trast in terms of the incidence of cancer of the urinary system. It can be assumed that the territorial variability in the number of patients with cancer of the organs of the urinary system of organs may well be a reflection of the correlation of the incidence rate, both exogenous and endogenous "risk factors".

Reference

1. Davydov M.I., Petrovskiy A.V. Onkologiya. Klinicheskie rekomendacii [Oncology. Clinical guidelines. Moscow, 2018; 976 p. (In Russ.).]
2. Ivanov P.M., Abramov A.F., Afanasieva L.N. Gidrosfera i zlokachestvennye novoobrazovaniya v YAkutii. [Hydrosphere and malignant neoplasms in Yakutia. Yakutsk: Offset, 2020. 212 p. (In Russ.).]
3. Chissov V.I. Starinsky V.V., Petrov G.V. Zlokachestvennye novoobrazovaniya v Rossii v 2010 g. (Zabolevaemost' i smertnost') [Malignant neoplasms in Russia in 2010 (morbidity and mortality): Moscow: 2012; 260 p. (In Russ.).]
4. Chissov V.I., Starinsky V.V., Petrova G.V. Zlokachestvennye novoobrazovaniya v Rossii v 2006 godu (zabolevaemost', smertnost') [Malignant neoplasms in Russia in 2006 (morbidity, mortality): Moscow: 2007. - 252 p. (In Russ.)].
5. Bray F., Ferlay J., Soerjomataram I., Siegel R.L., Torre L.A., Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J. Clin. 2018;68: 394–424. doi: 10.3322/caac.21492.;
6. Drinking water source and chlorination by-products. II. Risk of colon and rectal cancers / M E Hildesheim M, Cantor K, Lynch C [et.al] // Epidemiology. 1998; 9(1) :29-35.
7. Global Cancer Observatory: Cancer Today. International Agency for Research on Cancer / Ferlay J., Ervik M., Lam F.[et al.]. Lyon, France: 2018. [(accessed on 10 January 2020)].
8. Ingested nitrate and nitrite and bladder cancer in Northern New England / Barry K, Jones R, Cantor K [et al.] Epidemiology. 2020 Jan; 31(1): 136–144.
9. Mushtaq J., Thurairaja R., Nair R. Bladder Cancer. Surgery. 2019; 37:529–537. doi: 10.1016/j.mpsur.2019.07.003.
10. Water disinfection by-products and bladder cancer: is there a European specificity? A pooled and meta-analysis of European case-control studies / Costet N., Villanueva C., Jaakkola J. [et al.]. Occup Environ Med. 2011; 68(5):379-85. doi: 10.1136/oem.2010.062703.
11. Yaxley J.P. Urinary tract cancers: An overview for general practice / J Family Med Prim Care. 2016 Jul-Sep; 5(3): 533–538. doi: 10.4103/2249-4863.197258.

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BIOCHEMICAL PARAMETERS OF THE BLOOD OF THE POPULATION IN THE ZONE OF INCREASED NATURAL RADIOACTIVITY

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An analysis of the main biochemical parameters of the population living in the territory with unfavorable natural radioactivity of 222Rn revealed changes in the biochemical spectrum of blood serum in the population of the Aldan region, indicating the presence of signs of disadaptation. Lipid profile changes are associated with gender and smoking. The shift of lipid metabolism towards atherogenicity is more pronounced in men due to an increase in the atherogenic fractions of lipids in the blood that are susceptible to peroxidation and a decrease in the level of the antiatherogenic fraction of lipids. The shift of metabolic flows towards catabolism, activation of glycolysis, dyslipidemia indicate the tension of carbohydrate and lipid metabolism, which is a sign of disadaptation of the body and the risk of developing environmentally conditioned diseases, including neoplasms.

Keywords: radon, metabolism, lipids, carbohydrates, disadaptation.

Introduction. One of the environmental risks for human health is the radiation hazard caused by the anomalous content of radioactive elements in nature. On the territory of the Republic of Sakha (Yakutia), the population of the Aldan region is exposed to a similar risk, where there is an increased natural radioactivity of the rocks of the Aldan shield and the close location of the Elkon uranium ore region, in which the main reserves of uranium in Russia are concentrated. From rock dumps, the decay product of uranium isotope radium radon (222Rn) enters water, soil and air. In the sources of drinking water supply and in the air of the premises of Aldan and Tommot, as well as nearby villages, its high content is often noted [1, 3].

Radon is considered a carcinogenic agent and is an element of risk to human health [12]. An indicator of negative environmental impacts on the body is the level of the state of health of the population with such the most objective indicator as mortality. The general death rates of the population of the Aldan region are high compared to the nationwide indicators (respectively 13.4-14.2 versus 8.6-7.8 per 100 thousand population). Mortality from diseases of the circulatory system occupies a leading place and exceeds more than 2 times the data for RS (Y) (741.7 versus 354.0 per 100 thousand population). The second place is occupied by mortality from neoplasms (in 2019 - 214.0 and in 2020 - 215.5 per 100 thousand population), the third - mortality from external causes (in 2019 - 146.9 and in 2020 . - 143.3 per 100 thousand population). In the structure of the general morbidity of adults for 2000-2018. diseases of the respiratory organs, the circulatory system, and the musculoskeletal system are of decisive importance [2].

Thus, in the conditions of unfavorable natural radioactivity in the Aldan region, the state of health of the population is characterized by a steady downward trend. And any shift from health to disease occurs on the basis of a gradual decrease in the adaptive reserves of the body associated with a violation of homeostasis, and the constancy of the internal environment of the body is achieved by biochemical adaptation, which allows maintaining the physiologically normal state of the body [6]. In this regard, the determination of biochemical parameters of blood serum is necessary not only to identify pathological processes occurring in the body, but also to assess the signs of disadaptation.

Target. Assessment of biochemical parameters of the adult population living

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in the territory under the influence of natural sources of radiation to identify signs of disadaptation of the body.

Material and research methods. In the spring of 2022, a comprehensive medical and biological examination of 175 adults in the city of Aldan and the city of Tommot, Aldan district, was carried out, there were 66 men (37.7%), women - 109 (62.3%). The mean age was 44.0 (35.0; 52.0) ME, for men 45.0 (35.0; 53.0), for women 42.0(36.0; 51.0). The study was carried out as part of the research work of the YSC KMP "Regional features of biochemical, immunological and morphological parameters in the indigenous and alien population of the Republic of Sakha (Yakutia) in normal and pathological conditions" (FGWU-2022-0014) and the research work of the Academy of Sciences of the Republic of Sakha (Yakutia) "Evaluation of exposure levels of the population of the Aldan region due to natural sources of exposure and recommendations for the implementation of protective measures to reduce them». The study was conducted with the informed consent of the subjects and was approved by the decision of the Local Ethics Committee at the FSBSI "YSC CMP".

The material of the study was venous blood serum. Blood sampling was carried out from the cubital vein in the morning from 8 to 10 am on an empty stomach after a 12-hour abstinence from food. To assess the state of lipid metabolism, total cholesterol (TC), high-density lipoprotein cholesterol (HDLC), triglycerides (TG) were determined by the enzymatic method on an automatic biochemical analyzer "Labio" using reagents "Analyticon" (Germany). LDL-C and VLDLC were calculated using the formula of Friedewald et al. (1972). Atherogenic coefficients (AC) were calculated according to the formula proposed by A.N. Klimov: AC=(TC - HDLC)/HDLC (Klimov, Nikulcheva, 1999). Enzyme activities were determined: alanine aminotransferase (ALT), aspartate aminotransferase (AST), glutamyl transpeptidase (GGT), alkaline phosphatase (ALP), creatine kinase (CK), lactate dehydrogenase (LDH), blood serum levels of glucose, uric acid, urea, creatinine, total protein and albumin.

To determine the frequency of lipid metabolism disorders, the Russian recommendations of the VII revision of the Russian Society of Cardiology in 2020, compiled taking into account the European recommendations of 2019, were used. The level of total cholesterol ≥5.0 mmol / l (190 mg/dl) was taken for hypercholesterolemia (HCH) taking into account the risk cardiovascular death on the SCORE scale, elevated LDL-C >3.0 mmol/l (115 mg/dl) at low, >2.6 mmol/l at moderate, >1.8 mmol/l at high, >1 .4 mmol/l at very high and extreme risk, reduced HDLC - HDLC ≤1.0 mmol/l (40 mg/dl) in men and 1.2 mmol/l (46 mg/dl) in women . Hypertriglyceridemia (HTG) was defined as a TG level of >1.7 mmol/l (150 mg/dl). Fasting hyperglycemia was established at a glucose level of >5.6 mmol/l. Participants receiving specific medical treatment for these conditions were also classified as having these disorders.

Statistical data processing was carried out using the IBM SPSS Statistics 23 application software package. Standard methods of variation statistics were used: calculation of average values (M), mean error (m). The normality of the distribution was verified by the Kolmogorov-Smirnov method. In the case of a normal distribution of quantitative indicators, the Student's t-test was used to evaluate statistical hypotheses, and in the case of a deviation from the normal distribution, the Mann-Whitney U-test was used. Evaluation of relationships between variables was carried out using a paired correlation method using Pearson's criteria (for metric variables) and Spearman's (for variables measured in a rank scale), where r - is the correlation coefficient, p -is the significance of the result.

Results and discussion. The average values of all biochemical blood parameters of the examined sample did not go beyond normal values, except for a slight excess of total cholesterol (TCH) and triglycerides (TG). Gender comparison showed that ALT and ALP enzymes are significantly active in men, and the state of lipid metabolism turned out to be worse, as evidenced by the increased value of the atherogenic coefficient (AC) (p=0.017), which reflects the degree of risk of developing atherosclerosis and related heart diseases and vessels. The imbalance of the lipid profile in men is caused by a significantly high level of total cholesterol, a relatively low level of the anti-atherogenic lipid fraction (HDLC) (p=0.000) and a relatively high level of the atherogenic lipid fraction (LDLC) (p=0.000). In women, despite the high level of TG, AC was within the normal range due to a compensatory increase in HDLC cholesterol levels. The content of creatinine, uric acid and albumin within the normal range was significantly higher in men, and the content of urea in women (p<0.05) (Table 1).

The correlation analysis was carried out between the activity of enzymes (ALT, AST, GGT) involved in glucose homeostasis showed a close direct correlation at a level above r=0.600 (p=0.000). The activity of LDH (r=0.366; p=0.000), GGT (r=0.211; p=0.006) and CK (r=0.295; p=0.000) positively correlated with the glucose level. In addition, glucose concentration was associated with total protein (r=0.456; p=0.000), albumin (r=0.389; p=0.000), urea (r=0.224; p≤0.004), uric acid (r=0.242 p≤0.001).

Direct correlations of enzyme activity with the content of total cholesterol were obtained: ALT (r=0.261; p=0.001), AST (r=0.341; p=0.000), GGT (r=0.314; p=0.000), ALP (r=0.324; p =0.000).

The close correlations between enzymes and substrates are explained by the fact that the constancy of six biochemical blood parameters (total protein and albumin, glucose and cholesterol, urea and creatinine) is ensured by a numerous system of enzymes. The main enzymes involved in the main transamination flows are AST and ALT, where AST ensures the entry of substrates into the tricarboxylic acid cycle, i.e. supports adequate bioenergetics and thermogenesis, and ALT ensures the operation of the glucose-alanine shunt to maintain a constant blood glucose level. GGT, ALP, LDH and CK are also involved in the same metabolic pathways and are also the main enzymes that maintain homeostasis. All enzymes are involved in the processes of adaptation to new environmental conditions, loads, etc. The conditional general marker of metabolism is the de Ritis coefficient (AST/ALT), where AST shows the level of catabolism, ALT - the level of anabolism, while metabolic equilibrium is achieved at a value equal to 1.5, and fluctuations from 1.2 to 1.6 are taken as adaptive range [4, 5]. In clinical biochemistry, the de Ritis coefficient is used in the case of high enzyme activity to diagnose cardiac (>1.5) or hepatic (<1.5) pathology.

According to our data, the average value of the ratio of AST to ALT within the reference values was 2.18, which indicates an adaptive metabolic shift towards the predominance of the catabolic orientation of metabolic flows and is especially brighter in women (p=0.022).

Despite the average value of biochemical parameters within the normal range, significant differences were found in the frequency of a decrease or increase in certain indicators associated with gender (Table 2).

The frequency of lipid spectrum disorders. The level of total cholesterol (TCH) was high in 54.5% of men and 37% of women. A high value of triglycerides (TG) was found in 42.4% of men and 37.7% of women. Fluctuations in the levels of TCH and TG did not have

a significant association with gender, but violations of TCH are much more often recorded in men, which is confirmed by a significant high average value of total cholesterol (5.65±0.23 mmol/l).

Changes in the content of HDLC, LDLC and VLDLC are significantly associated with gender, which also indicates the dependence of changes in the atherogenic coefficient (AC) on these indicators. HDLC levels were mostly normal or high. Its value within the reference values was 14.5% more common in men, and an elevated level slightly above the upper limit of normal (>2.2 mmol/l) was 2 times more common in women (p=0.000). Among the surveyed, low HDLC was extremely rare - in two men. The content of LDLC in normal values was found in 80.4% of women and 56.1% of men, therefore, an increased level of this atherogenic lipid fraction is more than 2 times more common in men (p=0.001).

The value of AC within the normal range was significantly more common in women (94.4%), in men this figure was 21.7% lower. Accordingly, a high AC value was more often found in men (p=0.000).

Comparison of the average values of biochemical parameters in smokers and non-smokers showed significant differences in the content of lipid profile indicators. In smokers, the level of HDLC is significantly lower, and LDLC and AC are significantly higher. The imbalance of the lipid profile is especially pronounced in smoking men, as evidenced by the AC of smoking men, equal to 4.72, and this is 2 times higher than in non-smoking men (Fig. 1). Correlation analysis also showed a negative relationship of smoking with HDLC (r=-0.233; p=0.003), a direct relationship with LDLC (r=0.156; p=0.047), VLDLC (r=0.164; p=0.038) and AC (r=0.257; p=0.001) (Fig.1).

The frequency of violations of enzyme activity. The average activity of enzymes transaminases ALT, AST, as well as alkaline phosphatase, LDH and CC were within the reference values (table 1). Depending on gender, there was a significant difference in the activity of ALT and ALP within the normal range: in men, the activity of these enzymes was higher (Table 1).

Violations of the activity of enzymes ALT, AST, ALP occurred in isolated cases. Decreased or increased activity of LDH was significantly more common in women (23.6%) (p = 0.000). LDH is an enzyme involved in the final reaction of glycolysis under anaerobic conditions (the conversion of pyrubate to lactate). LDH maintains acid-base balance, and is stable, providing a constant pH level. If we take as the norm the reference indicator of LDH equal to 250 IU/l, then 78% of the population of the Aldan region has an increased activity of this enzyme. Moderately high LDH activity and elevated glucose levels indicate an intensification of anaerobic glycolysis. Glycolysis is a central metabolic pathway, and intermediates are the branching point of other pathways, including amino acid and fat synthesis pathways. The rate of glycolysis in tumor cells is 200 times higher than in normal cells; The source of energy for a rapidly growing tumor in a state of hypoxia is glucose. This phenomenon was described by Otto Warburger (1930) and called the Warburger effect, according to which the primary cause of cancer is dysfunction of mitochondrial metabolism [8]. While the dependence of cancer cells on glycolysis for energy production is well understood, the role of adipocytes and lipid metabolism reprogramming in the energy support of cancer growth is still being studied. Changes in lipid metabolism lead to changes in membrane composition, protein distribution and function, gene expression and cellular functions, and cause the development and progression of many diseases such as inflammation, hypertension, diabetes, liver disease, heart disease, kidney disease, neurological disorders, cystic fibrosis and cancer [10, 14, 15].

In science, correlations of radon with the incidence of lung cancer are known, especially in smokers [11, 13] and, possibly, kidney cancer, melanoma, hematological cancer and primary brain tumors are associated with long-term exposure to high doses of radon [9, 14]. In terms of the severity of the increase in oncological morbidity rates, the Aldan region is in second place (1.50%) after the Ust-Maisky region (1.79%) [2]. In terms of the prevalence of malignant neoplasms among the population of the Aldan region, the first place is occupied by neoplasms of the digestive system (25.9%), then the respiratory system (13.0%) and then the urinary system (6.3%).

The increase in GGT activity did not depend on gender; in both groups, the percentage of excess enzyme activity was 30% each. The Mann-Whitney test revealed a direct relationship between GGT activity and smoking (p=0.043). The average GGT activity in smokers (n=53) was 44.89±4.75U/l, in non-smokers -

Table 1

Indicators of biochemical parameters of blood in residents of the Aldan region

Indicator	Reference	Mean value (M±m)			P
		Total n=173	Men n=66	Women n=107	
Enzymes					
ALT <30 U/l	<30 U/l	15.62±0.66	17.39±0.85	14.53±0.92	0.024
AST	<40 U/l	30.56±1.05	32.62±1.61	29.29±1.38	0.120
AST/ALT	1,2-1,6	2.18±0.05	2.01±0.07	2.28±0.07	0.022
ALP	<258U/l	145.02±4.17	163.21±6.20	133.80±5.29	0.000
GGT <32, m	w.<32, m. <50U/l	39.36±2.97	45.09±3.83	35.82±4.15	0.103
LDH	225-450E/l	335.28±6.72	321.36±9.60	343.86±9.04	0.090
CK	<190U/l	122.62±13.02	117.58±12.91	125.73±19.54	0.728
Lipids					
Total cholesterol	<5,0 mmol/l	5.37±0.10	5.65±0.23	5.20±0.08	0.038
TG	<1,7 mmol/l	1.89±0.10	1.80±0.12	2.02±0.19	0.304
HDLC	>1,0 mmol/l	1.98±0.04	1.70±0.06	2.15±0.05	0.000
LDLC	<3,0 mmol/l	2.53±0.09	3.03±0.19	2.22±1.00	0.000
VLDLC	<1,5 mmol/l	0.86±0.04	0.91±0.09	0.82±0.05	0.396
Atherogenic coefficient	<3,0	2.23±0.33	3.26±0.86	1.60±0.07	0.017
Substrates					
Glucose	3,3-5,5 mmol/l	5.22±0.06	5.14±0.08	5.26±0.10	0.354
Urea	1,7-8,3 mmol/l	3.60±0.13	3.13±0.273	3.89±0.16	0.008
Creatinine<80, m	f. <80, м. <97 nmol/l	90.08±1.22	99.33±1.80	84.55±1.38	0.000
Urine acid	f. <357, м. <488 μmol/l	324.12±6.01	358.48±9.73	302.92±6.92	0.000
Tot. protein	65-85 g/l	78.11±0.58	77.64±0.85	78.39±0.77	0.518
Albumin 34 -48g/l	34 -48 g/l	46.45±0.39	47.45±0.78	45.82±0.40	0.046

Table 2

The frequency of violations of biochemical parameters men and women of Aldan region, n/%

Indicators	Gender		Pearson Chi-square	df	p
	Men	Women			
Total cholesterol (3.6-5.0 mmol/l)					
norm	28/42.4	65/60.7	5.536	2	0.063
<3.6	2/3.1	2/1.9			
>5.0	36/54.5	40/37.4			
Triglycerides (<1.7 mmol/l)					
norm	38/57.6	66/62.3	0.373	1	0.541
>1.7	28/42.4	40/37.7			
HDLC (0.78-2.2 mmol/l)					
norm	55/83.3	64/59.3	18.397	2	0.000
<0.78	2/3.0	0/0.0			
>2.2	9/13.6	44/40.7			
LDLC (<3.0 mmol/l)					
norm	37/56.1	86/80.4	11.548	1	0.001
>3.0	29/43.9	21/19.6			
VLDLC (0.8 - 1.5 mmol/l)					
norm	59/89.4	101/92.5	11.548	1	0.001
>1.5	7/10.6	6/5.6			
Atherogenic coefficient (<3)					
norm	48/72.7	101/94.4	15.741	1	0.000
>3.0	18/27.3	6/5.6			
ALT (<30 E/l)					
norm	64/97.0	104/96.3	0.057	1	0.812
>30	2/3.0	4/3.7			
AST (40 E/l)					
norm	61/91.0	98/90.7	0.005	1	0.946
>40	6/9.0	10/9.3			
De Ritis coefficient (1.2-1.6)					
Норма	17/25.8	23/21.3	2.294	2	0.318
>1.6	49/74.2	83/76.9			
GGT (women - 7-32 E/л; men - 11-50 E/l)					
norm	45/68.2	77/72.0	0.279	1	0.597
> norm	21/31.8	30/28.0			
LDH. E/l					
norm	64/97.0	81/76.4	15.808	2	0.000
<225	1/1.5	14/13.2			
>450	1/1.5	11/10.4			
Glucose (3.3-5.5 mmol/l)					
norm	52/78.8	75/71.4	1.169	1	0.280
>5.5	14/21.2	30/28.6			
Urine acid (women 155-357; men 268-488 µmol/l					
norm	57/86.4	85/78.7	8.296	1	0.004
> norm	4/6.1	23/21.5			
< norm	5/7.6	0/0.0			
Urea (1.7-8.3 mmol/l)					
norm	50/75.8	98/90.7	7.442	2	0.024
> norm	3/ 4.5	3/2.8			
< norm	13/19.7	7/6.5			
Creatinine (men <97; women <80 µmol/l)					
norm	25/39.7	48/44.4	2.359	2	0.307
> norm	38/60.3	58/53.7			
< norm	0/0.0	2/1.9			
Total protein (65-85 g/l)					
norm	58/87.9	78/74.3	8.756	2	0.020
<65.0	4/6.1	4/3.8			
>85.0	4/6.1	23/21.9			
Albumin g/l (34-48 g/l)					
norm	45/68.2	81/76.4	2.184	2	0.336
<34	1/1.5	3/2.8			
>48	20/30.3	22/20.8			

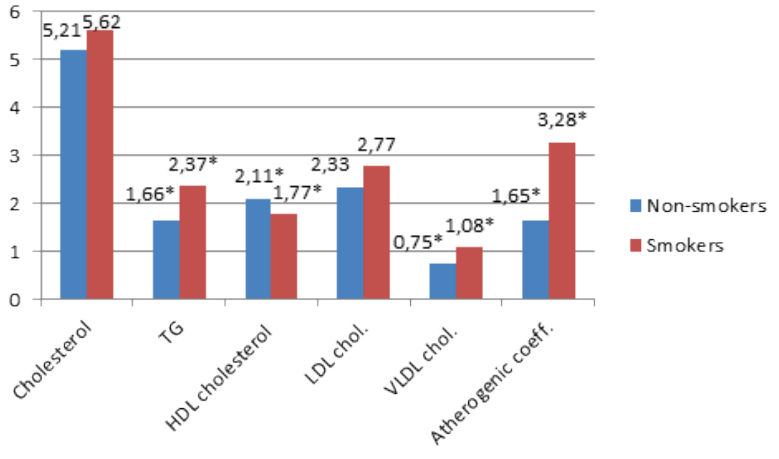
39.20±4.94U/l. GGT is one of the body's detoxifying systems and is a marker of intoxication and allergization. The main localization of HHG is in the liver. A slight activation of the GGT enzyme is an adaptive mechanism caused by a deficiency of amino acids in the blood and opens access to the proteins of internal organs in order to eliminate hypo- and dysproteimemia [4].

Hypoproteinemia among the population of Aldan was found only in 4 men and 4 women, hypoalbuminemia in 1 man and 3 women. Total protein and albumin are constant indicators. Their mean values were within the normal range, and the revealed fluctuations in the level of total protein were significantly associated with gender (p=0.001): in men -12.1%, in women - 26.7%. Elevated levels of total protein were 3.6 times more common in women (21.9%), possibly due to the fact that high levels of total protein are associated with stress. Maintaining the optimal level of total protein is controlled by transaminases ALT, AST and GGT. Residents of the Aldan region showed significant correlation coefficients for the level of total protein and albumin with the level of glucose (0.456; p=0.000 and 0.384; p=0.000, respectively) and LDH activity (0.578; p=0.000 and 0.426; p=0.000, respectively), which shows conjugation of carbohydrate and protein metabolism.

Urea and creatinine - products of nitrogen metabolism in the blood are one of the key indicators of kidney activity. Evaluation of violations of urea and creatinine content showed a gender association of changes in its level. High rates were found in 3 men and 3 women, and low rates were relatively more common, especially in men (Table 2). A decrease in the concentration of urea in the blood occurs during stress and is the result of an increased inclusion of nitrogen in blood proteins in the metabolic mechanisms of the body. The average level of urea in both groups was within the normal range, but significantly higher in women. Determining the level of urea is necessary to assess the intensity of catabolism and depends on the ratio of transaminase activity [5].

Mean creatinine levels were slightly elevated in both men and women (Table 1). The frequency of its moderate increase is not associated with gender. The percentage change in its level was 60.3% for men and 55.6% for women. The slight increase in creatinine may be related to muscle volume.

Glucose abnormalities above the upper limit of normal were not associated with gender (p = 0.280). An increase in



Lipid profile indicators depending on smoking

glucose levels was detected in 14 men and 30 women, which in percentage terms was 21.2% and 28.6%, respectively. In 6 people (3.4%), a high glucose level exceeding more than 10 mmol/l was determined, of which three did not have an established diagnosis. The correlation coefficient of glucose with TG level was r=0.445; p=0.000, with VLDLC - r=0.466; p=0.000.

Uric acid is a low molecular weight antioxidant. Its average value, both in men and women, is within the normal range, and changes in its level are also associated with gender: in women, an increased content of uric acid was 3.5 times significantly more common than in men (p<0.004).

Table 3 shows a comparative analysis of the biochemical parameters of women living in Aldan and Tommot. The average content of all biochemical parameters in both groups is within normal limits, except for TG and glucose in women from Tommot, which slightly exceeded the upper limit of normal (p=0.000). Despite the higher value of total cholesterol in the group of women in the city of Aldan, and TG in the group of women in the city of Tommot in both groups of AC was within the normal range. This is due to the fact that women in the city of Aldan have a higher level of HDLC, and in women in the city of Tommot the value of the antiatherogenic fraction of lipids - LDLC is lower than in women in the city of Aldan (p<0.000). In addition, in the group of women in Tommot, activation of ALT, LDH, and CK enzymes is noticeable. Indicators of carbohydrate and protein metabolism: the level of glucose, urea, uric acid, total protein and albumin were significantly higher than in women from Aldan (p<0.05) (Table 3).

The city of Tommot is located 40 km to the southeast, and the city of Aldan is 50 km east of the Elkon uranium ore region. The population surveyed by us is not employed directly in mining enterprises, so the effect of ionizing radiation is indirect. However, annual measurements of radioactive radiation from drinking water and indoor air show an unfavorable situation. In 2021, in 87 samples (20.4%) from underground sources of drinking water supply in the Aldan region, an excess of radon content (222Rn) was detected, and in 46 rooms of public buildings the value of ERVA of radon exceeded sanitary standards, the maximum recorded value of ERVA of 222Rn was 429 ± 86 Bq /m3 [1]. At low temperatures in rooms with thermal insulation and lack of ventilation, the radon concentration reaches significantly higher values [7,12], and the cold period in Yakutia lasts 6 months. Further studies of the health status of the working contingent of mining enterprises are needed.

Thus, in the population of the Aldan region, changes in the biochemical spectrum of blood serum indicate the presence of signs of disadaptation. Changes in the lipid profile are associated with gender. Violation of lipid metabolism in the direction of atherogenicity is significantly more common in men due to an increase in atherogenic fractions of lipids in the blood, susceptible to peroxidation and a decrease in the level of HDLC, especially in smokers. The observed shift

Table 3

Biochemical blood parameters in women in Aldan and Tommot

Indicator	Reference	Women, Mean value (M±m)			P
		Total n=107	Aldan n=57	Tommot n=50	
Enzymes					
ALT	<30 mmol/l	14.53±0.92	12.61±0.73	16.90±1.73	0.026
AST	<40 mmol/l	29.29±1.38	27.00±1.03	31.62±2.68	0.096
AST/ALT	1.2-1.6	2.26±0.07	2.36±0.09	2.15±0.11	0.160
ALP	<258 E/л	133.80±5.29	149.42±7.54	112.92±6.40	0.055
GGT	f.<32. м.<50 E/л	30.13±2.16	26.82±2.32	33.98±3.77	0.099
LDH	225-450 E/л	343.86±9.04	288.14±9.16	400.02±8.16	0.000
CK	<190 E/л	125.73±19.54	66.36±6.36	152.42±9.43	0.000
Lipids					
Total cholesterol	<5.0 mmol/l	5.20±0.08	5.32±0.13	5.04±0.08	0.094
TG	<1.7 mmol/l	2.02±0.19	1.32±0.13	2.37±0.15	0.000
HDL cholesterol	>1.0 mmol/l	2.15±0.05	2.14±0.07	2.17±0.06	0.789
LDL cholesterol	<3.0 mmol/l	2.22±1.00	2.55±0.12	1.85±0.13	0.000
VLDL cholesterol	<1.5 mmol/l	0.82±0.05	0.60±0.06	1.08±0.07	0.000
Atherogenic coefficient	<3.0	1.60±0.07	1.64±0.105	1.53±0.11	0.487
Substrates					
Glucose	3.3-5.5 mmol/l	5.26±0.10	4.93±0.12	5.83±0.17	0.000
Urea	<8.3 mmol/l	3.97±0.19	2.84±0.14	5.34±0.28	0.000
Creatinine<80, m	<97 µmol/l	84.55±1.38	83.58±1.74	85.54±2.22	0.454
Urine acid	f.<357. м.<488 µmol/l	302.92±6.92	277.72±8.53	331.14±9.77	0.000
Total protein	65-85 g/l	78.39±0.77	73.60±0.90	83.75±0.77	0.000
Albumin	34 -48 g/l	45.82±0.40	43.94±0.55	47.87±0.42	0.000

of metabolic flows towards catabolism, activation of glycolysis, dyslipidemia indicate a decrease in the body's adaptive reserves. Further intensification of enrichment of uranium ores will increase the impact of ionizing radiation on the population, which will require the continuation of biomedical and environmental research to prevent environmentally caused diseases.

Reference

1. Gosudarstvennyj doklad o sostoyanii i ohrane okruzhayushchej sredy Respubliki Saha (YAkutiya) v 2021 godu. [State report on the state and protection of the environment of the Republic of Sakha (Yakutia) in 2021. –URL: https://minpriroda.sakha.gov.ru/uploads/ckfinder/userfiles/2022/08/02/files/ Preview%20(25).pdf (In Russ.).]
2. O sostoyanii zdorov'ya naseleniya i organizacii zdravoohraneniya v Respublike Saha (YAkutiya) po itogam deyatel'nosti za 2020 g. (rukopis') [On the state of health of the population and the organization of health care in the Republic of Sakha (Yakutia) based on the results of activities for 2020 (manuscript). Yakutsk: Ministry of Health of the Republic of Sakha (Yakutia), 2021: 142 (In Russ.).]
3. Radiacionnaya obstanovka RGP territorii Respubliki Saha (YAkutiya) za 2021 g. [Radiation situation of the RSE of the territory of the Republic of Sakha (Yakutia) for 2021 (In Russ.).]
4. Rosly I.M., Abramov S.V., Pokrovsky V.I. Roslyj I.M. Fermentemiya-adaptivnyj mekhanizm ili marker citoliza [Enzyme-adaptive mechanism or marker of cytolysis]. Vestnik RAMN [Bulletin of the Russian Academy of Medical Sciences. 2002; 8: 3-8 (In Russ.).]
5. Fokina E.G., Rosly I.M. Enzimologicheskaya chast' biohimicheskogo pasporta cheloveka [Enzymological part of the human biochemical passport]. Epidemiologiya i gigiena [Epidemiology and hygiene]. 2013; 4: 28-31 [In Russ.).]
6. Khochachka I, Somero D. Biohimicheskaya adaptaciya [Biochemical adaptation]. Publishing house M.I.R. 1988: 586 (In Russ.).]
7. Yarmoshenko I.V., Onishchenko A.D., Malinovskij G.P. [et al.] Sravnitel'nyj analiz nakopleniya radona v zdaniyah razlichnogo klassa energoeffektivnosti na primere pyati rossijskih gorodov [Comparative analysis of radon accumulations in buildings of different energy efficiency classes on the example of five Russian cities]. Radiacionnaya gigiena [Radiation hygiene. 2020; 13 (2): 47-56 (In Russ.).]
Comparative analysis of radon accumulation in buildings of different energy efficiency classes on the example of five Russian cities / Yarmoshenko I.V., Onishchenko A.D., Malinovsky G.P. [et al.] //Radiation hygiene. 2020.- Vol. 13.- No. 2.- S. 47-56.8.
8. Akram M. Mini-review on glycolysis and cancer. J Cancer Educ. 2013 Sep;28(3):454-7. doi: 10.1007/s13187-013-0486-9. PMID: 23728993.
9. Bräuner EV, Andersen ZJ, Andersen CE, Pedersen C, Gravesen P, Ulbak K, Hertel O, Loft S, Raaschou-Nielsen O. Residential radon and brain tumour incidence in a Danish cohort. PLoS One. 2013 Sep 16;8(9):e74435. doi: 10.1371/journal.pone.0074435. PMID: 24066143; PMCID: PMC3774631.
10. Cao Y. Adipocyte and lipid metabolism in cancer drug resistance. J Clin Invest. 2019 Jul 2;129(8):3006-3017. doi: 10.1172/JCI127201. PMID: 31264969; PMCID: PMC6668696.
11. Darby S, Hill D, Auvinen A, Barros-Dios JM et al. Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies. BMJ. 2005 Jan 29;330(7485):223. doi: 10.1136/bmj.38308.477650.63. Epub 2004 Dec 21. PMID: 15613366; PMCID: PMC546066.
12. Grzywa-Celińska A, Krusiński A, Mazur J, Szewczyk K, Kozak K. Radon-The Element of Risk. The Impact of Radon Exposure on Human Health. Toxics. 2020 Dec 14;8(4):120. doi: 10.3390/toxics8040120. PMID: 33327615; PMCID: PMC7765099.
13. Henshaw DL, Eatough JP, Richardson RB. Radon as a causative factor in induction of myeloid leukaemia and other cancers. Lancet. 1990 Apr 28;335(8696):1008-12. doi: 10.1016/0140-6736(90)91071-h. PMID: 1970069.
14. Lammert, E.; Zee, M. Metabolism of Human Diseases: Organ Physiology and Pathophysiology; Springer: Berlin, Germany, 2014.
15. Mattes, R.D. Fat taste and lipid metabolism in humans. Physiol. Behav. 2005, 86, 691–697.
16. Zaballa I, Eidemüller M. Mechanistic study on lung cancer mortality after radon exposure in the Wismut cohort supports important role of clonal expansion in lung carcinogenesis. Radiat Environ Biophys. 2016 Aug;55(3):299-315. doi: 10.1007/s00411-016-0659-0. Epub 2016 Jun 22. PMID: 27334643.

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HIV-INFECTION AS A CAUSE OF DISABILITY OF THE POPULATION

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The article presents an analysis of the data of the state statistical reporting on the disability of the population of the Irkutsk region due to HIV infection and dispensary observation of patients. Changes in the stages of HIV infection, including the stage of secondary manifestations, are shown. The median of the average age of patients by disability groups among men and women was calculated, the structure of the causes of disability was presented. A forecast is given regarding the change in disability groups for 2022. Measures to increase the adherence of citizens with HIV infection to antiretroviral therapy, the prevention of secondary and opportunistic diseases will prevent early disability of the population.

Keywords: HIV infection, stages of HIV infection, disability, causes of disability.

Introduction. The HIV pandemic continues, influencing the main indicators characterizing the state of public health. The Health Development Strategy until 2025 defines HIV infection as a “threat to national security in the field of public health”. As of December 31, 2021, 0.8% of the population in the Russian Federation was living with HIV, including 1.5% of those aged 15–49 years. In 2021, the Irkutsk region was the leader in terms of incidence (99.6 versus 47.8 per 100 thousand in the Russian Federation); in terms of damage, it ranked second after the Kemerovo region with an indicator of 2042.5 per 100 thousand (http://www.hivrussia.info). Currently, HIV infection is classified as a chronic, treatable infection [7]. Thanks to antiretroviral therapy (ART), the life expectancy of patients with HIV infection increases. As a result, the social significance of HIV infection increases, including the disability of the population [6, 8]. General indicators of disability due to HIV infection in the Irkutsk region were studied until 2019 [4, 5]. However, given