energy from polyunsaturated fatty acids (PUFA) was 5.7% and in the diets of 66% students did not fulfilled the recommended 6-10%. About 80% of the students consumed less than recommended 2 g of C18:3 per day. Insufficient intake of EPA and DHA was observed in 71% students' diets. The average n-6/n-3 PUFA ratio was 7.2 and in the 76% of female diets exceeded the recommended value of 4:1. The diets of 80% of students were considered as atherogenic, because of elevated value of Keys score. The ratio between PUFA and SFA in the female diets was incorrect and amounted to 0.52 (recommended value $\geq$ 1.0).

Conclusions. Incorrect energy intake from daily diet and improper dietary intake of selected fatty acids in the diets of students may contribute to the development of CVD.

Key words: *diet, university students, atherogenicity, fatty acids, cholesterol*

STRESZCZENIE

Wprowadzenie. Czynniki żywieniowe oraz elementy stylu życia odgrywają istotną rolę w patogenezie chorób układu krążenia (ChUK). Nadmierne spożycie produktów wykazujących działanie aterogenne, bogatych w nasycone kwasy tłuszczowe (NKT) i cholesterol sprzyja występowaniu zaburzeń w przemianach lipidów w organizmie.

Cel. Celem badań była ocena zawartości kwasów tłuszczowych oraz aterogenności całodziennych racji pokarmowych (CaRP) studentek dietetyki, w aspekcie zagrożenia ChUK.

Materiał i metody. Badania przeprowadzono w latach 2011/2012, w grupie 100 kobiet, studentek dietetyki Uniwersytetu Medycznego we Wrocławiu. Średnia wieku badanych kobiet wynosiła 21 lat. Sposób żywienia studentek oceniono metodą bieżącego notowania jadłospisów z trzech dni, przy użyciu ankiety żywieniowej.

Wyniki. Wartość energetyczna analizowanych CaRP wynosiła średnio 1673,9 kcal/dzień. Zawartość tłuszczów ogółem wynosiła średnio 65,4 g, co stanowiło 34,5% energii z CaRP. Udział energii z NKT przekraczał dozwolone 10% energii z CaRP w dietach 82% kobiet i wynosił średnio 13,1%. Średni odsetek energii pochodzący z jednonienasyconych kwasów tłuszczowych (JNKT) w CaRP studentek wynosił 12,9% i w dietach 5% kobiet nie przekraczał zalecanych 10%. Udział energii z wielonienasyconych kwasów tłuszczowych (WNKT) w CaRP badanych kobiet wynosił średnio 5,7% i w dietach 66% kobiet nie mieścił się w granicach zalecanych 6-10%. Około 80% badanych kobiet spożywało mniej niż zalecane 2 g/dzień kwasu C18:3. Niewystarczające spożycie EPA i DHA stwierdzono u 71% badanych studentek. Stosunek n-6/n-3

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w badanych dietach wynosił średnio 7,2 i w CaRP 76% kobiet przekraczał zalecaną wartość 4:1. Diety 80% badanych kobiet, ocenione wskaźnikiem Keys'a, były aterogenne. W analizowanych CaRP stwierdzono nieprawidłową proporcję między zawartością WNKT a NKT wynoszącą 0,52 przy wartościach zalecanych ≥ 1.
Wnioski. Nieprawidłowa struktura energetyczna diety oraz nieodpowiednia zawartość poszczególnych kwasów tłuszczowych w racjach pokarmowych badanych studentek może w przyszłości przyczyniać się do rozwoju ChUK.

Słowa kluczowe: *dieta, studentki, aterogenność, kwasy tłuszczowe, cholesterol*

INTRODUCTION

Lifestyle, physical activity and nutrition play an important role in the pathogenesis of cardiovascular disease (CVD) [27].

Authors of the scientific research indicate that not only the quantity of fatty acids but also the quality and type of fatty acids in the diet have an important influence on the arteriosclerosis development, hypertension and neoplastic lesions [12, 39].

The diet atherogenicity is defined as a potential ability to induce an inflammation in human body. The excessive intake of products that contain saturated fatty acids (SFA) and cholesterol could demonstrating atherogenic activity, and furthermore insufficient intake of products that are sources of monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA), would also predisposes to lipid disorders development since the childhood [24].

Sufficient and regular intake of products that are sources of n-3 long-chain polyunsaturated fatty acids (LC-PUFA), including: α-linolenic acid (C18:3, ALA), eicosapentaenoic acid (C20:5, EPA), docosapentaenoic acid (C22:5, DPA) and docosahexaenoic acid (C22:6, DHA) may protect against CVD by reducing serum triglycerides, thrombotic tendency, lowering blood pressure and heart rate [1, 7]. The European Academy of Nutritional Sciences (EANS) recommendations indicate that the total daily intake of EPA and DHA should amount 200 mg [11]. However the recommendations of the International Society for the Study of Fatty Acids and Lipids (ISSFAL) suggest that the total daily intake of DHA and EPA should amount 650 mg, including the DHA intakes of at least 220 mg/day [16]. According to The Food and Drug Administration (FDA) the daily dietary and supplementary intake of EPA and DHA should not exceed 3.0 g/day [26].

According to the Polish Forum for Prevention of Cardiovascular Disease the proper n-6/n-3 PUFA ratio in the healthy diet should be less than 4/1 [19]. In the Western diet the n-6/n-3 PUFA ratio is significantly impaired [31]. This situation is connected with excessive consumption of products being a source of n-6 PUFA, promoting the effect of proinflammatory and prothrombotic eicosanoids formation [34]. Dietary sources rich in linoleic acid n-6 (C18:2, LA) are: sunflower oil, soybean oil, corn oil, safflower oil, grapeseed oil, wheat germ oil and their derivatives, like margarine. Cold--pressed rapeseed oil is characterized by particularly low content of SFA and also the correct n-6/n-3 PUFA ratio amounting to 2/1 [22].

Dietary LA and ALA are metabolized by the same group of enzymes, but the effectiveness of metabolism is different and depends on the source and ratio of amounts of these fatty acids in the diet. Efficient metabolism of n-3 PUFA, without the disruption in bioconversion pathway of those fatty acids is possible only when the daily diet is rich in both EPA and DHA [6, 14]. The bioconversion efficiency of ALA from the diet could be inhibited by excessive intake of LA even about 40-50% [2]. The main sources of n-3 PUFA in the diet are fatty marine fish, which should be consumed at least twice a week, according to the recommendations. Supplementary sources of n-3 PUFA in the diet are food supplements and fortified food [20, 21].

The aim of the study was to evaluate the fatty acids daily intake and assessment of the students diet atherogenicity, from the perspective of the CVD prevention.

MATERIALS AND METHODS

Subjects

The study was conducted in 2011-2012. The study group included 100 female students of dietetics of Wroclaw Medical University. The anthropometric characteristics of the study group are presented in Table 1. The nutritional status of the study group was evaluated based on anthropometric parameters such as body weight and height. The Body Mass Index (BMI)

Table 1. Anthropometric characteristic of the study group (n=100)

Parameter	Unit	Women (n=100)	
		X ± SD	Median
Age	year	21.2±1.1	21.0
Height	cm	166.7±6.0	166.0
Body weight	kg	57.9±8.6	57.5
BMI	kg/m^2	20.8±2.6	20.5
Waist	cm	70.4±6.2	70.0
Body fat	%	23.3±6.3	23.2

* BMI- body mass index; *X*±SD- arithmetic mean ± standard deviation

and the ideal body weight were computed based on the anthropometric parameters. The correct BMI ranged was determined by WHO [38]. The percentage content of body fat was determined by the body composition analyzer (Tanita Corporation, Japan, type BC-418MA).

The energy intake requirements for students with BMI below 18.5 kg/m^2 and above 24.9 kg/m^2 were set at ideal body weight values, while for the rest of the students on the actual weight. The daily energy intake and contents of selected nutrients in the diets of each student were compared with the recommendations specified individually for a particular person, taking into account gender, age, proper body weight and moderate physical activity [17].

Dietary habits in the study group were evaluated by the method of the 3-day diet record method including one weekend day. Overall 300 dietary interviews were analyzed. The weight of consumed products were determined by the "Album of photographs of food products and dishes" [35]. Analyses of the diets were performed using the "Food Processor" SQL version 9.8.1's by ESHA Research (USA), containing database of nutritional values of Polish food products and dishes [22].

Measures

The proportion of energy from macronutrients in the diet was assumed as follows: 12% energy from protein, 30% energy from fat and 58% energy from carbohydrates. It was assumed that the proper content of fiber in the diet should be 30 g/day, and SFA, MUFA and PUFA should provide respectively: <10%, 10-14%, 6-10% of daily energy intake [17].

The average daily energy intake and the average content of protein, carbohydrates, dietary fiber, total fat, cholesterol, selected SFA (C4:0, C6:0, C8:0, C10:0, C12:0, C14:0, C15:0, C16:0, C17:0, C18:0, C20:0), MUFA (C14:1, C15:1, C16:1, C17:1, C18:1, C20:1, C22:1), n-6 PUFA (C18:2, C20:4) and n-3 PUFA (C18:3, C20:5, C22:5, C22:6) and the sum of these fatty acids in the study group diets were assessed. In Table 2 and 3 the percentage of students whose nutrients in the daily diet deviated from the accepted recommendations were presented.

The atherogenicity of the diets were evaluated using the P/S ratio (the ratio of PUFA to SFA) and *Keys* score [18]. The *Keys* score was calculated as follows:

$$\text{Keys score} = 1.35 * (2 * SFA - PUFA) + 1.5 * \sqrt{(\text{diet chol.}/1000\ \text{kcal})}$$

where:

SFA- energy intake from saturated fatty acids [%]

PUFA- energy intake from polyunsaturated fatty acids [%]

diet chol.- cholesterol from diet per 1000 kcal [mg]

In order to determinate the diet atherogenicity the reference *Keys* score ($KS_{ref.}$) was established, including the average daily recommended energy intake (female - 2356 kcal/day), average age (21 years old) and moderate physical activity level (PAL=1.75) of the respondents [17]. According to the National Food and Nutrition Institute recommendations SFA should provide less than 10% of daily energy intake and PUFA 6-10% of daily energy intake [17]. Assuming that the daily energy intake of SFA and PUFA was respectively 10% and 6% of the daily energy intake and cholesterol was 300 mg/day the reference *Keys* score was 35.9. While assuming that the daily energy intake of PUFA was equal to 10%, reference *Keys* score was 30.5.

The ratio of n-6/n-3 PUFA in analyzed diets was calculated by using a model: n-6 PUFA (C18:2 + C20:4)/n-3 PUFA (C18:3 + C20:5 + C22:6).

RESULTS AND DISCUSSION

Among all of the respondents the vast majority (79%) had correct body weight. The BMI for 14% of

Table 2. The average energy intake and contents of selected nutrients in the daily food rations of the study group (n=100)

Nutrient	Unit	X ± SD	Median	% of the standard X ± SD	% of average daily food rations below the standard
Energy	kcal	1673.9±564.7	1591.2	71±20	80
Protein	g	68.5±28.8	63.7	98±30	56
Carbohydrates	g	215.2±257.6	190.6	60±18	99
Total fat	g	65.4±29.4	61.6	85±30	73
Dietary fiber	g	21.4±9.8	19.9	71±26	91
Cholesterol	mg	239.7±159.0	198.8		
Energy from protein	%	16.7±5.24	15.9		
Energy from carbohydrates	%	51.6±55.5	48.4		
Energy from fat	%	34.5±8.3	34.3		

X±SD- arithmetic mean ± standard deviation the students had a value of less than 18.5 kg/m^2, and pointed to underweight.

The average energy intake and the average amount of total protein, total carbohydrates, dietary fiber, total fat and cholesterol were presented in Table 2. Also the percentage of energy from macronutrients in the analyzed diets was presented.

The average energy intake in the analyzed female diets was 1673.9 kcal/day, which covered 71% of the recommendations. Appointed standard average energy value for women aged 21 years and moderate physical activity was 2356 kcal/day. The total energy intake of the diets of 80% students should be regarded as too low in relation to the acceptable daily recommendations. The authors of several studies have observed the abnormal energy intake in the students diet and tend to keep the energy deficit [4, 8, 10, 13, 29]. However, dietary assessment of Iranian students demonstrate the energy intake at a similar level to the recommend values [3].

Average protein content in the analyzed diets was 68.5 g/day. These values covered the standard in 98% of the average daily demand for protein for that population. In the diets of 91% female students the percentage of energy from protein exceeded the recommended 12% and averaged to 16.7%. The authors of other studies also reported too high protein energy intake in the daily students diets [4, 13, 32].

Carbohydrates intake in the analyzed female students diets was on average 215.2 g/day, which in 60% fulfilled the recommendations. The percentage of energy from carbohydrates in the analyzed diets amounted to 51.6% and only in the diets of 5% students was consistent to the recommendations. However, in 95% of female students diets the energy intake from carbohydrates was too low in relation to recommendations. The dietary fiber intake with the diets also seems to be inappropriate. Considering the 30 g/day of fiber in the daily diet as an optimum value, it was found that in the diets of 91% students the dietary fiber intake was too low and average amounted to 21.4 g/day. According to the studies of *Szczepańska* et al [33] and *Li* et al [23], the students diets did not provide the recommended levels of fiber, which average content was respectively 16.1 g/day and 15.9 g/day. *Regulska-Ilow* et al [29] reported that the students diets were deficient in fiber, which average intake amounted to 19.6 g/day.

The average intake of total fat in analyzed female students diets amounted to 65.4 g/day. The percentage of energy from fat in the diets was 34.5% and exceeded recommended value in 82% of respondents (Table 3). Average total fat content in the analyzed diets in 85% covered the standard for this nutrient, for the studied group. However, too low energy intake from carbohydrates caused that the percentage of energy from total fat exceed the recommendations. These data indicate on the disturbed in energetic structure of diet. Disturbed energy intake from fat in students diets was observed also in the researches of other authors [4, 13, 15, 29, 37].

Table 3. The percentage of respondents whose nutritional habits could cause the increase risk of lipid disorders (n=100)

Nutrient		% of respondent
Total fat > 30% E		82
SFA > 10% E		82
MUFA < 10% E		5
PUFA	< 6% E	64
	>10% E	2
ALA < 2 g/day		80
n-6/n-3 > 4;5/1		76
EPA + DHA < 0.2 g/day		71
Cholesterol > 300 mg/day		25
Dietary fiber < 30 g/day		91
P/S < 1.0		94
KS > 35.9		80

% E- the percentage of total energy; SFA- saturated fatty acids; MUFA- monounsaturated fatty acids; PUFA- polyunsaturated fatty acids; ALA- α-linolenic acid; EPA- eicosapentaenoic acid; DHA- docosahexaenoic acid; P/S- PUFA/SFA; KS- *Keys score*

The average content of cholesterol in the female students diets was 239.7 mg/day. In the diets of 75% students the content of cholesterol was consistent with the recommendations and not exceeded the recommended 300 mg/day (Table 3). Different results received *Bolesławska* et al. [4], in whose study the diets were characterized by high average amount of cholesterol (344 mg/day) in relation to the recommendations. As a rich source of cholesterol can be considered meat, giblets, dairy products, butter and eggs [22].

The content of each fatty acids and the percentage of energy from these fatty acids in analyzed diets of female students were shown in Table 4.

The sum of SFA content in the female students diets average amounted to 25 g/day. The average percentage of energy from SFA in female students daily food rations pointed on the derogations in comparison with recommended values and was 13.1%. In the diets of 82% students the energy intake from SFA exceeded the recommended values (Table 3). Related results were obtained by *Regulska-Ilow* et al. [29] and also *Waśkiewicz* and *Sygnowska* [37] in whose studies the percentage of energy from SFA in women diets amounted respectively to 13.3% and 14.3%.

The main sources of SFA in daily diet are: animal products, fast foods, snacks and sweets. The result of excessive consumption of products that are sources of SFA could affect the increase levels of total cholesterol and in particularly the increase of atherogenic chole-

Table 4. Content and value of energy intake of selected fatty acids in the daily diet of female students (n=100)

Nutrient	Unit	X ± SD	Median
Saturated Fatty Acids			
ΣSFA	g	25.0 ± 12.7	22.8
Energy from SFA	%	13.1 ± 4.5	12.8
Butyric acid (C4:0)	g	0.5 ± 0.3	0.4
Caproic acid (C6:0)	g	0.3 ± 0.2	0.3
Caprylic acid (C8:0)	g	0.2 ± 0.1	0.2
Capric acid (C10:0)	g	0.6 ± 0.4	0.5
Lauric acid (C12:0)	g	0.9 ± 0.5	0.8
Myristic acid (C14:0)	g	2.9 ± 1.8	2.5
Pentadecanoic acid (C15:0)	g	0.3 ± 0.2	0.3
Palmitic acid (C16:0)	g	13.4 ± 6.7	12.4
Heptadecanoic acid (C17:0)	g	0.2 ± 0.2	0.2
Stearic acid (C18: 0)	g	5.6 ± 3.3	5.3
Arachidic acid (C20:0)	g	0.1 ± 0.1	0.1
Monounsaturated Fatty Acids			
ΣMUFA	g	24.6±12.1	22.5
Energy from MUFA	%	12.9 ± 4.0	12.7
Myristoleic acid (C14:1)	g	0.3±0.2	0.2
Pentadecenoic acid (C15:1)	g	0.1±0.1	0.1
Palmitooleic (C16:1)	g	1.1±0.7	1.0
Margaroleic acid (C17:1)	g	0.2±0.1	0.1
Oleic acid (C18:1) n-9	g	22.3±11.3	20.6
Eicosenoic acid (C20:1)	g	0.3±0.4	0.2
Erucic acid (C22:1)	g	0.3±0.6	0.1
Polyunsaturated Fatty Acids			
ΣPUFA	g	10.9±7.2	9.4
Energy from PUFA	%	5.7 ± 2.7	5.2
Linoleic acid (C18:2) n-6	g	9.0±6.3	7.8
α-linolenic acid (C18:3) n-3	g	1.5±1.1	1.1
Arachidonic acid (C20:4) n-6	g	0.1±0.1	0.04
(C18:2) + (C18:3)	g	0.10±0.3	0.00
Eicosapentaenoic acid – EPA (C20:5) n-3	g	0.03±0.1	0.00
Docosapentaenoic acid -DPA (C22:5) n-3	g	0.20±0.6	0.01
Σ EPA + DHA	g	0.3±0.8	0.01
n-6/n-3		7.2±5.0	5.7
Keys score		44.9±16.4	44.7
P/S ratio		0.52±0.4	0.41

X ± SD- average ± standard deviation; SFA- saturated fatty acids; MUFA- monounsaturated fatty acids; PUFA- polyunsaturated fatty acids; P/S- PUFA/SFA

sterol LDL fraction in blood serum [34]. Depending on the length of the carbon chain of SFA they could affect different effects on cholesterol levels in blood serum.

Among SFA in the pathogenesis of CVD the most important are myristic acid (C14:0), palmitic acid (C16:0) and lauric acid (C12:0), which metabolism can cause the strongest hypocholesterolemic effect. Stearic acid (C18:0) and capric acid (C10:0) have not demonstrate significant hypercholesterolemic effect. Furthermore the stearic acid could also exhibits the prothrombotic effects [34, 36].

In the daily diets of female students the sum of lauric (C12:0), miristic (C14:0) and palmitic acid (C16:0) accounted for 68.8% of all SFA. The participation of the sum of stearic acid (C18:0) and capric acid (C10:0) accounted for an average 24.8% of all SFA. According to the study of *Regulska-Ilow* et al. [29] the average contents of lauric, miristic and palmitic acid in the students diets were on average 65.6% of all SFA. Furthermore the stearic and capric acid accounted for 25% of all SFA. In the study of *Radzymińska* et al. [28] indicated that the lauric, miristic and palmitic acids in daily students diets accounted for 75.8% of all SFA, whereas the stearic acid accounted for 22% of all SFA.

Average value of the *Keys* score in the diets of female students was 44.9 and highly exceeded the permitted range for this population amounting to 30.5-35.9. Average value of P/S ratio in study group was incorrect and amounted to 0.52. Merely in the diets of 6% female students the P/S ratio was at the recommended level ≥ 1.0 (Table 3). In the WOBASZ study (Multicentre Nationwide Study of the Polish Population's Health) [5] and the POL-MONICA bis Warsaw study (Multinational MONItoring of trends and determinands in CArdiovascular disease) [30] the *Keys* score determined for the population of women aged 20-34, amounted respectively to 45.7 and 44.8 and were higher than those obtained in the present study. Furthermore also in the POL-MONICA bis study for the same age group the average value of P/S ratio not fulfilled the recommended values and amounted to 0.67 [30]. According to the study of *Waśkiewicz* and *Sygnowska* [37] the average students daily food ration was also characterized by high atherogenicity, resulting from the high total fat and SFA intake.

Polish dietary recommendations indicate that MUFA should constitute a difference between the total fat content and the sum of SFA and PUFA [17]. The recommendations of Polish Forum for Prevention of Cardiovascular Disease [19] and American Dietary Association [21] indicate that in the daily diet MUFA should provide up to 20% of total energy intake and in prevention in CVD even up to 35%. MUFA reduces the concentration of total cholesterol and LDL atherogenic lipoprotein in the blood serum [25]. The representative of MUFA is oleic acid (C18:1 n-9). The oleic acid occurs abundantly in olive oil (69%) and canola oil (55%) [22].

The dietary intake of MUFA in the students diets was 12.9% of total energy. In the diets of 5% female students the percentage energy from MUFA was incorrect and not exceeded recommended 10% (Table 3).

To preserve the proper lipids metabolism in the body, it is advantageous if the energy of MUFA in daily diet partially cover the energy deficit arising from a shortage of carbohydrate in the diet. Insufficient energy intake from MUFA in analyzed students diets was caused by the permanent nutritional mistakes occurring in students population.

Among MUFA predominated the oleic acid, which amounted to 91% of all MUFA. *Regulska-Ilow* et al. [29] and *Radzymińska* et al. [28] also indicated that the oleic acid was dominated among MUFA as in the present study.

The content of PUFA in the diets of female students was on average 10.9 g/day. According to the *Ilow* [15] study the content of PUFA in the diets of female was on average 13.5 g/day. The students diets from Bialystok were characterized by lower content of PUFA in comparison with the present study, which amounted respectively to 6.6 g/day and 3.9 g/day [8, 32]. In the analyzed students diets the percentage of energy from PUFA was 5.7% and in the diets of 66% female students did not fulfilled the recommendations (Tab. 3). *Regulska-Ilow* et al [29] and *Waśkiewicz* and *Sygnowska* [37] also reported improper energy intake from PUFA in the students diets which amounted to 5.3%. *Dybkowska* et al [9] pointed that the average energy intake from PUFA in the average Polish food ration amounted to 5.2% (13.1 g/day). The main source of PUFA in the daily diet are vegetable fats (63%), while the lower amounts of these fatty acids are consumed with meat and meat products (15%) and cereal products (11%) [9].

Linoleic acid (LA) and arachidonic acid (AA) are two of the main representative compounds of n-6 PUFA. Beneficial antiatherosclerotic effect of LA consists in reducing the levels of LDL cholesterol, reducing susceptibility to thrombosis and mild hypotensive effects [36]. In the daily diet the AA is needed only in small quantities, because it can be synthesized in the body from LA. The AA is an eicosanoids precursor, and the excessive amount of AA in the daily diet could stimulate the inflammation effect [40]. The main source of the AA in the diet are meat and meat products (81%), eggs (8%) and animal fats (5%) [9].

Excessive consumption of products being a source of n-6 PUFA in diet, promotes the inhibition of the synthesis of prostacyclin, weakening of the immune system and increase the risk of gallstones. Furthermore during the consumption of large quantities of n-6 fatty acids (> 10% of energy) may also reduce the concentration of HDL cholesterol levels [36].

The average content of LA in female students diets was 9.0 g/day, which accounted for 83% of energy of all PUFA. These values coincide with the results obtained by *Regulska-Ilow* et al. [29]. The average content of ALA in analyzed diets was 1.5 g/day, which accounted for 14% of energy of all PUFA. In view of the recommendations can be concluded that the content of ALA in the students diets was too low and about 80% of the female consumed much less ALA than the recommended 2 g/day.

The sum of essential fatty acids (EFA) (C18:2 + C18:3), in the students diets was on average 10.5 g/day. According to the ISSFAL recommendations [16] the amount of LA in diet should provide 2% of energy, while the amount of ALA should provide about 1.2% of energy in daily diet. In the analyzed students diets LA amounted to 5% of total average energy intake and exceeded the recommendations set out by the ISSFAL. However the average percentage of energy from ALA in the diets was approximately 0.8% what was lower than recommendations. *Dybkowska* et al. [9] pointed out that LA content in the average food ration was about 12.9 g/day, which accounted for about 5.1% of energy of the diet, and ALA content was about 2.3 g/day which accounted for 0.9% of energy of the diet.

The sum of EPA and DHA in the analyzed diets was 0.3 g/day, and the ratio of n-6/n-3 PUFA amounted to 7.2:1. Insufficient intake of EPA and DHA were observed in the diets of 71% of female students. In the diets of 76% of the students the n-6/n-3 ratio exceeded the recommended value. *Dybkowska* et al. [9] estimated that in the average Polish food ration the n-6/n-3 ratio is 5.5:1.

There is a need to preserve the balance in n-3 and n-6 PUFA intake in the daily diet according to the recommendations. Excessive amount of n-6 PUFA in the body, in relation to the amount of n-3 PUFA can contribute to the synthesis of the compounds having a proinflammatory and prothrombotic activities [31, 34]. It is therefore justified the selection of appropriate food products which are rich in n-3 PUFA and exhibit a beneficial n-6/n-3 ratio.

CONCLUSIONS

1. Excessive content of SFA in the female students diets and insufficient intake of MUFA and PUFA may be the cause of atherosclerosis lesions and is one of the nutritional risk factor for prevalence of the CVD.
2. The *Keys* score and P/S ratio used as an atherogenicity criterion of the diets pointed to the need to reduce consumption of products being a source of SFA and increase consumption of the products being a source PUFA, which have the antiatherosclerosis activity.
3. Eating habits preferred among students population may cause the increased proatherosclerosis activity incidence. In order to effectively plan and implement the healthy lifestyle it is need to expand the knowledge of nutrition, in order to prevention of CVD.

Conflict of interest
The authors declare no conflict of interest.

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