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Eating habits and the risk of cardiovascular disease in patients with recurrent depressive disorders

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Summary

Aim. The aim of the research was to assess the fatty acid content and atherogenicity of daily food rations in patients with recurrent depressive disorders in the aspect of risk of developing cardiovascular disease.

Methods. The study included 126 persons (62 persons with diagnosed recurrent depressive disorders and 64 healthy volunteers). A 24-hour recall was used in the quantitative assessment of the diet. Anthropometric and chemical measurements as well as body composition analysis were used to assess the nutritional status.

Results. The diets of 40% of tested women and 55% of men were atherogenic, according to an assessment using Keys' index. The proportion between the PUFA and SFA content was 0.3 (women) and 0.2 (men) with recommended values of ≥ 1. In the group of women there were no significant correlations between the selected clinical features of the illness and components of diet and biochemical data of nutritional status. It was only observed that a higher intensity of depressive symptoms had a significantly negative effect on the glucose concentration in the women's blood. It was also observed that in the group of women suffering from depression, the total consumption of fats and cholesterol content in the food decreased with age. No statistically significant correlations between the assessed variables were observed in the group of men taking part in the study.

Conclusions. The improper energy structure and the composition of the subjects' food rations may contribute to the development of the cardiovascular system diseases in the future and make it difficult to maintain mental health at the same time.

Key words: depression, eating habits, atherogenicity

The study was approved by the Bioethics Committee of the Medical University of Bialystok: Resolution No. R-I-002/370/2014.

Introduction

The spread of depression and other mental disorders, which is observed these days, indicates that mental diseases will predominate among civilization diseases in 2020 [1, 2]. A properly balanced diet is extremely important in the nutrition of persons suffering from depression. Studies show that there is a relationship between the diet and the occurrence of this illness. It has been found that 5-hydroxy-l-tryptophan and L-tryptophan as serotonin precursors in the CNS, anthranilic acid and fatty acids, especially omega-3, prevent the development of this illness [3, 4]. In addition, it was shown in many studies that depression proved to be an independent predictor of cardiovascular disease, including coronary artery disease, promoted an increase in the body weight and an increase in the percentage of overweight and obese persons, especially with abdominal obesity and collection of metabolically active visceral adipose tissue (VAT) [2, 5, 6].

Aim

The main aim of the research was to assess the fatty acid content and atherogenicity of daily food rations in patients with recurrent depressive disorders in the aspect of risk of developing cardiovascular disease. Relationships between clinical features of the illness (age at which the first symptoms appeared, the duration of the illness, intensity of symptoms) and ingredients and parameters of the diet influencing its atherogenicity.

Material

The study group consisted of 62 persons (42 women and 20 men aged 18–65). The group included patients with diagnosed recurrent depressive disorders (according to the ICD-10 criteria) [7]. The study was conducted between January 2015 and May 2015. Both patients with the first depressive episode (F32.0–F32.2) and patients with subsequent episodes in the course of recurrent depressive disorders (F33) were included in the study. The total duration of the illness was not longer than 5 years and the current depressive episode could not last longer than a month. Moreover, the treatment time of the current episode, in the form of monotherapy with one of the following antidepressants: venlafaxine, mirtazapine, escitalopram, sertraline, citalopram, paroxetine was not longer than 4 weeks. Persons abusing alcohol, taking psychoactive substances, with a history of damage to the CNS, suffering from neurological diseases which are known to be related to the CNS damage, suffering from other mental disorders, and suffering from diseases which may influence changes in metabolic parameters were excluded from the study. The following persons were also excluded from the study: persons with blood serum glucose levels $\geq$ 126 mg/dl and with lipid disorders, persons using anti-diabetes or a treatment reducing lipid concentrations or on special diets to reduce glucose concentrations or the lipid level.

The control group consisted of 64 healthy volunteers (43 women and 21 men aged 18–69) without any mental disorders, nutritional disorders, chronic diseases related to metabolism of nutrients.

The patients who took part in the study were informed about the purpose and methodology of the conducted research. The patients gave their written consent to participation in the study. This research was approved by the Bioethics Committee of the Medical University of Bialystok (No. R-I-002/370/2014).

Method

The severity of depressive disorder during the current episode was assessed using the Hamilton Depression Rating Scale (17-item version) [8]. Persons who scored at least 13 points on the Hamilton scale were included in the study. Basic anthropometric measurements were performed in all patients. At the next stage, the patients had their body composition analysed using electrical bioimpedance measured by a MALTRON BioScan 920-2 device (manufactured by Maltron International TLD). Also, biological parameters of the blood and fasting glycemia were tested and a lipid profile was performed (generally adopted standard ranges of reference values were regarded as the normal limits).

Assessment of the diet

A questionnaire developed at the Department of Dietetics and Clinical Nutrition, Medical University of Bialystok was used for collecting data. A 24-hour recall from 3 weekdays and one weekend day (total number of daily food rations of female and male, respectively – 248 and 256) was used for quantitative assessment of the diet and the results were next averaged according to recommendations [9, 10]. The computer program Dieta 5.0 developed by the Food and Nutrition Institute in Warsaw was used to calculated the nutritional value of daily food rations. Nutrition standards for the Polish population were used for the assessment of compliance of nutrient consumption with recommendations [9]. The following percentages of energy from consumption of basic nutrients were adopted as normal: from proteins – 12%, from fats – 30%, from carbohydrates – 58%. Moreover, the supply of dietary fibre amounting to 30 g/day, of cholesterol in food amounting to 300 mg/day, the supply of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA) amounting to < 10%, 10–14%, 6–10%, respectively, of the daily energy supply were considered to be consistent with recommendations [9]. The fatty acids ratio was calculated according to the following model: n-6/n-3 (n-6 PUFA (C18:2 + C 20:4)/ n-3 PUFA (C18:3 + C 20:5 + C22:6)). Keys' index of the atherogenicity of the diet was calculated according to the following formula: 1.35 x (2 x SFA-PUFA) + 1.5 x √cholesterol/1000 (kcal); where SFA is the energy from saturated fatty acids (%) and PUFA is the energy from polyunsaturated fatty acids (%) [10].

Statistics

Statistical analysis of the obtained results was performed using the Statistica 10.0 software by StatSoft to calculate the mean values, standard deviation and percentage values. The χ^2 and Mann-Whitney U tests were used to calculate the significance of differences. Multiple regression analysis was used to assess the influence of the diet ingredients on its atherogenicity and the intensity of symptoms of depression. The Spearman's correlation coefficient was also used to test relationships between individual features. The level of significance was stated as $\alpha = 0.05$.

Results

Table 1 presents characteristics of demographic and anthropometric variables of the subjects. It was observed that in the compared groups of female patients a significantly more women suffering from depression lived in the country and had a secondary or primary/vocational level of education. In the case of men, these differences were not statistically significant. While assessing anthropometric parameters of the examined patients, it was shown that the group of women suffering from depression was characterized by a greater waist circumference (a statistically significant difference) and the content of both visceral and subcutaneous adipose tissue. Similar tendencies were observed in comparative groups of men (the content of the visceral adipose tissue was significantly higher in the group of men suffering from depression).

Table 1. **Study groups characteristics**

Variables	Women		Men	
	Depression n = 42	Controls n = 43	Depression n = 20	Controls n = 21
	X ± SD	X ± SD	X ± SD	X ± SD
Age (years)	46.7 ± 11.6	45.3 ± 10.4	45.7 ± 10.5	44.6 ± 11.4
Place of residence n (%)				
Urban	27 (64%)*	37 (86%)	16 (80%)	19 (90%)
Rural	15 (36%)	6 (14%)	4 (20%)	2 (10%)
Education n (%)				
Primary/vocational	15 (36%)**	4 (9%)	11 (55%)	4 (19%)
Secondary	21 (50%)	11 (26%)	5 (25%)	9 (43%)
Higher	6 (14%)	28 (65%)	4 (20%)	8 (38%)
Marital status n (%)				
Married	29 (69%)	32 (74%)	15 (75%)	15 (71%)
Single	13 (31%)	11 (26%)	5 (25%)	6 (29%)
Body weight (kg)	70.5 ± 13.6	68.0 ± 10.6	89.5 ± 14.5	89.2 ± 6.5
Height (cm)	163.3 ± 6.2	163.0 ± 4.9	176.1 ± 7.6	175.0 ± 4.1

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BMI (kg/m^2)	26.6 ± 5.0	25.6 ± 4.3	28.9 ± 4.0	29.0 ± 2.4
< 25.0 ≥ 25.0	16 (38%) 26 (62%)	19 (44%) 24 (56%)	3 (15%) 17 (85%)	2 (10%) 19 (90%)
Waist circumference (cm)	94.3 ± 13.6**	84.6 ± 8.6	103.8 ± 8.7	99.1 ± 9.0
Fat mass (%)	34.2 ± 9.1	31.3± 6.6	29.4 ± 6.3	25.3 ± 6.7
Visceral Fat (VAT) (cm^2)	268.9 ± 188.9	154.8 ± 82.4	438.5 ± 385.0*	204.7 ± 91.1
Subcutaneous Fat (SAT) (cm^2)	113.5 ± 45.7	78.7 ± 18.2	131.4 ± 55.5	104.1 ± 23.9
VAT/SAT ratio	2.3 ± 1.3	1.8 ± 1.1	3.3 ± 2.6	2.6 ± 0.7
Hamilton scale (points)	18.6 ± 4.0		17.5 ± 5.1	
Mean illness duration n (%) 4 years 2–3 years < 1 year	 21 (50%) 10 (24%) 11 (26%)		 9 (45%) 3 (15%) 8 (40%)	
Episodes of depression n (%) 1 2–4 > 4	 11 (26%) 11 (26%) 20 (48%)		 8 (40%) 4 (20%) 8 (40%)	
Treatment n (%) Venlafaxine Sertraline Mirtazapine Escitalopram Paroxetine	 15 (36%) 8 (19%) 7 (16%) 6 (14%) 6 (14%)		 7 (35%) 4 (19%) 3 (15%) 3 (15%) 3 (15%)	

n – number of subjects; X ± SD – arithmetic mean ± standard deviation; p – critical value of the test comparing depression and controls within gender groups. * $p < 0.05$; ** $p < 0.01$; p – critical value of the test comparing depression and controls within gender groups.

Table 2 presents the average energy value of daily food rations and the average consumptions of selected nutrients by the tested patients. In the group of women suffering from depression, a significantly lower value of the dietary fibre supply and the percentage of energy from protein consumption as well as of the PUFA/SFA ratio and a significantly higher value of energy from total fat and from saturated fatty acids and the value of Keys' index was observed in comparison to healthy women. The food rations of men from the experimental group were characterized by a significantly lower supply of total carbohydrates, dietary fibre, arachidic acid and the PUFA/SFA ratio, and a higher value of energy form saturated fatty acids and the value of Keys' index, as compared to food rations of men from the control group. The average energy intake in the analyzed female diets was 1660 kcal/day and 1649 kcal/day respectively, which covered approx. 89% of the recommendations. The average energy intake in the male diets was 1877 kcal/day and 2150 kcal/day, which covered over 80% of the

recommendations. At the same time the total energy intake of the diets of 50% of women and 75% of men with depression and 43% of men without depression should be regarded as too low in relation to the acceptable daily recommendations. In the assessment of the patients' diet in terms of habits which may increase the risk of lipid disturbances, it was observed that the percentage of food rations which provided more than 30% of energy from fats in the group of women with depression was 50% and 28% in the control group, it amounted to 75% in the group of males with depression and 48% in the control group. In the assessment of the percentage of energy from the consumption of saturated fatty acids (recommended < 10%), it was shown that the percentage of food rations which exceeded these recommendations in the group of female subjects was 71% (37% in the control group) and among male subjects 90% exceeded the recommended value (62% in the control group). In diets of 14% of women and 15% of men from the experimental group and 16% of women and 19% of men from the control group, the percentage of energy from monounsaturated fatty acids was abnormal and it did not exceed the recommended 10%. In the assessed diets, there is also an incorrect structure of the consumption of polyunsaturated fatty acids. The percentage of energy from the consumption of these acids below the recommended 6% was observed in 86% of diets of women and 90% of diets of men from the experimental groups and 74% of diets of women and 81% of diets of men from the control groups. α-linolenic acid (ALA) (C18:3) n-3 should provide approx. 0.5% of energy in everyday diet. In the conducted research, the percentage of energy from ALA consumptions did not comply with the recommendations in nearly 60% of subjects with depression and 50% of women and 33% of men from the control group. According to recommendations, the n-6/n-3 acids ratio should be 4:1 or 5:1; in the presented results, these values were on average 6.5–7:1. In the diets of 57% of women and 46% of men from the experimental group and over 70% of the diets of patients of both sexes from the control group, this ratio exceeded the recommended values. According to the recommendations, the total supply of EPA and DHA should be 0.25 g/day; insufficient consumption of these acids was observed in 90% of diets in all tested groups. The average cholesterol content in food did not exceed the recommendations; however, values exceeding the recommendations were observed (> 300 mg/day) in diets of 26% of women with depression and 30% of men with depression and in diets of 30% of healthy women and 38% of healthy men. While assessing the supply of dietary fibre, it was shown that the percentage of food rations which provided amounts of this ingredient below the recommendations was over 80% in the groups of patients and the control group of women and 67% in the control group of men. In addition, it was also observed that the average value of ratios between the PUFA and SFA was abnormal and ranged from 0.2 to 0.5 with recommended values ≥ 1 (this ratio (≥ 1) occurred only for 7% of food rations of women with depression and 14% and 5% of women and men from the control group, respectively). The reference Keys' index calculated for this group, considering the adopted values of the fatty acid supply, should fall between 30 and 35. 40% of food rations of women with depression and 55% of food rations of men with depression exceeded these recommendations (in the control group this percentage was 18% and 30%, respectively).

Table 2. **The average energy intake and contents of selected nutrients in the daily food rations of the study participants**

Variables	Women		Men	
	Depression n = 42	Controls n = 43	Depression n = 20	Controls n = 21
	X ± SD	X ± SD	X ± SD	X ± SD
Energy (kcal)	1660.9 ± 624.6	1648.9 ± 586.1	1877.3 ± 645.8	2149.7 ± 494.5
Total protein (g)	64.5 ± 25.6	72.5 ± 23.4	71.4 ± 24.4	85.0 ± 32.2
Energy from protein (%)	15.6 ± 2.7**	18.6 ± 5.1	15.9 ± 4.1	16.2 ± 5.3
Total carbohydrates (g)	230.9 ± 84.6	241.7 ± 97.3	237.7 ± 69.4*	297.3 ± 95.0
Energy from carbohydrates (%)	53.07 ± 7.5	54.1 ± 9.0	49.1 ± 4.1	51.7 ± 10.7
Dietary fiber (g)	16.8 ± 4.8*	20.3 ± 8.4	17.0 ± 6.9*	22.2 ± 7.2
Total fat (g)	60.3 ± 29.9	51.5 ± 24.6	77.0 ± 38.8	75.9 ± 29.3
Energy from fat (%)	31.2 ± 8.0*	27.1 ± 8.9	34.5 ± 7.3	30.9 ± 8.5
Cholesterol (mg)	261.5±208	263.2±198.1	291.5±191.7	262.2±126.4
Total Saturated fatty acids (g)	24.6 ± 14.2	19.9 ± 11.2	33.8 ± 17.7	29.5 ± 12.6
Energy from SFA (%)	13.2 ± 4.2*	10.8 ± 4.4	15.4 ± 4.0*	12.4 ± 4.9
Butyric acid (C4:0) (g)	0.3 ± 0.2	0.3 ± 0.1	0.3 ± 0.2	0.2 ± 0.2
Caproic acid (C6:0) (g)	0.2 ± 0.1	0.2 ± 0.2	0.3 ± 0.2	0.2 ± 0.1
Caprylic acid (C8:0) (g)	0.2 ± 0.1	0.1 ± 0.1	0.2 ± 0.1	0.1 ± 0.1
Capric acid (C10:0) (g)	0.4 ± 0.3	0.3 ± 0.2	0.6 ± 0.4	0.4 ± 0.3
Lauric acid (C12:0) (g)	0.6 ± 0.5	0.7 ± 0.9	0.9 ± 0.6	0.8 ± 0.5
Myristic acid (C14:0) (g)	2.7 ± 1.9	2.1 ± 1.7	3.9 ± 2.5	3.2 ± 1.9
Pentadecanoic acid (C15:0) (g)	0.7 ± 0.1	0.2 ± 0.1	0.5 ± 0.3	0.4 ± 0.2
Palmitic acid (C16:0) (g)	13.8 ± 7.9	10.9 ± 5.5	19.0 ± 9.7	16.5 ± 7.0
Heptadecanoic acid (C17:0) (g)	0.2 ± 0.1	0.1 ± 0.1	0.3 ± 0.2	0.2 ± 0.1
Stearic acid (C18:0) (g)	5.6 ± 3.2	4.5 ± 2.7	7.8 ± 4.5	7.0 ± 3.3
Arachidic acid (C20:0) (g)	0.1 ± 0.2	0.1 ± 0.1	0.04 ± 0.01*	0.1 ± 0.07
Total monounsaturated fatty acids (g)	23.4 ± 13.0	18.8 ± 10.1	30.2 ± 15.4	29.9 ± 13.1
Energy from MUFA (%)	12.8 ± 5.6	10.9 ± 4.8	13.7 ± 3.2	12.2 ± 3.9
Myristoleic acid (C14:1) (g)	0.2 ± 0.1	0.1 ± 0.1	0.3 ± 0.2	0.2 ± 0.1
Pentadecenoic acid (C15:1) (g)	0.05 ± 0.04	0.06 ± 0.01	0.06 ± 0.06	0.05 ± 0.05
Palmitoleic acid (C16:1) (g)	1.4 ± 0.8	1.1 ± 0.6	2.07 ± 0.9	1.9 ± 1.1
Heptadecenoic acid (C17:1) (g)	0.1 ± 0.0	0.09 ± 0.08	0.2 ± 0.2	0.1 ± 0.1

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Oleic acid (C18:1) (g) n-9	20.4 ± 11.9	17.7 ± 9.0	27.3 ± 14.2	26.3 ± 12.1
Eicosenoic acid (C20:1) (g)	0.2 ± 0.1	0.3 ± 0.2	0.3 ± 0.2	0.6 ± 0.1
Erucic acid (C22:1) (g)	0.07 ± 0.1	0.15 ± 0.3	0.04 ± 0.14	0.52 ± 1.33
Total polyunsaturated fatty acids (g)	6.5 ± 4.6	8.0 ± 5.1	6.9 ± 4.2	10.2 ± 6.4
Energy from PUFA (%)	3.4 ± 1.9	4.4 ± 2.5	3.1 ± 1.0	4.1 ± 2.0
Linoleic acid (C18:2) (g) n-6	5.3 ± 4.0	6.8 ± 4.3	5.7 ± 3.3	8.2 ± 5.5
α-linolenic acid (C18:3) n-3 (g)	0.9 ± 0.7	1.0 ± 0.6	0.9 ± 0.8	1.2 ± 1.1
Arachidonic acid (C20:4) n-6 (g)	0.12 ± 0.07	0.13 ± 0.13	0.17 ± 0.1	0.18 ± 0.19
Eicosapentaenoic acid (EPA) (C20:5) n-3 (g)	0.02 ± 0.11	0.04 ± 0.16	0.01 ± 0.01	0.2 ± 0.6
Docosapentaenoic acid (DPA) (C22:5) n-3 (g)	0.55 ± 3.48	0.02 ± 0.1	0.01 ± 0.04	0.03 ± 0.1
Docosahexaenoic acid (DHA) (C22:6) n-3 (g)	0.09 ± 0.07	0.13 ± 0.04	0.03 ± 0.08	0.27 ± 0.8
EPA + DHA (g)	0.11 ± 0.03	0.18 ± 0.06	0.04 ± 0.09	0.24 ± 0.8
n-6/n-3	6.5:1	7.3:1	7.0:1	7.3:1
Keys' index	41.8 ± 12.0**	34.3 ± 12.4	47.9 ± 10.8**	37.5 ± 13.5
PUFA/SFA ratio	0.3 ± 0.2*	0.5 ± 0.4	0.2 ± 0.0*	0.4 ± 0.3

n – number of subjects; X ± SD– arithmetic mean ± standard deviation; SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; p – critical value of the test comparing depression and controls within gender groups;* $p < 0.05$; ** $p < 0.01$; p – critical value of the test comparing depression and controls within gender groups

The assessment of the lipid metabolism (Table 3) showed that significantly higher concentrations of total cholesterol and the LDL fraction of cholesterol and glucose were characteristics of patients of both sexes from the experimental group, as opposed to the control group. Moreover, increased levels of total cholesterol (≥ 90 mg/dl) were observed in 71% of women and 80% of men from the experimental group and 32% of women and 44% of men from the control group. Lower HDL cholesterol levels (≤ 50 mg/dl) were observed in 21% of women from the experimental group and 32% of women from the control group. HDL cholesterol concentrations below 40 mg/dl were observed in 30% of men from both groups. Elevated LDL cholesterol levels (> 115 mg/dl) were observed in approx. 70% of patients from the experimental group and 35% of patients from the control group. Elevated values of triglycerides in the blood occurred in 17% of women and 45% of men from the experimental group and 7% of women and 39% of men from the control group. For fasting glycemia, increased glucose values (≥ 100 mg/dl) were found in 43% of women and 35% of men from the experimental group and in 14% of women and 11% of men from the control group. Glucose concentration < 70 mg/dl was observed for 14% of women from the experimental group.

Table 3. **Selected biochemical parameters of the study participants**

Variables	Women		Men	
	Depression n = 42	Controls n = 43	Depression n = 20	Controls n = 21
	X ± SD	X ± SD	X ± SD	X ± SD
Total cholesterol (mg/dl)	212.2 ± 34.5**	186.8 ± 27.2	232.5 ± 29.6**	183.8 ± 40.8
HDL-cholesterol (mg/dl)	55.3 ± 11.5	58.0 ± 17.5	42.7 ± 5.6	43.6 ± 16.5
LDL-cholesterol (mg/dl)	127.9 ± 36.7*	107.2 ± 26.5	150.4 ± 36.7**	102.8 ± 31.5
Triglycerides (mg/dl)	117.6 ± 63.8	113.4 ± 65.7	202.8 ± 100.3	152.8 ± 81.9
Glucose (mg/dl)	105.7 ± 14.6**	93.9 ± 6.6	102.1 ± 14.9*	90.9 ± 10.9

n – number of subjects; X ± SD – arithmetic mean ± standard deviation; * $p < 0.05$; ** $p < 0.01$; p – critical value of the test comparing depression and controls within gender groups.

In the assessment of correlations between selected clinical features of the illness and ingredients of the diet and biochemical data of the nutrition (Tables 4 and 5), it was observed that no statistically significant correlation occurred between the age at onset of the illness and the duration of the illness, and the assessed parameters. It was only noticed that a higher severity of depressive symptoms had a significantly negative effect on the blood glucose concentration. It was also observed that in the group of women suffering from depression, the total consumption of fats and cholesterol content in the food decreased with age. No statistically significant correlations between the assessed variables were observed in the group of men taking part in the study.

Table 4. **Correlations between demographic and clinical variables and selected nutrients intake and parameters of lipid metabolism (women)**

Selected nutrients and blood biochemical parameters	Spearman's correlations (r)			
	Clinical variables			Demographic variables
	Age at onset of the illness (years)	Duration of the illness (years)	Severity of depressive symptoms (Hamilton scale)	Age (years)
Total fat (g)	-0.1731	-0.0827	-0.3313	-0.3380*
Total SFA (g)	-0.1431	0.0359	-0.2572	-0.2502
Energy from SFA (%)	-0.1386	0.0007	-0.0758	-0.2745
Total MUFA (g)	-0.0878	-0.0051	-0.3341	-0.2378
Energy from MUFA (%)	-0.0142	-0.0542	-0.2628	-0.2128
Total PUFA (g)	-0.1776	-0.1538	-0.3152	-0.2854
Energy from PUFA (%)	-0.0682	-0.1258	-0.2507	-0.1623
Dietary cholesterol (mg)	-0.1454	-0.0231	-0.3077	-0.3255*

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Eicosapentaenoic acid (C20:5) EPA (g)	-0.1779	-0.0369	-0.2139	-0.0273
Docosahexaenoic acid (C22:6) DHA (g)	-0.1174	-0.1019	-0.1108	-0.1335
EPA + DHA	-0.1173	-0.1025	-0.1123	-0.1334
n-6/n-3	-0.1812	0.0449	0.1711	-0.2223
PUFA/SFA ratio	-0.0012	-0.0943	-0.0595	0.0118
Keys' index	-0.1417	0.0616	-0.0744	-0.2236
Total Cholesterol (mg/dl)	-0.0532	0.0146	-0.2681	0.0232
HDL-cholesterol (mg/dl)	-0.2407	0.0454	-0.0443	-0.0837
LDL-cholesterol (mg/dl)	0.4233	-0.0709	-0.1031	0.1581
Triglycerides (mg/dl)	0.3001	-0.1379	0.0099	0.0490
Glucose (mg/dl)	0.0745	0.2747	-0.4431*	0.2835

SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; * $p < 0.05$; p – critical value of the test for significance of Spearman's rank correlation coefficient

Table 5. **Correlations between demographic and clinical variables and selected nutrients intake and parameters of lipid metabolism (men)**

Selected nutrients and blood biochemical parameters	Spearman's correlations (r)			
	Clinical variables			Demographic variables
	Age at onset of the illness (years)	Duration of the illness (years)	Severity of depressive symptoms (Hamilton scale)	Age (years)
Total fat (g)	-0.0870	-0.3146	0.1056	-0.2958
Total SFA (g)	-0.1873	-0.1782	0.183	-0.2770
Energy from SFA (%)	-0.1618	-0.2627	0.1584	-0.3936
Total MUFA (g)	-0.0527	-0.2562	0.1232	-0.2453
Energy from MUFA (%)	0.0466	-0.4548	-0.0176	-0.3432
Total PUFA (g)	0.0474	-0.2719	-0.1126	-0.2062
Energy from MUFA (%)	0.1856	-0.2990	-0.4014	-0.1351
Dietary cholesterol (mg)	-0.0219	-0.2571	0.4260	-0.3071
Eicosapentaenoic acid (C20:5) EPA (g)	0.0160	0.0143	0.1701	0.0480
Docosahexaenoic acid (C22:6) DHA (g)	0.1792	-0.3949	0.2405	-0.2430
EPA + DHA	0.2195	-0.3081	0.0297	-0.1481

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n-6/n-3	0.2102	0.0018	-0.3274	0.1972
PUFA/SFA ratio	0.3270	-0.0489	-0.3031	0.2089
Keys' index	-0.2321	-0.2227	0.1725	-0.3959
Total Cholesterol (mg/dl)	0.1700	0.2519	-0.5462	0.2411
HDL-cholesterol (mg/dl)	0.3208	-0.4480	-0.1091	-0.0622
LDL-cholesterol (mg/dl)	0.1225	0.2745	-0.3188	0.3922
Triglycerides (mg/dl)	0.1182	-0.3380	0.1636	-0.3906
Glucose (mg/dl)	0.1056	-0.0988	-0.2706	0.0682

SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; * $p < 0.05$; p – critical value of the test for significance of Spearman's rank correlation coefficient

The results of multiple regression analysis which assessed the relationship between the diagnosis of depression and the composition of the diet, is presented in Table 6. Severity of depressive symptoms was related to a lower cholesterol supply in the diet and a lower n-6/n-3 acid ratio and the relationship was statistically significant. A relationship, which was close to statistical significance, was observed between the intensity of depressive symptoms and a low supply of eicosapentaenoic acid (C20:5).

Table 6. **Multiple regression analysis**

		Beta coefficient	p	R^2
Severity of depressive symptoms	Dietary cholesterol	-0.072	0.0155	0.287
	n-6/n-3	-1.513	0.0116	
	Gender	2.100	0.3190	
	Eicosapentaenoic acid (C20:5) EPA	-2.5	0.0612	
	Docosahexaenoic acid (C22:6) DHA	5.5	0.1995	

p – critical value of the test for significance of coefficients in regression analysis; R^2 – coefficient of determination

Discussion

As it results from data provided by WHO, depression was the main cause of mental disorders in the 1990s and, together with cardiovascular disease, it will become one of the most frequently occurring diseases in the 21st century [2, 6, 11, 12]. Among nutritional factors, excessive consumption of fat is of key importance for the development of cardiovascular disease; however, apart from its total amount in the diet, its quality is also important, which results from the percentage content of individual groups of fatty acids. The quality of consumed fats is also vital for the proper brain function and mental status. As it results from contemporary research on the consumption of food and diets of patients with depression, their typical diets are characterized by high consumption of processed food, refined cereals, products with a high content

of simple sugars, full-fat dairy products; on the other hand, they eat less fresh fruits, vegetables, nuts, and dry legumes [12, 13]. This is reflected by an improper balance of the diet as regards the energy and basic nutrients (a low percentage of energy from carbohydrates (48–50%), and a high percentage of energy from fats (33–40%), with a high percentage of saturated fatty acids (12–13%), and a low percentage of energy from polyunsaturated fatty acids, which does not exceed 3.5–5%) [5, 13, 14].

In the conducted research, this involves both an improper supply of the majority of nutrients which are of key importance for the development of cardiovascular disease, as well as insufficient consumption of selected nutrients which are important for proper brain function. Meals of the subjects were predominated by saturated fatty acids, especially palmitic (C16:0), stearic (C18:0), myristic (C14:0) acids. Among saturated acids, myristic, palmitic and lauric acids (C12:0) play the most important role in pathogenesis of cardiovascular disease as their metabolism may result in the strongest hypercholesterolemic action [9]. Stearic and caprylic acid (C10:0) do not show such an action; however, stearic acid has prothrombotic action. In the conducted research, in diets of both groups of women and men from the control group, the total amount of lauric, myristic and palmitic acid was 69% of saturated acids (70% for men from the experimental group). The percentage of stearic and caprylic acids was 24% of saturated fatty acids in both groups of women and 25% of saturated acids in both groups of men. Research by Regulska-Ilow et al. showed that the supply of lauric, myristic and palmitic acids was 65% in women's diets and 69% in men's diets, while the percentage of stearic acid was similar to the result obtained in this study and it amounted to 25% of total saturated acids [10, 15].

According to contemporary nutritional recommendations, monounsaturated acids should provide the most energy as compared to the other groups of acids. Monounsaturated fatty acids, including mostly oleic acid (C18:1, n-9), do not influence the level of the LDL-cholesterol fraction, but when consumed with the diet, they increase the likelihood of a beneficial increase in the HDL fraction of cholesterol [9]. In the conducted research, the oleic acid was the predominating acid from the group of monounsaturated acids and constituted 87% and 90% of total monounsaturated acids in women and men from the experimental groups and 94% and 88% of total monounsaturated acids in the control groups, respectively. In the research by Sanchez-Villegas et al., it was shown that consumption of olive oil (a source of oleic acid) was negatively correlated with the risk of depression [14]. Similarly, research by Lucas et al. showed that the consumption of olive oil, green leafy vegetables and yellow vegetables was significantly negatively correlated with concentrations of inflammatory cytokines: interleukin IL-6 and acute-phase proteins, the secretion of which increases together with the severity of depressive symptoms [6]. Many studies have shown that omega-3 fatty acids (especially EPA and DHA) play a significant role in cerebral processes, influencing the liquidity of mucous membranes, the activity of mucous membrane enzymes and synthesis of eicosanoids [1, 16]. According to another theory, EPA and DHA acids influence the transduction of signals in brain cells by activating PPARs receptors, inhibition of G proteins and protein kinase C [1]. According to Lakhan and Vieira, the daily supply of omega-3 fatty acids in

amounts of 1–2 g is sufficient for healthy persons, while supplies amounting up to 9.6 g seem to be safe and sufficient for patients with mental disorders [17]. According to other research, daily supplementation with as little as 4 g of EPA + DHA is related to significant mood changes (a higher level of vigor, lower levels of states, such as anger, anxiety, tiredness) [4]; however, the EPA/DHA ratio is also important, better effectiveness was revealed for EPA doses ≥ 1 g [6]. The conducted research showed that the total supply of EPA and DHA was on average only 0.1 g in women and 0.04g in men from the experimental group. Research by other authors showed a similar low consumption of these acids (0.07–0.21g) [6]. The failure to keep the proper ratio between the n-6 and n-3 groups of acids also deserves attention. An excessive amount of n-6 PUFA acids, as compared to the amount of n-3 PUFA acids, may contribute to the synthesis of compounds with pro-inflammatory and prothrombotic action. The research has shown an improper PUFA/SFA ratio – on average 0.3 in an experimental group of women and 0.2 in the experimental group of men. A higher value (0.7), which, however, was not consistent with recommendations, was also observed in research by other authors [13].

The ratio of polyene acids to saturated acids may be related to economic factors, especially in women from the experimental group, as most of them had primary or secondary education. As shown in the literature, education can be a factor which determines the selection and the quality of consumed products [13]. Many studies have shown that social problems, external environment stressors, are more common in cities than rural areas [14, 17]. However, other researches emphasize that dietary habits of patients suffering from depression are frequently characterized by improper proportions in the intake of individual nutrients independently of place of residence. The most commonly reported errors include eating foods with high glycemic index or incorrect diet composition in terms of fatty acids independently of cultural habits of place of residence [12, 13].

In the conducted research, no significant correlations between selected components of the diet and clinical variables of the illness were observed, apart from the relationship between the severity of depressive symptoms and blood glucose concentrations in the group of women. Moreover, it was only observed that, among the demographic variables, age was negatively correlated with total consumption of fats and cholesterol in case of women.

The conducted research confirms that cardiovascular diseases and depression may have common nutritional factors related to diet and especially, the supply of fatty acids.

Conclusions

1. The menus of patients suffering from depression were characterized by a significantly higher supply of energy from fats, especially from saturated fatty acids and a significantly higher value of Keys' index as compared to healthy persons.
2. It was observed that in the group of women suffering from depression, the total consumption of fats and cholesterol decreased with age (however, the incorrect proportions of the fatty acid supply were retained).

3. It was shown that a higher severity of depressive symptoms was negatively correlated with glucose concentrations in the blood of women from the experimental group and the correlation was significant.
4. The multiple regression analysis showed that severity of depressive symptoms was correlated to a lower cholesterol supply in the diet and a lower n-6/n-3 acid ratio and the relationship was statistically significant. The relationship between the severity of depressive symptoms and a low supply of eicosapentaenoic acid (C20:5) was close to statistical significance.
5. The excessive content of saturated fatty acids in the diet, which was revealed in the research, accompanied by too low supply of polyunsaturated fatty acids and an improper n-6 to n-3 acid ratio may be one of risk factors for cardiovascular disease in patients from the experimental group.
6. In the treatment of patients suffering from depression, attention should be paid to the necessity of nutritional education pertaining to healthy nutrition, and, mostly, the selection of proper groups of food products (a lower supply of meat, milk and milk products and a higher supply of olive oil, fish and nuts) to minimize the risk of co-occurrence of diet-related diseases, while ensuring an optimal supply of nutrients with a positive effect on the brain function and mental health.

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