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State of Lipid and Fat-Acidic Spectrum of Blood Plasma in the Residents of the Plain Regions of Transcarpathia Depending On Age and Trophological Status

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Abstract. **The objective of the study** – is to identify the age peculiarities of the fat-acidic and lipid blood plasma spectrum in the inhabitants of the plain settlements of the Transcarpathian region with overweight and obesity.

Materials and methods. There were examined 107 persons, who applied for the assistance to the Family Medicine Outpatient Clinic №7 in Uzhgorod. The examined persons were estimated the following data: age, gender, BMI, waist circumference, lipid and fat-acidic spectrum.

Results of the study. The study involved 74 women (69.1%) and 33 men (30.9%). The average age of the examined persons was 52.4±1.0 years. The BMI of the examined patients was 27.5±0.4 kg/m^2, and the waist circumference was – 92.4±1.6 cm. All patients were divided into 6 age groups with intervals of 5 years, starting with 40 years. Starting from the 46 years and older, in each age group, there was a significantly higher BMI compared to persons under 40 years of age. In the examined persons over 40 years the changes of the lipid spectrum in the direction of growth of atherogenic fractions were observed.

Beginning from the age of 46 years, the levels of total ω6-PUFA and ω3-PUFA are significantly higher compared to persons aged under 40 years. In individuals aged under 50 years there is an increase of average levels of PUFA, therefore the highest growth of ω3-PUFAs is observed in the period from 40 to 50 years of age (from 60.10±5.50 μg/ml to 102.9±5.20 μg/ml, p< 0.01), and of ω6-PUFA in the period from 45 to 50 years (from 1288.10±62.40 μg/ml to 1501.10±67.50 μg/ml; p=0.03).

Conclusions. There is a shift in the lipid spectrum, which corresponds to atherogenic dyslipidemia, in the examined persons aged over 40 years. In individuals aged under 50 years there is an increase in total levels of PUFA, thus the highest growth of ω3-PUFA is observed in the period from 40 to 50 years, and ω6- PUFA in the period from 45 to 50 years. The stabilization of the fatty acids composition was revealed in persons aged 50 years and more.

Key words: trophological status; age peculiarities; lipid spectrum; fat-acidic spectrum; plain settlements.

Problem statement and analysis of the latest research

Obesity is a topical problem, not only because of the pandemic extent of distribution, but also because it is one of the risk factors for the development of a number of cardiovascular diseases, metabolic syndrome (MS), type 2 diabetes mellitus (DM), Pickwickian syndrome and some oncological nosologies. The detection of the peculiarities of metabolic processes at the level of lipid and fat-acidic metabolism, depending on the body mass index and age, is one of the directions of the author's work.

According to the meta-analysis of six prospective cohort studies (31096 patients with a follow-up period of 5.9 to 17.7 years), elevated levels of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were associated with a decreased risk of cardiovascular events [1, 2]. After the studies of Dyerberg [3] and Kagawa [4], who noted the protective effect of eicosapentaenoic acid on cardiovascular diseases, a large number of studies has been performed to evaluate the effect of fatty acids (FA) on the profile of lipoproteins and the effect on cardiovascular risk (CVR). Reviews made by Chowdhury [5] and Michas [6] summarized the existing view of the association between individual FA, groups of fatty acids and CVR. Polyunsaturated fatty acids (PUFAs), especially ω3-PUFAs, according to Kelley [7] and Ninomiya [8], can reduce CVR, while saturated and monounsaturated FA can increase CVR. Similarly, certain subclasses of lipoproteins, in particular, small particles of LDL, are associated with an increase in CVR [9].

Studies on age-related effects on the level of FA and lipid profile were performed by Lin [10] and Risé [11]. They have shown an increase in the levels of EPA and DHA, starting with childhood, among adults and the elderly, among both genders. Otsuka with the co-authors [12, 13] found a positive correlation between age and absolute concentrations of EPA and DHA among adults aged 40-79 years. Harris with the co-authors [14] analyzed the state of erythrocytes among 160 000 patients who were determined CVR and found an increase in relative levels of EPA and DHA.

Rajalahti with the co-authors [15] showed that for individuals of both genders, absolute concentrations of EPA and DHA increase beginning from prepubertal age to adulthood (up to 40 years). Among women, this process continues with age (EPA and DHA continues to increase) and continues even in the elder age, while there is no such tendency among men. At the same time, it was revealed, that among males with age (from prepubertal up to adult age) the concentrations of most of the fatty acids increased with 16-18 carbon atoms, although there was no such tendency in women.

The objective of the study. To reveal the age peculiarities of the fat-acidic and lipid plasma spectrum of blood in the inhabitants with overweight and obesity of the plain inhabited localities in the Transcarpathian region.

Materials and methods

There were examined 107 persons who applied for assistance to the Family Medicine Outpatient Clinic №7 in Uzhgorod. The following persons were evaluated for the next data: age, gender, BMI, waist circumference, indeces of lipid spectrum (total cholesterol levels (TCL), low density lipoprotein cholesterol (LDL cholesterol), high density lipoprotein cholesterol (HDL cholesterol), triglycerides (TG), coefficient of atherogenicity (CA)), levels of saturated FA (myristinic acid (14:0), pentadecanoic acid of FA (15:0), stearinic acid of FA (18:0), palmitinic acid (16:0)), monounsaturated FA (palmitoleic acid (16:1), oleinic acid FA (18:1)), polyunsaturated FA, in particular ω6 PUFA (linoleic acid (18:2), γ- linolenoic (γ-18: 3), digomo-γ- linolenoic (γ-20:3), adrenic (22:4), docosapentaenoic (22:5), arachidonic (20:4), and ω3 PUFA (α-linolenoic (α-18:3), eicosapentaenoic (20:5) and docosahexaenoic (22:6)).

Determination of the parameters of lipid metabolism was performed using the spectrophotometric method on the basis of the laboratory department of the "Gemo Medica" clinic (Uzhhorod, Ukraine), using SIEMENS Dimension RxL Max apparatus.

Determination of the fatty acid composition of the plasma was carried out using gas chromatography. There were used an analytical gas chromatograph Varian 3900 (USA) and a quartz capillary column with an immobilized phase Supelkovaks-10 (15 x 0.25 mm x 0.25 μm, manufactured by SUPELKO, Switzerland) to study the fatty acid

composition of the plasma.

In the course of performance of the examination of patients, we've used international and Ukrainian regulatory medical ethics documents, namely: the Geneva Declaration, the Helsinki Declaration, the International Code of Medical Ethics, International Guidance on the Ethics of Biomedical Research on Human Personality, CIOMS (Geneva, 1993), Declaration on Patient Care in Europe, World Health Organization (1994), ICH GCP. Involvement of the patient into the study was carried out only with the signature of his/her voluntary individual informed consent.

Statistical data processing, in particular the determination of the T-test and the Pearson rank-correlation coefficient, was performed using the "Microsoft Excel 2013" software.

Results of the study and their discussion

The study involved 74 women (69.1%) and 33 men (30.9%). The average age of the examined persons was 52.4±1.0 years. The BMI of the examined patients was 27.5±0.4 kg/m^2, the waist circumference was 92.4±1.6 cm. Among the concomitant pathology, arterial hypertension was prevalent in 35.1% of the patients, the angina pectoris was recorded in 5.4%, BMI in anamnesis – in 4.1%, type 2 DM was observed in 4.1% of people. The complicated hereditary history of cardiovascular diseases was in 39.2%; 29.8% of the studied persons were smokers at the time of the research, 6.8% smoked in the past, 63.5% did not smoke at all.

The mean values of TCL were 5.08±0.1 mmol/l, LDL cholesterol 3.3±0.08 mmol/l, HDL cholesterol 1.31±0.02 mmol/l, TG 1.55±0.08 mmol/l, and **CA** 2.97±0.1.

The total level of all PUFAs was 1443.1±34.4 μg/ml, of which ω6-PUFA was 1349.1±32.1 μg/ml, and ω3-PUFA was 94.0±3.7 μg/ml.

All patients were divided into the following age groups: up to 40 years (subgroup 1), 41-45 years (subgroup 2), 46-50 years (subgroup 3), 51-55 years (subgroup 4), 56-60 years (subgroup 5), 61-65 years (subgroup 6).

When comparing these age groups, there is a tendency of BMI increase from 24.80±1.10 kg/m^2 in subgroup 1 to 26.05±1.90 kg/m^2 in subgroup 2 (p=0.58), starting from age of 46 years and older, in each age group, there was a significantly higher BMI compared with the subgroup 1: 27.80±1.10 kg/m^2 in subgroup 3 (p=0.05), 28.90±1.20 kg/m^2 in subgroup 4 (p<0.01), 28.70±1.10 kg/m^2 in subgroup 5 (p<0.01), 28.80±1.40 kg/m^2 in subgroup 6 (p<0.01). According to the data of theInstitute for Health Metrics and Evaluation, most people with obesity were found in the age of 50-70 years [16].

Regarding indicators of lipid metabolism, in the subgroup of persons younger than 40 years, normal lipidograms were found: TCL – 3.95±0.16 mmol/l, LDL cholesterol 2.60±0.12 mmol/l, HDL cholesterol 1.21±0.07 mmol/l, TG 1.67±0.23 mmol/l. In each of the following age groups, there were significantly higher levels of both TCL and LDL cholesterol compared to the subgroup of persons under 40 years of age (see Table 1).

Table 1. Age peculiarities of lipid spectrum indices

№ of subgroup	Age limits	TCL, mmol/l	p	LDL cholesterol, mmol/l	p
1	under 40 years	3.94±0.16		2.60±0.12	
2	41-45 years	5.38±0.28	<0.01	3.47±0.21	<0.01
3	46-50 years	4.95±0.24	<0.01	3.15±0.19	<0.01
4	51-55 years	5.57±0.25	<0.01	3.60±0.22	<0.01
5	56-60 years	5.36±0.19	<0.01	3.51±0.19	<0.01
6	61-65 years	5.31±0.32	<0.01	3.39±0.27	=0.01

At the same time, there were no significant differences in the parameters of TCL, LDL cholesterol between subgroups 2-6. There were no age differences between the mean levels of HDL cholesterol and triglycerides in any of the six subgroups compared. Thus, in the examined patients over 40 years of age, changes in the lipid spectrum are observed in the direction of growth of atherogenic fractions. Although there is no significant difference between subgroup 1 and subgroup 2 in relation to BMI, persons in the second subgroup have already had atherogenic changes in the lipid spectrum. The study involved 1058 residents of Barnaul; it was found that levels of TCL and LDL cholesterol are believed to increase in persons over 30 years of age, regardless of gender [17].

When comparing the fat-acidic composition of plasma of patients in the 1 and 2 age subgroups, no significant differences were found regarding the total level of saturated fatty acids. At the same time, differences in the levels of the individual ω3-PUFA and ω6-PUFA were revealed. In patients aged 41-45 years, compared with individuals under the age of 40 years, significantly higher levels of oleinic FA were detected (18:1, 573.40±51.80 μg/ml against 412.70±50.20 μg/ml, p=0.04), linoleic acid (18:2, 1001.70±44.70 μg/ml versus 835.90±48.10 μg/ml, p=0.02), arachidonic FA (20:4, 221.30±14.10 μg/ml against 172.40±10.20 μg/ml, p=0.01), eicosapentaenoic acid (20:5, 12.80 1.40 μg/ml versus 7.90±1.40 μg/ml, p=0.03), docosapentaenoic (22:5, 12.70±1.40 μg/l against 8.30±0.70 μg/ml, p=0.02) and docosahexaenoic acids (22:6, 53.80±5.20 μg/ml versus 38.30±3.50 μg/ml, p=0.03). According to the data of the Japanese population study [10], serum EPA and DHA increased, while levels of arachidonic acid decreased with age, and remained unchanged even after adjusting for intake of fatty acids. It was found that levels of EPA and EPA/arachidonic acid ratio compared with DHA levels correlate more strongly with those subgroups of lipoproteins associated with CVR decrease, but this is more pronounced in women and less in men [10].

The average level of total ω3-PUFA in subgroup 2 was 1.46-fold higher than that one of subgroup 1 (87.60±7.20 μg/ml versus 60.10±5.50 μg/ml, p<0.01) , whereas the ω6-PUFA level was 1.22-fold higher (1288.10±62.40 μg/ml versus 1056.30±60.10 μg/ml, p=0.02). When comparing the fat-acidic profile of subgroup 2 and subgroup 3, there is an increase of the total level of PUFA 1.17-fold from 1375.70±63 μg/ml to 1604±74.60 μg/ml (p=0.03) due to ω6-PUFA, which is performed at the expense of ω6-PUFA, the level of which in the subgroup 2 was 1288.10 62.40 g/ml, and in the subgroup 3 – 1501.10±67.50 μg/ml (p=0.03).

Beginning from 46 years (subgroups 3-6), the levels of total ω6-PUFA and ω3-PUFA are significantly higher than those in persons under 40 years of age (Fig. 1). In people under 50 years of age there is an increase of average levels of PUFA, though the highest growth of ω3 PUFA was observed in the period from 40 to 50 years, and ω6 PUFA in the period from 45 to 50 years. There were no significant differences in the comparison of subgroups 3,4,5 and 6 with the respect to the average levels of higher fatty acids. This indicates a stabilization of the fat-acidic composition of blood after 50 years.

There were revealed significantly higher levels of individual ω6 and saturated FA in subgroup 3: γ-linolenic FA (γ-18:3, 16.50±2 vs. 10.80±1.10 μg/ml, p=0.02), digomo-γ-linolenic (γ-20:3, 42.30±3.30 vs. 31.10±2.90 μg/ml, p=0.02), arachidonic (20:4, 272.30±16 vs. 221.30±14.20 μg/ml, p=0.02), stearic (18:0,

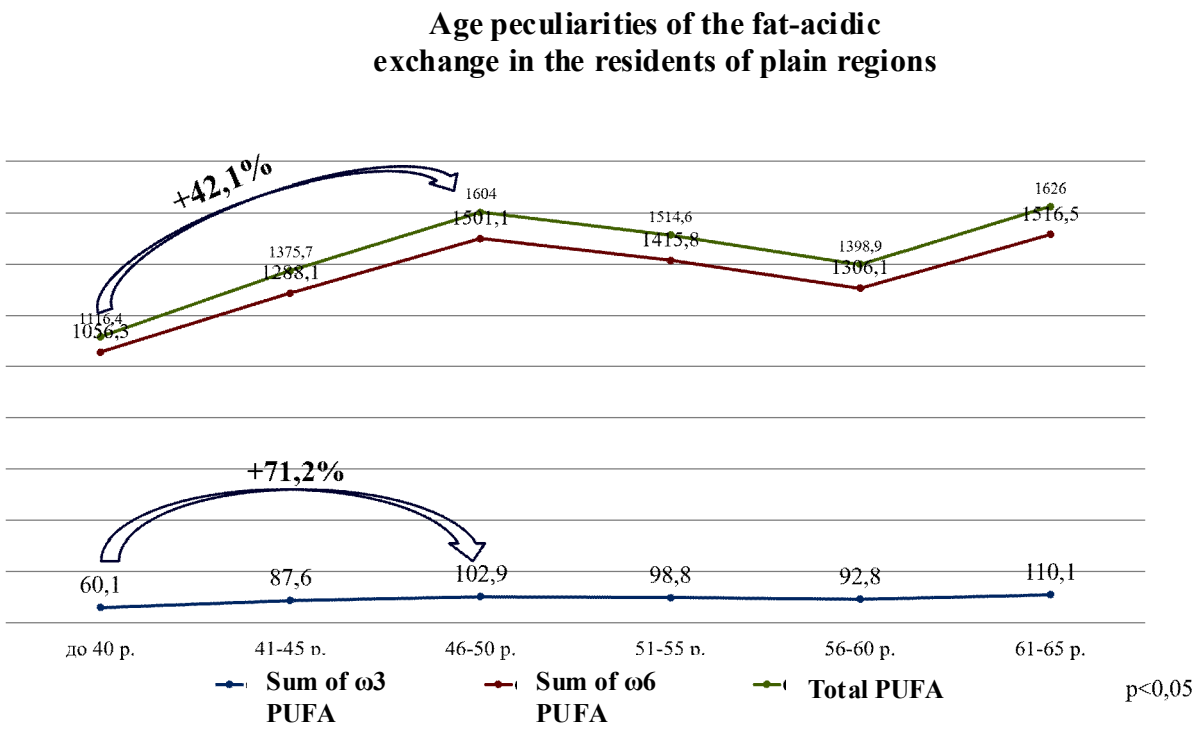

Fig.1. Total levels of polyunsaturated fatty acids in different age groups

241.70±34.70 vs. 157.90±16.40 μg/ml, p=0.02) and linoleic FA (18:2, 1149.70±56 versus 1001.70±44.70 μg/ml, p=0.04). Patients aged 41 to 45 have significantly lower levels of stearic (18:0), γ-linolenic (γ-18:3) and digomo-γ-linolenic FA (γ-20 3) compared to those in subgroups 3-6 (see Table 2). According to the data of another Japanese study, the concentration of arachidonic acid in blood serum increased during 4 years in both men and women aged 40-69, even after adjusting of intake of arachidonic acid [13]. Higher levels of DHA and lower EPA levels in young women are consistent with an elevated conversion of EPA to DHA during the reproductive age [14].

Conclusions

In the examined persons over 40 years of age there is a change in the lipid spectrum, which corresponds to atherogenic dyslipidemia.

In individuals under 50 years of age there is an increase of total levels of PUFA, with the highest growth of ω3-PUFA which was observed in the period from 40 to 50 years, and ω6-PUFA in the period from 45 to 50 years. After 50 years of age, the stabilization of the fatty acid composition occurs.

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Table 2. Age peculiarities of the fat-acidic spectrum

Higher fatty acids		Age 41-45 years (subgroup 2)	Age 46-50 years (subgroup 3)		Age 51-55 years (subgroup 4)		Age 56-60 years (subgroup 5)		Age 61-65 years (subgroup 6)	
IUPAC formula (from the methyl end)	Trivial name	Levels of FA M+m μg/ml	Levels of FA M+m μg/ml	p (subgroup 3/ subgroup 2)	Levels of FA M+m μg/ml	p (subgroup 4/ subgroup 2)	Levels of FA M+m μg/ml	p (subgroup 5/ subgroup 2)	Levels of FA M+m μg/ml	p (subgroup 6/ subgroup 2)
18:00	Stearic	157.90± 8.40	241.70± 34.70	0.02	207± 14.40	0.01	199 30± 9.70	0.01	231.30± 20.30	0.01
Ɣ-18:3	γ-linolenic	10.80± 1.10	16.50±2	0.02	17.60± 2	0.01	16.20± 1.40	0.01	16.30± 1.50	0.01
Ɣ-20:3	digomo-γ-linolenic	31.10± 2.90	42.30± 3.30	0.02	47.30± 3.70	0.01	43.10± 2.30	0.01	44.30± 4.10	0.01
20:4	arachidonic	221.30± 14.20	272.40± 16	0.02						
Total PUFA		1375.70± 63	1604± 74.60	0.03						
Total ω6-PUFA		1288.10± 62.40	1501.10± 67.50	0.03						

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