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HYGIENE, SANITATION, EPIDEMIOLOGY AND MEDICAL ECOLOGY

L.D. Olesova, A.P. Chevychelov, P.I. Sobakin, E.D. Okhlopkova, T.E. Popova, S.I. Sofronova, A.N. Romanova

THE STATE OF THE ADAPTIVE POTENTIAL OF THE WORKING POPULATION IN THE ZONE OF INCREASED RADIATION EXPOSURE

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A radiological and medical-biological study of the population of Aldan and Tommot of the Aldan region of South Yakutia, located in the zone of increased natural radiation, was carried out. The annual individual effective exposure dose to the population turned out to be 2 times higher in the city of Aldan (6.22 mSv). The contribution of radon and its decay products in the city of Aldan was 59.5%, in the city of Tommot - 48.3%.

Assessment of the adaptive potential (AP) of the circulatory system of the population showed a high percentage of the occurrence of functional stress of adaptation mechanisms, especially among residents of the city of Aldan (86.5%). The correlation showed a negative role of an increase in the level of triglycerides, urea, the activity of LDH, CK, and a decrease in the activity of alkaline phosphatase on AP. The presence of GBL dysfunction and, especially, fatty hepatosis was also associated with a decrease in AP.

Keywords: radon, radiation, adaptive potential, Yakutia, fatty hepatosis.

Yakut Scientific Center for Complex Medical Problems: **OLESOVA Lyubov Dygynovna** – PhD, leading researcher, supervisor of lab. oles59@mail.ru, https://orcid.org/0000-0002-2381-7895; **OKHLOPKOVA Elena Dmitrievna** – PhD, senior researcher, https://orcid.org/0000-0002-7061-4217; **POPOVA Tatyana Egorovna** – MD, Deputy director; **ROMANOVA Anna Nikolaevna** – MD, Director; SOFRONOVA Sargylana Ivanovna – PhD, chief researcher - supervisor.

Institute of Biological Problems of Cryolithozone SB RAS: **CHEVYCHELOV Alexander Pavlovich** – Doctor of Biological Sciences, chief researcher, https://orcid.org/0000-0002-2668-9745; **SOBAKIN Petr Innokent'evich** – Doctor of Biological Sciences, chief researcher, https://orcid.org/0000-0003-2385-8045

Introduction. Natural sources of ionizing radiation, as a constant physical environmental factor, dominate the collective effective dose, causing the main harm to public health (about 70%), and cause reasonable concern among the population in areas with an unfavorable radioecological situation. In the Republic of Sakha (Yakutia), in the Aldan region, there are 2 uranium-bearing provinces, where the main uranium reserves of the Russian Federation are concentrated. The Elkon uranium ore region with an area of 1,500 km2 is located 50 km east of the administrative center, the city of Aldan, with a population of more than 20,000 people. and 40 km southeast of the city of Tommot with a population of more than 7 thousand people. The federal highway Neryungri -Yakutsk passes through the central part of the district from south to north with a high traffic intensity [2].

According to the Gosatomnadzor of the Far Eastern District of the Russian Federation, in the process of large-scale geological prospecting since 1959, more than 1 million tons of mining and ore mass containing about 2000 tons of uranium have been extracted from the bowels and stored on the day surface in the form of dumps. There were centers of radioactive contamination with high DER values (equivalent dose rate), reaching 1500-2000 μR/h. In 2022, in 40 premises of public buildings in the Aldan district, the values of ERVA (equivalent equilibrium volumetric activity) of radon exceed-

ed sanitary standards. The maximum value of EEVA for 222Rn was 1313±198 Bq/m3.

The proportion of water samples from centralized water supply sources exceeding the intervention level in terms of the content of specific activity of 222Rn was 20.3%. The maximum detected content of 222Rn in the sample was 362.9±40.1 Bq/l. In general, in the surveyed settlements of the Aldan region, the annual individual effective dose to the population varies from 3.02 to 6.92 mSv/year and exceeds the average for the Republic of Sakha (Yakutia) (2.99 mSv/year). In the Russian Federation, the average value of GIEDON is 3.24 mSv/year [4]. A certain contribution to environmental pollution is made by heavy motor traffic on the federal highway. The concentration of lead in the snow cover in places where vehicles are concentrated (gas stations, parking lots) can reach 0.7 g/m2. The ecological situation in the area is 53.5% of the area as satisfactory, 39.6% of the area is tense, and 6.9% of the area is critical [2].

The World Health Organization (WHO) has recognized radon as a human lung carcinogen [25] and is the second leading cause of lung cancer after smoking. Smokers are 25 times more likely to develop cancer than non-smokers. [24]. Data from the official statistics for 2000-2020. show high values of general mortality rates of the population of the Aldan region in comparison with the national indicators (respectively 13.4-14.2 versus 8.6-7.8 per 100 thousand population). The first place is occupied by mortality from diseases of the circulatory system, more than 2 times higher than the data for RS (Y) (741.7 versus 354.0 per 100 thousand population). Mainly from ischemic heart disease (325.9) and cerebrovascular diseases (133.4) [14]. In second place is mortality from neoplasms (in 2019 - 214.0 and in 2020 - 215.5 per 100 thousand of the population), in third - mortality from external causes (in 2019 - 146.9 and in 2020 - 143.3 per 100 thousand population). For 2011-2015 the annual total rate of oncological morbidity of the adult population in the Aldan region of the Republic of Sakha (Yakutia) amounted to 790 diseases per 100,000 people. (for 461 men and 328.2 for women), which is 2 times higher than in the Russian Federation. According to the ranking of the administrative territories of the Republic of Sakha (Yakutia) with a high level of cancer incidence for 2011-2020. Aldan region, with an increase in incidence over 10 years by 31.3%, ranks second [7]. In the structure of the general morbidity of the adult population for 2000-2018. diseases of the respiratory organs, the circulatory system, and the musculoskeletal system were of decisive importance [12].

Thus, the deterioration of the health status of the population in the zone of increased radiation exposure persists. And any shift from health to disease occurs on the basis of a gradual decrease in the body's adaptive reserves [21].

In this regard, complex radioecological and biomedical studies of the population in areas of increased radiation exposure require an assessment of the adaptive potential (AP) and are relevant.

The purpose of this work was to assess the levels of exposure of the working population of the cities of Aldan and Tommot of the Aldan region from natural sources of radiation and to determine the adaptive potential of the circulatory system.

Methods of biomedical research. In the spring season of 2022, researchers and practicing physicians of the Yakut Scientific Center for Complex Medical Problems conducted a survey of the adult and child population of the cities. Aldan and Tommot of the Aldan region with the participation of a therapist, cardiologist, ophthalmologist, neurologist, oncologist, gynecologist, ultrasound doctor, endoscopist and pediatrician. The object of the study were 175 people. adult population working and living in Aldan and Tommot of the Aldan region (Table 1).

The program of the study of the adult population included the following: informed consent of the respondent to conduct research; questionnaire survey to assess the objective state of health; anthropometric examination with measurement of height and body weight with calculation of body mass index, waist and hips; blood donation (according to the protocol of the local bioethical committee of the YSC CMP) from the cubital vein in the morning on an empty stomach after a 12-hour abstinence from food for biochemical and immunological studies. After centrifugation, the serum was stored in a freezer (at -70°C) until analysis.

Blood pressure (BP) was measured twice with an OMRON M2 Basic automatic sphygmomanometer (Japan) in the sitting position with the calculation of mean blood pressure with a maximum permissible measurement error of ±3 mmHg [20]. Arterial hypertension (AH) was defined as BP ≥ 140/90 mm Hg. or taking antihypertensive drugs during the survey period or stopping them less than 2 weeks before the survey [23]

Determination of total cholesterol (TC), high-density lipoprotein cholesterol (HDL cholesterol), triglycerides (TG), glucose, uric acid, urea, creatinine, total protein and albumin, The activity of enzymes of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (AP), creatine kinase (CK), lactate dehydrogenase (LDH) was measured by the enzymatic method on an automatic biochemical analyzer "Labio" using reagents "Analyticon" (Germany). The nosological diagnosis was made by specialists according to the International Classification of Diseases of the 10th revision.

The state of the adaptive reserve of the body was assessed by the method of calculating the adaptive potential (AP) of the circulatory system using its functional indicators and anthropometric data according to the formula of R. M. Baevsky and A. P. Berseneva [1]:

AP \u003d 0.011 (HR) + 0.014 (SBP) + +0.008 (DBP) + 0.014 (V) + 0.009 (BW) - - 0.009 (P) - 0.27,

where AP is the degree of AP, HR is heart rate, SBP is systolic blood pressure, DBP is diastolic blood pressure, B is age, years, BW is body weight, kg, P is height, cm.

According to the results of calculations, the degree of AP was assessed:

1) good adaptation (AP <2 c.u.);

2) satisfactory adaptation (AP = 2.10 units) — sufficient functionality of the circulatory system;

3) functional stress of adaptation mechanisms (AP = 2.11-3.20 units);

4) unsatisfactory adaptation (AP = 3.21-4.30 conventional units) - a decrease in the functionality of the circulatory system with an insufficient, adaptable response to stress;

5) failure of adaptation (AP >4.30 units) — a sharp decrease in the functionality of the circulatory system with the phenomenon of failure of the mechanisms of adaptation of the whole organism.

Methods of radioecological research. Gamma-ray survey of objects was carried out using the SRP-68-01 radiometer according to the method adopted in geology and radiation ecology [8, 13]. The measurement of the dose rate of gamma radiation with a radiometer was carried out both at a height of 1 m from the radiating surface, and near it, within 0.1 m. The DER value was estimated by the arithmetic mean of 3-5 measurements at each survey point. As a result of dosimetric gamma survey, sites were selected for sampling the fine earth of dumps, soils, water and plants.

To determine the content of natural radionuclides (uranium, radium, thorium and potassium) in the prepared sample

samples, nuclear-physical (X-ray spectral, gamma-ray spectrometric), radiochemical (emanation) and physicochemical (laser-luminescent) methods were used, which are widely used in geology and radioecology [16, 17].

As the main spectrometric instrumentation, a GAMMA-01 multichannel analyzer (SPC Aspect, Russia) with a sodium-iodine scintillation detector measuring 150x100 mm, as well as a RKG-AT1320 spectrometric type gamma radiometer was used. A high-performance device ARF-6M was used for X-ray spectral analysis.

Determination of the uranium content in water was carried out by the laser-luminescent method using an AUF-101-"Angara" fluorometer. The emanation method for determining the content of radium includes the decomposition of samples (0.5-5 g) by fusing them with a mixture of caustic soda and soda, and then the isolation of radium from the hydrochloric acid solution by co-precipitation of BaSO4, the subsequent dissolution of the precipitate with 0.6 N hydrochloric acid and the measurement of the radium emanation activity -radon on the Alfa-1M device.

Radonometry was carried out by measuring the volumetric activity of radon (RAR) and the radon flux density (RFR) from the soil surface using radiometers of the RRA-01M-01, Alfarad plus AV and Alfarad plus RP types, as well as the POU-04 sampling device according to the method [13] . Calculation of the radon SPD based on the measurement results was carried out according to the formula: SPD (mBq/s-m2) = (Q - Qf) · (V2+V3)/ T S2, where: Q is the measured RAR (Bq/m3); Qf is the background RSA (Bq/m3); V2 is the volume of the PPA measuring chamber, V2 = 1.60 l; V3 is the free volume of the storage chamber-2 and connecting tubes, V3 = 0.093 l; T is the operating time of the FOU blower, T = 300 s; S2 is the area of radon collection by the accumulation chamber-2, S2 = 0.0016 m2. The repeatability of PPR measurements is 5-fold, while the error in determining RVA and PPR was maximum 30-40%.

The normality of the distribution of features was tested using the Shapiro-Wilk test. Due to the partial asymmetry of the distribution series, nonparametric statistics methods were used. The data for the samples are presented as medians (Me) with a percentile interval (25%; 75%). To assess differences between groups, the Mann-Whitney U-test was used. The level of statistical significance for group comparison was taken at $p<0.05$. The relationship of indicators was assessed using the Spearman correlation coefficient.

Results and discussion. Annual individual effective dose of public exposure from natural sources in the Aldan region of the Republic of Sakha (Yakutia). The effective dose is a value that is used as a measure of the risk of long-term consequences of exposure to both the entire human body and its individual organs and tissues, taking into account their radiosensitivity.

The values of the individual annual effective dose of external exposure of adult residents of the Aldan region were determined from the results of measurements of the dose rate of gamma radiation in residential and public buildings and in open areas within the territories of settlements based on the standard model of the time spent by the population indoors and outdoors - 80 and 20%, respectively. The dose of internal exposure of adults from long-lived natural radionuclides in drinking water and food is calculated taking into account the annual per capita consumption of the relevant food (milk, bread, meat, potatoes, vegetables and fish) in the Republic of Sakha (Yakutia). [5]. At the same time, the content of radionuclides in food products and drinking water, presented in the methodological recommendations [18], was used in the calculations, and the standard annual consumption of drinking water (730 l/ year) was also used. When assessing individual effective doses of public exposure due to radon and its daughter decay products, the value of the dose coefficient is assumed to be 0.028 mSv/year/Bq/m3 radon EA or 9 mSv/h/Bq/m3 radon EEVA, which complies with the UNSCEAR recommendations [9]. The annual individual effective exposure dose to the population from natural sources of radiation in the Aldan region varies from 3.02 to 6.92

Table 1

Sex and age composition of the surveyed population

gender	Aldan	Tommot	Total
Men	44 (33; 52) n=59	62 (41; 64) n=7	45 (34.50; 53) n=66
Women	39 (32; 45) n=58	48 (37; 59) n=51	42 (36; 51.50) n=109
Total	41.35 (33.25; 49) n=107	48.84 (37.75; 60.25) n=66	44 (35; 52) n=175

Table 2

Annual individual effective dose of exposure of the population from natural sources in the Aldan region of the Republic of Sakha (Yakutia)

Type of exposure	Effective dose, mSv/year	%
Aldan		
cosmic radiation	0.40	6.4
External gamma radiation from natural radionuclides	1.80	28.9
Radon and its decay products indoors	3.70	59.5
^{40}K in the body	0.17	2.7
Radionuclides: in food	0.14	2.3
in water	0.01	0.2
Сумма	**6.22**	100
Tommot		
cosmic radiation	0.40	11.4
External gamma radiation from natural radionuclides	1.10	31.2
Radon and its decay products indoors	1.70	48.3
^{40}K in the body	0.17	4.8
Radionuclides: in food	0.14	4.0
in water	0.01	0.3
Сумма	**3.52**	100

mSv/year. Its value in the city of Aldan is almost 2 times higher than in the city of Tommot, while the contribution of radon and its decay products was 59.5% in the city of Aldan, and 48.3% in the city of Tommot (Table 2).

Exposure of the population due to natural sources of ionizing radiation (SIR) includes external and internal exposure. The share of internal exposure due to short-lived daughter products of radon isotopes contained in indoor air accounts for more than 70% [6]. A certain contribution to the dose of internal exposure of the population is made by the oral intake of natural radionuclides with drinking water and food. The dose of internal exposure due to the intake of ^{40}K with water and food is almost the same for all people. Due to the intake of radionuclides of the uranium and thorium radioactive series, it is proportional to the annual intake of radionuclides with drinking water and food.

External exposure of the population is formed mainly due to gamma radiation of natural radionuclides contained in the external environment, as well as cosmic photon and corpuscular radiation. The variability of the levels of public exposure to natural radiation sources depends on the values of internal exposure to radon isotopes and the intake of radionuclides of the uranium and thorium radioactive series with drinking water and food, as well as external gamma radiation. In addition, technogenic radionuclides of global fallout as a result of nuclear weapons testing, as well as technogenic radionuclides introduced into the environment and concentrations of natural radionuclides as a result of various human activities, are practically an integral part of the natural radiation background, which leads to increased levels of both internal and external exposure population. Currently, exposure from natural background radiation continues to be the main source of human exposure in the modern world.

The contribution of natural sources in 2021 was 78.5%. The average annual effective dose in the Republic of Sakha (Yakutia) is 4.80 mSv per year, in the Russian Federation - 3.20 mSv per year [12].

The initial data for calculating individual annual effective doses of exposure to the population due to natural sources of ionizing radiation should include:

- data on the average annual values of the equivalent equilibrium volume activity (EEVA) of radon isotopes in the air of residential and public buildings, as well as in the atmospheric air on the territory of a settlement (district, etc.);

- data on the average values of the dose rate of gamma radiation in residential and public buildings, as well as on the territory of a settlement (district, etc.);

- information on the content of natural radionuclides in the water of sources of drinking water supply for the population:

- data on the main components of the diet of the population, the annual consumption of food products and the values of the specific activity of natural radionuclides in them;

- data on the average annual content of dust (aerosols) in the surface layer of atmospheric air and the specific activity of long-lived natural radionuclides in dust. The average value of the individual annual effective dose of exposure of adult residents of a settlement (district, etc.) from all natural sources of ionizing radiation is determined by the sum of all components:

$$Epr.=0.57+Eext.+1.05Eext.Rn+$$
$$+Eext\ pp.+Eext.pv.+Eext.ing.,$$

where Eext is the dose of external gamma radiation; internal exposure dose: due to Evn.Rn - short-lived decay products of radon isotopes, Evn.pl - due to radionuclides in food, Evn.dv - due to radionuclides in drinking water; Evn.ing. due to inhalation of dust. The term 0.57 in the above formula takes into account the contribution of the ionizing component of cosmic radiation (0.40 mSv) and internal exposure due to 40K [18] to the effective doses of public exposure.Assessment of adaptive potential.

Nonparametric correlation analysis showed a close association of AP with age (0.624; p=0.000) and place of residence (0.355; p=0.000).

In table. 3 shows a significant association of the state of AP with the place of residence. Good (1) and satisfactory adaptation (grade 2) are extremely rare, only 3 Aldans (1.70%). Basically, the surveyed are in a state of functional tension of adaptation mechanisms (grade 3) - 133 people (81.6%) and more often in Aldan.

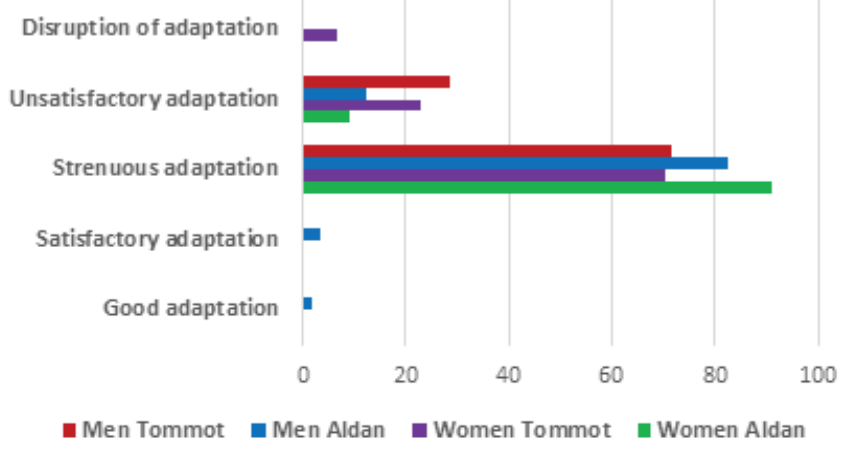
Unsatisfactory adaptation - a decrease in the functionality of the circulatory system with an insufficient, adaptive response to stress is quite common: in 24 people. (13.3%). In percentage terms, the 4th degree of AP is 2 times more common among residents of the city of Tommot. 5th degree of AP - failure of adaptation, i.e. a sharp decrease in the functional capabilities of the circulatory system with phenomena of violation of the mechanisms of adaptation of the whole organism was also detected in 3 tommots (5.7%).

Depending on gender and place of residence, the functional tension of adaptation mechanisms (3rd stage) is more common in men and women in Aldan (figure).

Table 3

The degree of AP among residents of Aldan and Tommot, abs. number/%

Groups	Degree of adaptive potential					Pearson's chi-square	df	p
	1	2	3	4	5			
Aldan	1/0.9	2/1.8	95/**86.5**	12/10.8	-	12723	4	0.013
Tommot	-	-	37/71.2	12/23.1	3/5.7			
Total:	1/0.6	2/1.2	133/81.6	24/14.7	3/1.8			



The state of AP in men and women in Aldan and Tommot, %

Unsatisfactory adaptation (the 4th degree of AP) is higher among residents of Tommot, in addition, adaptation failure was detected in 3 visiting women 36; 60 and 75 years old, also living in Tommot.

According to Table. 4, the average AP in women is worse than in men (p<0.048), while in Tommot, AP is slightly lower in men, and in Aldan, in women.

With age, there is a significant deterioration in AP. Comparison of groups of Aldans under 45 and after 45 showed a decrease in AP by 12.3%, and among Tommots by 20.3%. Comparison of age-standardized groups of Aldans and Tommots under 45 revealed a higher AP value by 3.48% of Tommots, and in groups after 45 years, the difference in AP of Tommots was 10.96%.

Comparison of standardized groups by age and northern experience showed that the AP of the newcomer population of Tommot over 45 years of age and with northern experience of more than 20 years turned out to be worse by 16% than that of the Aldans. In the group born in the area and aged over 45 years, AP was worse by 4% among Tommots.

AP had a close positive correlation with CVS pathology (0.557**; p=0.000) and fatty hepatosis (r=0.478**, p=0.000), which indicates a negative impact of a decrease in the adaptive reserves of the body on the functional state of the cardiovascular and hepatobiliary systems. This is evidenced by the fact that the presence of CVS pathologies was accompanied by a significant tension in the AP, especially pronounced in the residents of the city of Tommot (p=0.001). Нарушение функции печени и желчевыводящих путей у обследованного населения встречается довольно часто (43,9%), из них 18,9% обусловлено жировым гепатозом. В процентном отношении ожирение печени чаще встречается у жителей Томмота.

Non-alcoholic fatty liver disease (NAFLD) is an increasingly common disease, affecting more than 25% of the adult population worldwide, and varies by race and ethnicity [22]. In the Republic of Sakha (Yakutia), the incidence of NAFLD in the Yakut population is 50-60%, among Russians – 20% [10].

The main factors in the development of fatty hepatosis are an unhealthy lifestyle (high-calorie diet combined with insufficient physical activity, diabetes mellitus, thyroid disease, CCC and gallbladder diseases), exposure to the body of chemically active compounds: organic solvents, organophosphate poisons, metal compounds and natural toxins.

Alcoholic fatty liver disease (AFH) is the second most common and relevant liver disease after viral hepatitis.

Of the 17 Aldans with fatty hepatosis, only 4 people admitted to drinking alcohol once a week (23.5%), and among the residents of the city of Tommot - 2 people. (13.3%). Perhaps these data are erroneous due to untruthful answers of the respondents. Nevertheless, the frequency of fatty hepatosis is higher in percentage terms among residents of the city of Tommot than among Aldans (Table 5).

The table 6 shows the association of GBS pathology with CVS pathology (p=0.033) and especially closely with fatty hepatosis (p=0.011).

Statistical analysis of the odds ratio showed that the frequency of fatty

Table 4

Average values of adaptive potential depending on gender, age, place of residence, northern experience and pathologies of CVS and fatty hepatosis

(M±m)			p
All n=163	Men n=64	Women n=99	
2.81±0.03	2.72 ±0.05	2.87±0.04	0.048
Me(Q1;Q3)			
2.73 (2.46; 3.13)	2.65 (2.36; 3.01)	2.79 (2.52; 3.14)	0.054
AP by age			
Age	Aldan	Tommot	
Up to 45 years old	2.52 (2.33; 2.74 n=64	2.61(2.45;2.91) n=20	0.021
over 45 years	2.83 (2.56; 3.14) n=48	3.14(2.89; 3.42) n=31	0.000
	p=0.000	p=0.000	
AP depending on the place of residence			
Location	Aldan	Tommot	
All	2.65 (2.40; 2.92) n=107	2.99 (2.63; 3.34) n=51	0.000
Men	2.60(2.33; 2.93) n=57	3.13 (2.99; 3.77) n=7	0.007
Women	2.66 (2.45; 2.90) n=55	2.91 (2.63; 3.33) n=44	0.001
AP among visitors and local population			
Groups	Aldan	Tommot	
Northern experience >20 years, age over 45 years	n=16 2.87 (2.64; 3.17)	n=17 3.16 (2.93; 3.41)	0.072
born, Age over 45 years	n=14 2.83 (2.48; 3.25)	n=10 2.96(2.82; 3.24)	0.380
AP in patients with CVD pathology			
Groups	Healthy	Sick	
All	2,46 (2,31; 2,64) n=59	2,92 (2,65; 3,23) n=104	0,000
Aldan	2,43 (2,29; 2,64) n=47	2,82(2,52; 3,14) n=65	0,009
Tommot	2,54 (2,42; 2,79) n=12	3,13 (2,88; 3,42) n=39	0,000
p	0,088	0,001	
AP in patients with fatty hepatosis			
Groups	Здоровые	Больные	
All	2.45(2.32; 2.62) n=21	2.85(2.54; 3.16) n=31	0.000
Aldan	n=15 2.43(2.18; 2.64)	n=18 2.76(2.39; 3.16)	0.021
Tommot	n=6 2.51(2.40; 2.68)	n=13 2.89(2.69; 3.18)	0.009
p	0.276	0.150	

Table 5

The frequency of fatty hepatosis among the surveyed population, abs.h. /%

	Aldan		Tommot	
	Abs. num.	%	Abs. num.	%
Total	n=112	100	n=58	100
Hepatosis	17	15.1	15	25.8
Hepatosis drinkers once a week	4	23.5	2	13.3

Table 6

Association of CVS and GBS pathologies

Cardiovascular pathology	GBS pathology				X^2	df	p	OR (95% confidence interval)	p
	No		Yes						
	Abs. num.	%	Abs. num.	%					
No	42	43.8	22	28.7	4.527	1	0.033	1.98 (1.041-3.744)	0.036
Yes	54	56.3	56	71.8					
Fatty hepatosis									
No	21	84.0	6	18.2	6.463	1	0.011	3.10 (1.207-8.000)	0.019
Yes	84	59.2	27	81.8					

hepatosis is 4.5 times more common in people with cardiovascular pathology than in people without such a pathology (table 6).

Fatty hepatosis is one of the factors in the development of atherosclerosis: in persons with cardiovascular diseases, fatty hepatosis occurs 3.10 times more often. The complication of NAFLD is a risk factor for atherosclerotic cardiovascular disease, which is the leading cause of death in patients with NAFLD. According to a scientific statement from the American Heart Association, NAFLD and NASH are becoming increasingly common conditions that are underdiagnosed and underestimated as risk factors for morbidity and mortality from CVD [22].

A direct correlation was found between AP and the level of TG (0.249; p=0.001), the activity of LDH enzymes (0.258; p=0.001), CK (0.162; p=0.039), and urea (0.298; p=0.000), which indicates a negative role in reducing the adaptive reserves of the body of hypertriglyceridemia, metabolic disorders of carbohydrates and proteins. A negative relationship was found with ALP activity (-0.231; p=0.003). A decrease in ALP activity was registered among residents of the city of Tommot. This fact does not agree with the fact that one of the factors for reducing the activity of alkaline phosphatase is radiation, since the largest annual individual effective dose was recorded in the city of Aldan (6.22 μSv), and the smallest - in the city of Tommot (3.52 μSv).

Thus, a comparative calculation of the annual individual effective dose of exposure of the population of the city of Aldan and the city of Tommot of the Aldan region showed a higher value of annual individual effective dose to the population in the city of Aldan. The adaptive potential of the inhabitants of the Aldan region is mainly in a state of functional tension of the mechanisms of adaptation, more often among the inhabitants of the city of Aldan. However, a further decrease in AP is more common among residents of the city of Tommot. The decrease in AP is directly related to an increase in the level of triglycerides, urea, the activity of energy metabolism enzymes LDH, CK, with a decrease in the activity of alkaline phosphatase, which indicates the negative role of dyslipidemia, impaired carbohydrate and protein metabolism in reducing the adaptive potential of the circulatory system. In addition, a decrease in AP was associated with dysfunction of the hepatobiliary system, especially with fatty hepatosis. Fatty hepatosis, detected three times more often in those examined with pathology of the cardiovascular system, is a negative risk factor for reducing AP and the associated risk of developing atherosclerotic cardiovascular diseases.

Conclusion: The high frequency of functional stress of the mechanisms of adaptation of the population of the city of Aldan in conditions of increased natural radiation, and especially poor adaptation, failure of adaptation, frequent occurrence of fatty hepatosis among the inhabitants of the city of Tommot, undoubtedly require the study of the complex impact of negative factors.

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L.G. Marinova, S.V. Markova, N.M. Zakharova,
V.B. Egorova, E.S. Nikolaeva

PHYSICAL DEVELOPMENT OF PRESCHOOL CHILDREN IN MUNICIPAL DISTRICTS OF THE REPUBLIC OF SAKHA (YAKUTIA)

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The relevance of studying the state of children's health is closely related to the issues of their physical development, which is one of its main indicators. Our article presents data from the analysis of the anthropometric indicators of preschool children living in the regions of the Republic of Sakha (Yakutia). The study was conducted in 17 municipal districts representing 5 socio-economic zones of the republic: arctic, eastern, western, central, southern. A total of 643 pupils of preschool educational institutions aged 3 to 6 years were examined. The study group on physical development consisted of children with an actual age of 3 years in the amount of 208 people and children of 6 years old in the amount of 127 people.

Keywords: body weight, height, body mass index (BMI), physical development, anthropometry, head circumference, subcutaneous fat, obesity, tall stature, short stature.

MARINOVA Lyudmila Germanovna – PhD, Associate Professor of the Department of Propaedeutics of Children's Diseases of the M.K. Ammosov NEFU Medical Institute, marinovalg@mail.ru; **MARKOVA Sardana Valerievna** – PhD, Head of the Department of Propaedeutics of Children's Diseases, M.K. Ammosov NEFU Medical Institute, saramark@mail.ru; **ZAKHAROVA Nadezhda Mikhailovna** – PhD, Associate Professor of the Department of Propaedeutics of Children's Diseases of the MI NEFUB nadezdamix15@mail.ru; **EGOROVA Vera Borisovna** – PhD, Associate Professor of the Department of Pediatrics and Pediatric Surgery, M.K. Ammosov NEFU Medical Institute, veraborisovna@yandex.ru; **NIKOLAEVA Elena Stanislavovna** – Resident of the Department of Pediatrics and Pediatric Surgery, NEFU Medical Institute.

Introduction. The physical development of children is one of the main indicators reflecting the health of the younger generation and the nation as a whole. According to the definition of the Union of Pediatricians of Russia, physical development is understood as a dynamic process of growth (increase in body weight and length, development of organs and body systems) and biological maturation of a child. Healthy growth and development means that children are supported to thrive in areas including physical, cognitive, language and emotional areas that play an important role in children's lives from birth to adulthood [4, 6]. Monitoring height and weight helps to correctly diagnose diseases and implement therapeutic and preventive measures.

Not only genetic predisposition, but