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COMPARATIVE ASSESSMENT OF THE FREQUENCY OF DYSLIPIDEMIA AMONG THE INDIGENOUS POPULATION OF THE ARCTIC ZONE OF YAKUTIA

ABSTRACT

One-stage population studies of biochemical markers of the lipid transport function of the indigenous population in the Arctic, Central and Southern zones of Yakutia have been carried out. An increase in the content of triglycerides and cholesterol and atherogenic fractions of lipids in the population from the north to the south was noted. Atherogenic changes in lipid metabolism are more pronounced in the arctic Yakuts, than in Dolgans, living in the same zone, and Evens of the Southern zone, which indicates a lower susceptibility to a disadaptive change in lipid metabolism in the Dolgans and the Evens.

Keywords: dyslipidemia, indigenous population, Arctic.

Introduction

Cold is one of the factors limiting activity of a human body. The most northern inhabited territory is the Arctic where living conditions differ in the maximum extremeness. The Arctic zone of the Russian Federation includes 2/5 of the Sakha (Yakutia) Republic territory. According to bioclimatic zoning by the magnitude of the complex cooling effect and the coefficient of discomfort, this area belongs to the extreme-severe zone, which is characterized by prolonged exposure to cold, strong winds, powerful heliomagnetic disturbances, specific photoperiodicity and permafrost.

It is known that under the influence of external high-latitude factors in the indigenous population in the process of long-term adaptation, certain metabolic and morphofunctional features were formed, aimed at maintaining homeostasis. A characteristic feature of the northern metabolism, a «polar metabolic type» (E.L. Panin, 1978) is an increase in the role of lipids for the intensification of energy processes and an increased content of unsaturated fatty acids in tissues and blood that are faster incorporated into catabolism and compensated by diet as the most important manifestation of human adaptation in the North [1, 4, 8]. The protein - lipid type of nutrition can be considered a prevention of the development of alimentary - dependent diseases, since the metabolism of indigenous lipids is characterized by a lower content of total cholesterol, triglycerides and a higher level of antiatherogenic fraction of lipoproteins [1, 7, 9].

A healthy, educated, able-bodied population is the key to the development of the economy, and, consequently, the quality of life. The implementation of national interests in the Arctic, noted in the

development strategy of the Arctic zone of the Russian Federation and ensuring security for the period until 2020, requires the improvement of demographic processes [12]. The worsening of the demographic indicators of the population of the Arctic zone in recent decades indicates the manifestation of disadaptive processes. Depopulation in the Arctic regions of Yakutia is associated, mainly, with high mortality of the population from diseases of the circulatory system (345.7 per 100.000 people) [3, 13].

Disruption of adaptation, which is caused by biochemical disruption of the functioning of regulatory and protective systems of the body, underlies the development of various pathologies. Timely detection of persons with signs of disadaptation, in particular lipid imbalance and the restoration of body reserves, is the main task of preventive measures to preserve public health and to justify the need for investment in the development of public health in general and Arctic medicine in particular.

Purpose of the study: comparative assessment of lipid metabolism in a population sample of indigenous residents of the Arctic zone of Yakutia.

Materials and methods of research

The material was collected in winter time at one-stage population random sample research of an indigenous population in the Arctic zone (Anabary and Srednekolymsky districts). The comparison groups comprised samples of the indigenous population of the Central (Megino-Kangalassky, Gorny districts) and Southern (Lensky, Ust-Maysky districts) zones of the Sakha Republic (Yakutia). In total 678 people aged 18 to 68 years were examined - 406 women and 272 men. The average age in the groups was 45 years. All participants in the study were representatives of

indigenous populations: the Yakuts, Dolgans, Evens.

To assess the objective state, a survey was conducted on the questionnaire developed at the FSBSI «Yakut scientific center of complex medical problems». We received informed consent from respondents for research and blood donation. Blood for biochemical research was taken from the ulnar vein in the morning on an empty stomach, 12 hours after eating.

Biochemical parameters were determined by the enzymatic method using standardized sets on a biochemical analyzer: the level of total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL cholesterol). The concentration of low-density lipoprotein cholesterol (LDL cholesterol) and very low-density lipoprotein cholesterol (VLDL cholesterol) was calculated by the formula of Friedewald et al. [17]. Assessment of lipid and lipoprotein content of blood plasma was carried out in accordance with the criteria of NCEP ATP III (2001) [16]. To assess atherogenic disorders of blood lipid profile, the following markers of atherogenicity were used: the ratio of total cholesterol to high-density lipoprotein cholesterol (Chol / HDL - C) (more than 5), low density lipoprotein cholesterol to high (LDL-C / HDL-C) (more than 3.3), atherogenicity coefficient (Ca) (more than 3). (Ca) was calculated by A.V. Klimov formula (1990): $Ca = TC - HDL - C / HDL - C$. The indicator Ca more > 3.1 is used as a marker of the risk of atherosclerosis development [6].

Statistical processing of the results was carried out using the SPSS 11.5 for Windows software package. At performing the statistical analysis, the normality test for the distribution of the quantitative indicators studied was

carried out according to the Kolmogorov-Smirnov test. The data of the descriptive analysis are presented in the form of $M \pm m$ and median, where M is the mean value, m - is the standard error of the mean value. At comparing the quantitative indices of the groups, the significance of the differences was assessed using the Student's t-test and ANOVA using the Bonferroni method for independent samples with normal distribution and the Mann-Whitney test for an abnormal distribution. The threshold level of statistical significance was taken at the value of the criterion $p < 0.05$.

Results and discussion

The examined population within the zones was divided into 3 groups according to the level of total cholesterol. One group included individuals with a «normal» level of total cholesterol, equal to or below 5.2 mmol / l, the other - those with a «borderline high» level of total cholesterol, equal to 5.21-6.19 mmol / l and the third - individuals with a «high» level of total cholesterol, equal to and above 6.2 mmol / l.

In a percentage ratio, the occurrence of «normal» cholesterol levels in the blood is higher among the Arctic population, a «borderline high» level of total cholesterol falls on the Central zone population. A lower percentage of the frequency of occurrence of the «high» level of TC is found among the population of the Arctic zone (8.2%), which is 8.8% lower than in the Central, and 13.5% - than in the Southern zone (Fig. 1).

Summing of the percentages of the occurrence of «borderline high» and «high» total cholesterol levels in the zones showed that in the surveyed population of the Arctic zone the incidence of high cholesterol is lower (34.5%) than in the Central and Southern zone by 16.9% and 7.1 % respectively.

Comparison of the percentages of the occurrence of «normal» and «borderline high» total cholesterol content with respect to the «high» total cholesterol

content in each zone showed a more favorable picture in the Arctic zone. The proportion of people with «normal» cholesterol among the arctic population is 2 times higher than in the inhabitants of the central and southern zone (Fig. 2).

However, the evaluation of the values of markers of atherogenicity among groups with «normal», «borderline high» and «high» levels of total cholesterol within the zones revealed a rather high incidence of atherogenic disorders, even among groups with normal cholesterol level (Table 1).

Thus, in the group with «a normal» level of cholesterol of the Arctic zone, the mean percentage of occurrence of atherogenic disorders was 24.8%, in the Central zone group - 38.7%, in the Southern zone group - 25.2%. In groups with a «borderline high» level of cholesterol, the percentage of occurrence of atherogenic disorders in the Arctic zone averaged 36%, in the Central zone 24.7%, in the Southern zone 45.9%. In groups with a «high» level of cholesterol, the occurrence of atherogenic disorders is lower in the Central zone (29%), in the Arctic zone an average of 45.7% and the highest in the Southern zone - 56.7%.

As follows from Table 2, the total cholesterol content exceeded the norm for residents of the Southern zone. The content of triglycerides, lipoprotein cholesterol does not go beyond the limits of normal values.

Determination of the significance of differences in the non-parametric Mann-Whitney method showed significant differences between the mean values of the Arctic and Southern zones in the content of triglycerides, high-density lipoprotein cholesterol and very low density lipoprotein cholesterol. An increase in the level of TG, total cholesterol and VLDL cholesterol is observed in the direction from north to south. The content of the HDL-C anti-atherogenic fraction was lower in the Southern zone and higher in the Central

zone.

Analysis of mean values of markers of atherogenicity by zones showed that the coefficient of atherogenicity (Ca) in all zones exceeded the norm, which indicates a chronic tension of the organism. The indicators of TC / HDL-C and LDL - C / HDL-C, unlike Ca, did not go beyond normal values, lower values of three markers of atherogenicity were found in the inhabitants of the Central zone (Table 3).

Comparative analysis of average lipogram data by sex and ethnicity did not reveal significant differences. An analysis of the frequency of occurrence of atherogenic disorders, depending on ethnic factors and the zone of residence, showed that the occurrence of dyslipidemia in all ethnic groups is quite high. In the Arctic zone, in percentage terms, atherogenic changes are more common in the Yakuts than in Dolgans. In the Southern zone the same tendency is observed: in the Yakuts the occurrence of atherogenic disorders is greater than in the Evens (Table 4). This indicates a process of changing the gene phenotypically conditioned adaptation mechanisms of indigenous people in the cold climate of the North, based on the traditional way of life i.e. high physical exertion with prolonged cold exposure and asian protein-lipid type of nutrition. In the opinion of V.V. Tsukanov. et al. [14] the leading cause of stable metabolism of lipids and low frequency of so-called «metabolic» diseases in a number of ethnic groups of Mongoloids of Siberia is the ability of the liver to active cholesterol esterification, intensive synthesis of bile acids and efficient transportation of sterols to bile.

L.I. Kolesnikov et al. [5] believe that on the scale of evolution a fairly rapid change in the nature of nutrition in favor of the prevalence of the carbohydrate part of the diet occurs, in the north aboriginates an intensive transformation of the protein-lipid type of metabolism

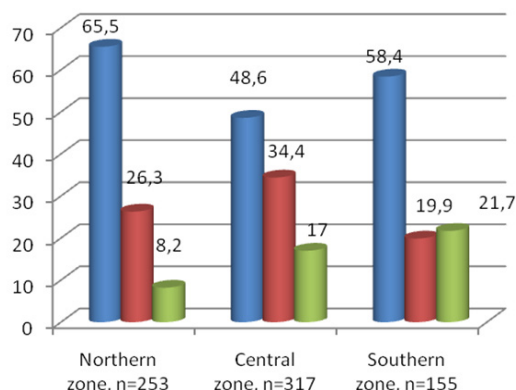


Fig.1. Distribution of the researched people by the level of total cholesterol in the zones of Yakutia (%)

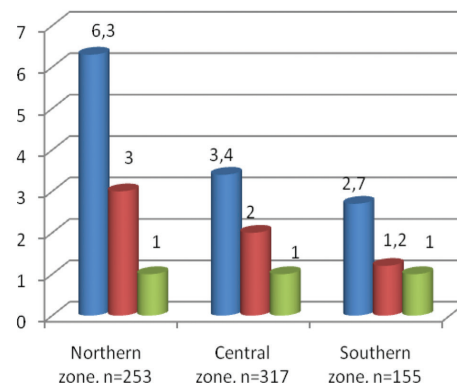


Fig.2. Ratio of the proportion of «normal», «borderline high» and «high» level of total cholesterol within the zones of Yakutia

into protein-carbohydrate continues. The formation of the type of metabolism of the population is slower than the nature of nutrition changes, and this fact can be the cause of the development of metabolic disadaptation or alimentary dependent diseases [5].

If we compare the percentage indices of the atherogenic coefficient among the Yakuts by zones (Table 4), then we can say that the frequency of dyslipidemia is the greatest in the northern Yakuts. The share of atherogenic changes in the zones does not differ sharply, which indicates the signs of a violation of the mechanisms of population adaptation to the changing external factors of the environment, not only climatic, but also to whole complexes of socioeconomic, technogenic and other factors that led to a drop in the quality of life. The main negative factors are a drop in the level of medical care for remote settlements, a complicated transport scheme, low income, unemployment, depression, alcoholism, problems of northern delivery, problems of development of traditional sectors of the arctic economy, increasing pollution of the environment, violation of vulnerable ecosystems in conditions of modern nature management [11, 13, 15]. Medical and social studies conducted in Yakutia have shown that a high level of personal anxiety among rural residents is primarily associated with a low standard of living [10]. A state of prolonged emotional stress is one of the reasons for the disruption of adaptive reactions of the organism [2].

Conclusions

1. Percentage ratio of the frequency of occurrence of the «normal» level of total cholesterol by zones in Yakutia shows that in the population of the Arctic zone the proportion of people with normal cholesterol is greater than in other zones.

2. The detected atherogenic shifts in the lipogram in individuals with a «normal» cholesterol level indicate the onset of changes in the lipid transport system. A greater imbalance in lipid metabolism was found in the inhabitants of the Central zone.

3. Reliable dependence of mean values of triglycerides, HDL-C, VLDL - C and markers of atherogenicity from the zone of residence is expressed in an increase in the level of TG, CHOL, LDL-C, LDLP-C from the north to the south. The content of the anti-atherogenic cholesterol fraction is lower in the Southern zone and higher in the Central zone.

4. According to the frequency of atherogenic shifts of the lipogram depending on ethnic factors, the disadaptive change in the body's lipid transport system is more pronounced

in the northern Yakuts than in the Dolgans of the Arctic zone and Evens of the Southern zone.

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Table 1

The frequency of atherogenic disorders, depending on the level of cholesterol in the zones of Yakutia (%)

The level of total cholesterol, mmol/l	Zone of Yakutia	Ca		CHOL/ HDL-C		LDL-C / HDL-C	
		<3,0	>3,0	<5	>5	<3,2	>3,2
=or<5,2	Arctic	62,9	37,1	85,4	14,6	77,2	22,8
	Central	55,2	44,8	55,2	44,8	73,4	26,6
	South	65,5	34,5	80,5	19,5	78,2	21,8
5,21-6,19	Arctic	61,2	38,8	66,6	33,4	64,2	35,8
	Central	65,1	34,9	81,7	18,3	78,9	21,1
	South	43,3	56,7	65,5	34,5	53,3	46,7
=or>6,2	Arctic	71,4	28,6	45,5	54,5	45,5	54,5
	Central	59,3	40,7	77,8	22,2	75,9	24,1
	South	27	73	54,1	45,9	48,6	51,4

Table 2

The content of triglycerides and cholesterol depending on the zone of residence, mmol / l

Zone	Statistics	TG	CHOL	HDL-C	LDL-C	VLDLP-C
Arctic	Mean	0,95±0,02	5,05±0,05	1,24±0,02	3,40±0,04	0,44±0,01
	Median	0,83	4,95	1,18	3,33	0,39
Central	Mean	0,96±0,02	5,20±0,06	1,34±0,02	3,42±0,05	0,45±0,01
	Median	0,88	5,18	1,32	3,39	0,40
South	Mean	1,07±0,02	5,72±0,06	1,31±0,02	3,61±0,10	0,51±0,01
	Median	0,97	5,62	1,15	3,45	0,44
Significance of differences		P _{1,3} <0,007		P _{1,2} <0,000		P _{1,3} <0,006
		P _{2,3} <0,002		P _{2,3} <0,032		P _{2,3} <0,005

Note: In the Tables 2-3 the significance of the differences is determined by the Mann-Whitney t- criterion.

Table 3

Mean value of markers of atherogenicity by zones of Yakutia

Zone	Статистика	Ca	CHOL/ HDL cholesterol	LDL cholesterol /HDL cholesterol
Arctic	Mean	3,29±0,07	4,28±0,07	2,89±0,06
	Median	3,2	4,19	2,81
Central	Mean	3,09±0,08	4,08±0,07	2,72±0,06
	Median	2,90	3,91	2,56
South	Mean	3,33±0,10	4,30±0,07	2,86±0,08
	Median	3,0	4,02	2,66
Significance of differences		P _{1,2} <0,019 P _{1,3} <0,050	P _{1,2} <0,020	P _{1,2} <0,022

Table 4

Frequency of occurrence of dyslipidemia by nationality and zones of Yakutia, %

Zone	National.	Ca		CHOL/ HDL-C		LDL -C /HDL-C	
		<3,0	>3,0	<5	>5	<3,2	>3,2
Arctic	Yakuts N=107	42(39)	65 (61)	76 (71)	31(29)	63(59)	44(41)
	Dolgans N=147	76(52)	71(48)	116(79)	31(21)	98(67)	49(33)
Mean	N=254	118(46,4)	136(53,6)	192(76)	62(24,4)	161(63)	93(37)
	Yakuts N=271	161(59)	111(41)	215(79)	59(22)	196(72)	76(28)
South	Yakuts N=70	34(48,5)	36(51,5)	47(67)	23(33)	44(63)	26(37)
	Evens N=83	57(68)	26(32)	62(74)	21(28)	59(71)	24(29)
Mean	N=153	91(60)	62(40)	109(71)	44(29)	103(67)	50(33)

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