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THE FREQUENCY OF DYSLIPIDEMIA AMONG THE ARCTIC REGION POPULATION OF YAKUTIA

ABSTRACT

Biomedical research of the indigenous Arctic population of the Republic Sakha (Yakutia) for 1994 and 2013 showed reduction in the proportion of people with normal cholesterol level and increase of proportion of the individuals with borderline high and high cholesterol. There has been growth of triglyceride level as well. High cholesterol is not always accompanied by a shift towards the atherogenic changes, in 75% of men and 76% of women increased cholesterol level can be considered as a consequence of the process of adaptation to changing conditions of life. The imbalance in lipid profile was identified also in people with normal cholesterol level, which is indicating the need for a mandatory determination of lipid fractions, regardless of its level. The tension of regulatory mechanisms of metabolism of proteins and carbohydrates, associated with atherogenic changes in lipid profile requires assessment of all risk factors and mandatory correction of the diet.

Keywords: adaptation, indigenous people, lipid metabolism, atherogenic changes.

Violation of adaptation of the indigenous inhabitants of the Arctic observed in recent decades is confirmed by the demographics. The average duration of life of northerners of Russia decreased by 11 to 14 years, mortality has increased in 1.4 times in comparison with industrialized northern countries [20]. In the Republic Sakha (Yakutia) in the Arctic group of regions the coefficient of total mortality of the working-age population by 2012 against 1990 increased in 2.5 times, and it is significantly higher than average republican index. The process of depopulation is associated primarily with high mortality from diseases of the circulatory system (345.7 per 100.000) [8], although until recently the incidence of hypertensive heart disease, coronary disease and obesity among the small peoples of the Russian North has been at a rather low level [2, 13, 21]. The deterioration of population health in the Arctic is associated with the deterioration of the quality of life, when to the natural risk factors, were added difficult socio-economic, health infrastructure and anthropogenic factors [11, 16, 19, 24]. Stress factors, the gradual departure from the traditional lifestyle and change of diet, increased in recent years, could not fail to affect homeostatic body systems, in particular on the regulation of lipid metabolism. The imbalance in lipid profile towards atherogenic is regarded as one of the major risk factors of cardiovascular diseases.

Therefore, the evaluation of lipid metabolism of the indigenous population of the Arctic region in dynamics is relevant in the justification of increasing the efficiency of preventive measures for preservation and strengthening of health, improvement of quality of life of indigenous peoples of the North.

The purpose of the study was to assess the frequency of the atherogenic lipid profile of the indigenous population of Saskylah Anabar district Sakha Republic (Yakutia).

MATERIAL AND METHODS

In the spring season of 1994 in a cross-sectional epidemiological study we examined a random sample of the indigenous population of Saskylah Anabar district Sakha Republic (Yakutia). We surveyed 134 indigenous people (22 men and 109 women). The average age was 38.8±1.19. In April 2013 in the village we surveyed 170 people aged 18 to 75 years (107 women and 63 men). The average age of patients was 46.6±0.77 years (men were at the age 46.3±1.53; women - 46.8 ± 0.90). To identify changes in the level of cholesterol and triglycerides of them we selected a group of 139 individuals in the appropriate age-sex structure as the sampling of 1994 (29 males, 110 females, average age of them 38.8±1.19). All study participants were representatives of indigenous populations: Yakuts, Evens and Evenks.

The study was approved by the local Committee on biomedical ethics of "Yakut scientific center of complex medical problems" was and carried out subject to voluntary informed consent of participants.

Biochemical parameters were determined by enzymatic method using standard kits on a biochemical analyzer. In the morning on an empty stomach serum, we take into account the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma-glutamyl transferase (γ-GT), glucose, total cholesterol (TC), triglycerides (TG), cholesterol of high density lipoproteins (HDL cholesterol). The concentration of low density lipoproteids cholesterol (LDL cholesterol) and cholesterol of lipoproteins of very low density (VLDL cholesterol) was calculated by the formula of Friedewald et al. [26]. To assess the atherogenic lipid profile of blood were used the following markers of atherogenicity: the ratio of total cholesterol to cholesterol of lipoproteins of high density (total cholesterol/HDL cholesterol) (more than 5); cholesterol low-density lipoproteins to high (LDL cholesterol/HDL LPV) (3.3) [19, 25]. The atherogenic coefficient (K_a) was calculated by the formula proposed by A. V. Klimov (1990): CA=total cholesterol-HDL cholesterol/HDL cholesterol (<3.0). K_a 4.1 is used as an indicator of risk of development of atherosclerosis. Statistical processing of obtained results was performed using the statistical package SPSS 11.5 for Windows. Quantitative data are represented as averages (M) and standard error of the mean (m) under the normal distribution. The statistical significance of differences was determined by paired t-Student test for independent samples, the threshold level of statistical significance was considered at value of $p < 0.05$. Correlation analysis was carried out by the method of Spearman.

THE RESULTS AND THE DISCUSSION

The change of lipid metabolism of Saskylah indigenous people for 19 years is characterized by growth of average level of total cholesterol (TC) by 10.7%, reduction in the share of persons with an "optimal" level of total cholesterol (<5.2 mmol/l) by 19%; increase the proportion of persons with "borderline high" (5,21 - 6,19 mmol/l) and "high" levels of total cholesterol (≥6.2 mmol/l) in 15% and 4%, respectively (Fig.).

The proportion of violations of the cholesterol in dynamics, %

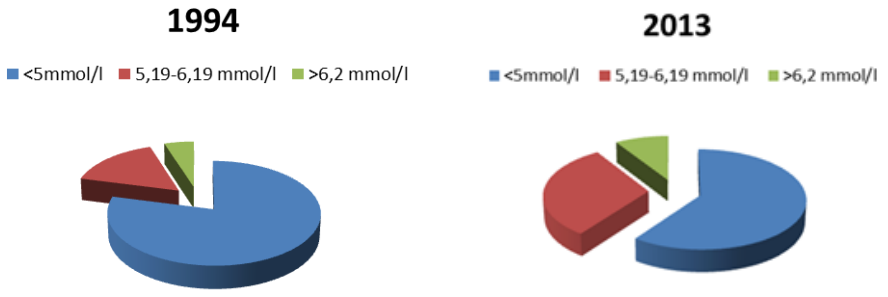
Average triglyceride levels increased by 19%. The increase of cholesterol levels was observed by increasing the content as triglycerides, LDL cholesterol, and HDL cholesterol. The increase of cholesterol levels was observed by increasing the content as triglycerides, LDL cholesterol, and HDL cholesterol. Lipids atherogenicity is detected not only in persons with high total cholesterol, but also those whose level of total cholesterol is within normal values, i.e. there is a destabilization of the balance of the lipid profile. On the concept of Panin L. E. (1978) metabolic adaptation of indigenous people to the rigors of high latitudes was accompanied by the formation of "polar metabolic type" with increasing energy the role of protein and fat. Lipid metabolism of the Northern peoples in comparison with the migrant population was characterized by lower blood levels of total cholesterol, triglycerides and higher levels of antiatherogenic fraction of lipoproteins [1, 6, 7, 10, 15].

In men with normal content of cholesterol atherogenic violation is observed in 20% of patients, and for women to 43% depending on the indicators of atherogenic markers. Among persons with borderline high total cholesterol (> 5.2 mmol/l) risk of developing atherosclerosis was detected in 30% of men and 37% women (table 1).

The average percentage of atherogenic shifts according to the ratio of total cholesterol/HDL cholesterol, LDL cholesterol/HDL cholesterol and according to K_a does not have significant gender differences. In the examined population the proportion of persons with atherogenic shift in lipid profile among men was on average 25% (23%, 26,9%, 25,3) respectively), among women the average - 24% (22,3%, 28,8%, 22% respectively). In the remaining 75% of the surveyed men and 76% of women a high level of total cholesterol has not atherogenic changes (table 2).

Percentile distribution of indicators of markers of atherogenic and frequency of atherogenic disorders

According to the other authors among the indigenous population of the Gornyj and Zhigansky districts of Yakutia, hypercholesterolemia in 80% of cases in men and 87 % in females was not accompanied by a shift in the direction of atherogenic fractions and was compensated adaptive in nature [18]. Negative correlation of marker of atherogenic and de Rytis coefficient indicates a metabolic shift, since the



The frequency of atherogenic disorders, depending on the level of cholesterol

Table 1

The frequency of atherogenic infringements depending on the level of cholesterol

TC, mmol/l	TC/HDL chol. > 5		LDL chol / HDL chol > 3,3		Atherogenic coefficient > 4,1	
	Men	Women	Men	Women	Men	Women
<5,20	20 (8/40)	14,2 (14/98)	20 (8/40)	19,4 (19/98)	20 (8/40)	43,9 (43/98)
≥5,20 <6,20	29,4 (5/17)	28 (14/50)	41,1 (7/17)	34 (17/50)	29,4 (5/17)	26 (13/50)
≥6,20	33,3 (2/6)	59,1 (13/22)	33,3 (2/6)	59,1 (13/22)	33,3 (2/6)	59,6 (13/22)

Note. The data presented in the format % (n/N).

Table 2

Percentile distribution of indicators of markers of atherogenic and frequency of atherogenic disorders

parameter	n	Percentiles					The share of persons with a violation , n (%)
		10	25	50	75	90	
Men							
TC/HDL cholesterol	63	3,27	3,66	4,26	4,98	6,62	15 (23)
LDL chol./HDL chol.	63	1,82	2,38	2,80	3,62	5,05	17 (26,9)
Atherogenic coefficient	63	2,20	2,67	3,30	4,02	5,64	16 (25,3)
Women							
TC/HDL cholesterol	170	2,83	3,41	4,20	4,91	6,18	38 (22,3)
LDL chol./HDL chol.	170	1,69	2,16	2.83	3,42	4,32	49 (28,8)
Atherogenic coefficient	170	1,90	2,40	3,20	4,00	5,07	39 (22)

change of transaminases in the blood reflects adaptive mechanisms of metabolic nature. The change in the balance of correlation transaminases - coefficient de Rytis downward shows the violation of lipid metabolism, therefore, on the assessment of Krivoshapkina Z. N. (2010) the low coefficient de Rytis (liver variant) can be used as an inexpensive marker of disorders of lipid metabolism and disadaptive reactions of the organism [9]. One of the main causes of changes in lipid metabolism of the surveyed population over the past decades is the changing nature of power. In extreme environmental conditions, the formation of “”polar metabolic type” indigenous peoples have contributed to the traditional way of life and protein-lipid type of food, which is more than adequate, stress-resistant, and reduces the ecological stress due to low levels of cortisol than people with another type of food [3, 14, 17, 23]. By assessment of S. L. Safonova (1995) in residents of Yakutia the nature of power has gradually shifted from protein-lipid type on protein-carbohydrate type [17]. This fact concerning to residents of Arctic village Saskylah is confirmed by the results of the evaluation of the actual nutrition that we held in 2007. The imbalance in the daily diet is due to the excessive intake of carbohydrates, including pure sugar (93.3 g, instead of 35g recommended by the WHO) [21]. As a result, in this period of time, there is an increase in the average glucose in the blood by 6.7% and increase the proportion of persons with high glucose levels. A direct correlation of glucose levels and a stronger connection of high glucose levels with markers of atherogenic is a testament to the tension regulation of metabolism of carbohydrates and lipids. In addition, environment of Anabar district is under quite high anthropogenic and technogenic impact. The water of the river Anabar near village Saskylah and soil are contaminated with heavy metals [4, 5, 22] that on the food chain get into the human body.

CONCLUSION

The change of lipid metabolism indigenous residents of the Arctic village Saskylah from 1994 to 2013 is characterized by a decrease in the proportion of persons with normal cholesterol levels and increase in the proportion of persons with borderline high and high cholesterol. Violation of lipid metabolism is accompanied by an increase in blood levels OH, TG, hol-LDL and decreased hol-HDL. High cholesterol is not always accompanied by a shift in the direction of atherogenic changes; in about 75% of men and 76% women increased level of cholesterol has compensated adaptive character. The occurrence of atherogenic changes among people with normal cholesterol indicates the need for determining fractions of lipids regardless of the level of total cholesterol. As an inexpensive marker of disorders of lipid metabolism can be used the low coefficient de Rytis (liver variant), which has feedback with markers of atherogenicity. A positive correlation of atherogenicity markers with glucose level and a stronger connection with high glucose level is a testament to the regulation tension of metabolism of carbohydrates and lipids. Great importance for the prevention of atherosclerosis would be correction of the violated traditional diet of the indigenous population of the Arctic.

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ERYTHROCYTE MEMBRANE MICROVISCOSITY IN THE POPULATION OF SAMBURG VILLAGE

ABSTRACT

We studied the indices of relative microviscosity of the erythrocyte membranes in the two groups of inhabitants of the village Sumburgh Yamalo-Nenets Autonomous District: indigenous (tundra and forest Nenets) and non – indigenous arrived from central Russia. We revealed a significant increase in microviscosity of lipid-lipid interactions in the native women aged 46-55 years ($p < 0.05$) compared with the non – indigenous ones. Increased membrane microviscosity may obstruct erythrocytes passage through microcapillary channel and lead to the development of the northern hypoxia.

Keywords: microviscosity of erythrocyte membranes, the indigenous people of the North, the Yamalo-Nenets Autonomous District.

INTRODUCTION

Climate conditions of the North regions impel the human organism to change its level of homeostasis. This affects the biochemical reactions, functioning of cell membranes, and rheological properties of blood. A change in relative microviscosity of membranes can serve as a marker of the metabolic state of cells. It is known from the literature that microviscosity of human membranes increases with age, which is related to an excess of cholesterol [1], accumulation of lipid peroxidation (LPO) products, and changes in the composition of phospholipid bilayer. Therewith, biological membranes become rigid and porous, the cell shape is distorted [1]. The state of erythrocyte membranes changes with alteration of the lipid composition of blood [5] and in type 1 and 2 pancreatic diabetes [9]. These changes show up as a decrease in fluidity (an increase in microviscosity) of membranes, which is attributed to the glycolysis of membrane proteins and to the action of insulin, which is involved in the activation of LPO and facilitates the growth of intracellular calcium level [2].

An increase in erythrocyte membrane microviscosity may be caused by a decreased content of the main antioxidant, tocopherol, and accumulation of lipid peroxidation products (diene conjugates) as well as lysoforms of phospholipids, which can disturb the diffusion of gases (CO_2, O_2) through erythrocyte membranes [6,8]. Our earlier *in vitro* study demonstrated and increase in erythrocyte membrane microviscosity with raising the concentration of hormones (cortisol, adrenalin, noradrenalin, androsterone, and testosterone) in the ghost suspension [1]. This is caused by a simultaneous interaction of carbonyl and hydroxo groups of the hormones with CO and NH_2 groups of membrane proteins and phospholipids [11].

The **objective** of the work was to investigate age-related changes in erythrocyte membrane microviscosity in non-indigenous and indigenous population of Samburg village (YNAO).

MATERIALS AND METHODS

Material for the study was collected during the expeditions to the Yamal-Nenets Autonomous Okrug in 2012-2014 by researchers from the Laboratory of population ethnogenetics at ICG SB RAS under the supervision of Ph.D. (biol.) Osipova L.P. Blood donations were obtained in compliance with international rules using the informed consent from volunteers who were practically healthy at the time of the study. The study involved indigenous persons and non-indigenous population of Samburg village (latitude 67°0' north, longitude 78°25′ east), Purovsky district, YNAO. Overall 136 inhabitants (60 men and 76 women) 25 – 65 years of age were examined. Among them were 98 representatives of indigenous nation (tundra and wood Nenetses) and 38 – non-indigenous Caucasian inhabitants of Samburg village.

Blood was taken from the ulnar vein after 10-12 hours of night fasting. Erythrocyte ghosts were obtained by haemolysis in a hypotonic phosphate buffer (pH 7.35) containing 2.75 mM KH2PO4 and 8.5 mM Na2HPO4. Ghosts were sedimented by centrifugation at 5500 g, the supernatant was decanted. Ghosts were obtained and stored at 4°C. Microviscosity of erythrocyte membranes was measured on a RF-5301(PC)SCE (Shimadzu) spectrofluorimeter by a technique reported elsewhere [9,10].

Statistical treatment was carried out with Statistika 9.0 software using nonparametric statistical methods (Mann-Whitney rank sum test). Membrane microviscosity was measured at the Shared Equipment Center of Spectrometric measurements (FSBI Research Institute of Biochemistry (Novosibirsk).

RESULTS AND DISCUSSION

Relative microviscosity of erythrocyte membranes was measured in indigenous and non-indigenous men and women that were divided into four groups according to their age: 25-35, 36-45, 46-55 and 56-65 years. The study showed a significant increase in relative microviscosity of membranes by 26% ($P < 0.05$) in the region of lipid-lipid interaction in indigenous men of age 56-65 as compared to the group of indigenous men of age 25-35. No significant differences were found in other groups.

A significant age-related increase in relative microviscosity of membranes was revealed also in women (Table).