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## SEASONAL CHANGES IN THE PITUITARY-THYROID SYSTEM IN CHILDREN OF THE ARCTIC REGIONS OF YAKUTIA

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In recent years, work on the study of adaptive mechanisms and reserves of the body in the Arctic has become increasingly relevant. One of the areas of research is the study of the role of the endocrine system in the adaptation process. The article presents the data of the study of seasonal fluctuations of pituitary-thyroid hormones in 362 children of the Arctic regions of Yakutia. Higher TSH levels were found in winter, which should be considered as physiological shifts reflecting adaptation to the changing season of the year.

**Keywords:** hormones, pituitary gland, thyroid gland, thyroid-stimulating hormone, thyroid profile, Yakutia, seasons, Arctic.

**Introduction.** The impact of a complex of extreme climatic and geographical factors of the North is accompanied by dynamic changes of the parameters of the functional systems of human body. In regulation of this adaptive restructuring the leading role is played by the endocrine system. Thyroid gland is considered as one of the main components, providing effective adaptation to conditions of cold climate [3, 9]. In Arctic conditions activity of thyroid gland is often limited by low content of iodine, which is necessary for its normal functioning [1, 4, 7].

In childhood and adolescence even a slight change of adaptive processes can lead to the disease development and, in the absence of correction, to its chronization [5, 7, 8]. Thyroid hormones affect on metabolic processes occurring in the body, height and development of the child. The analysis of the literature showed that despite the presence of researches on age and gender characteristics [2, 5, 7, 8], there is not enough information about seasonal changes of the pituitary-thyroid system of children.

In this regard the objective of the research was to explore the seasonal dynamics of the pituitary-thyroid system in children of the Arctic regions of the Republic of Sakha (Yakutia) as one of the components of adaptation to extreme environmental conditions.

**Materials and methods.** Panel researches were conducted among children and adolescents of the Arctic regions of Yakutia during field medical expeditions in 2018-2020. A total of 362 children living in Bulunsky, Anabarsky, Allaikhovsky, Nizhnekolymsky, Verkhnekolymsky districts were examined. The distribution of the examined children and adolescents by gender, age, and season of biological material collection is shown in Table 1.

Laboratory researches were conducted at clinical and diagnostic laboratory of Clinic of Medical Institute of SVFU named after M. K. Ammosov. Thyroid-stimulating hormone (TSH) and free thyroxine were determined by enzyme immunoassay (FT4).

The research was approved by local ethics committee on biomedical ethics by FGBNU «Yakut Scientific Center for Complex Medical Problems» (Yakutsk city, protocol №4, March 1, 2018).

Statistical calculations were completed using software IBM SPSS Statistics 17 (IBM®, USA). For comparison of groups was used Mann-Whitney criteria. Criti-

cal value of significance level for statistical hypotheses checking was accepted equal 5%.

**Results.** Distribution of levels of TSH and FT4, divided by children gender and age is shown in Table 2. In all groups values corresponding to the upper quartile of the distribution of indicators were in the range of the laboratory standards. Comparison of values of age subgroups between boys and girls in 2 seasons of year revealed no statistically significant differences in the content of the researched parameters in the blood serum ( $p > 0.005$ ). There are also no differences in each age group depending on gender ( $p > 0.005$ ). So, levels of TSH and FT4 in research groups aren't depend on age and gender of children. In the further analysis, the indicators were compared between 2 seasons (winter and spring). The limitation of this research towards the estimation of the seasonal dynamics of indicators is a cross-sectional design, in which independent groups were formed in each season. However, this research is extremely relevant in view of the fact that it determines promising areas of research.

Comparison of each group by the level of the analyzed indicators in different seasons of the year show that more stable differences are observed in the content of TSH (Table 2). Moreover, in all groups they have the same orientation towards higher values in the winter period. In case

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Table 1

An amount of examined children by gender and age

Gender and age of examinees	The season of taking blood tests for ELISA	
	Winter	Spring
Girls 10-14 years	59	53
Girls 15-18 years	54	34
Boys 10-14 years	53	40
Boys 15-18 years	33	36
Bcero	199	163

Table 2

## Comparison of levels of TSH and FT4 between seasons of year\*

Indicator	Winter	Spring	
Girls 10-14 years			
TSH, mIU/ml	2.1 (1.4; 3.1)	1.8 (1.2; 2.5)	0.055
FT4, pmol/l	14.0 (9.6; 16.9)	12.7 (11.5; 14.4)	0.857
Girls 15-18 years			
TSH, mIU/ml	1.9 (1.3; 2.6)	1.3 (1.0; 1.8)	0.003
FT4, pmol/l	14.2 (10.5; 16.1)	12.8 (11.0; 14.8)	0.318
Girls 10-18 years			
TSH, mIU/ml	2.0 (1.4; 2.8)	1.6 (1.1; 2.1)	0.002
FT4, pmol/l	14.2 (9.8; 16.7)	12.8 (11.4; 14.5)	0.373
Boys 10-14 years			
TSH, mIU/ml	2.1 (1.7; 3.2)	1.6 (1.1; 2.3)	0.001
FT4, pmol/l	12.8 (9.3; 16.1)	12.9 (11.4; 14.5)	0.411
Boys 15-18 years			
TSH, mIU/ml	2.1 (1.5; 3.3)	1.6 (1.3; 2.4)	0.028
FT4, pmol/l	11.6 (9.4; 15.5)	14.1 (12.6; 15.02)	0.015
Boys 10-18 years			
TSH, mIU/ml	2.1 (1.7; 3.2)	1.6 (1.1; 2.3)	<0.001
FT4, pmol/l	12.3 (9.3; 1.0)	13.6 (12.0; 14.8)	0.034

Note: \* — data showed as median and interquartile span in ME format (Q<sub>1</sub>; Q<sub>3</sub>); p – reached level of significance of groups comparison (Mann-Whitney criteria).

of FT4 statistically significant differences are observed only among young men 15-18 years.

Earlier season difference of indicators of в показателях pituitary-thyroid system was described only описаны in the adult population of central Yakutia. The presence of seasonal dynamics of thyroid hormones was shown and the signs of "polar T3 syndrome" were also established [6, 10, 11].

The evidence for seasonal variations of TSH in the literature is several contradictory. During the examination 206 486 patients of Pekin's medical college bigger TSH indicators were observed in winter, a negative correlation was established with the ambient temperature ( $r = -0,66$ ,  $p < 0,001$ ) [9]. Analysis with using of «big» data that includes 1,5 millions of observations showed that TSH levels were highest at summer and winter regardless of level of peripheral hormones, age, gender and ambient temperature [12].

Results of our research evidence about season changes of regulation of the pituitary-thyroid system in children and adolescents of the Arctic regions of Yakutia. More high levels of TSH at winter should be considered as physiological shifts, reflecting adaptation to the changing season of the year. Tracking of changes in the pituitary-thyroid system more possible in the format of a longitudinal research. Of course, one of the most

promising areas of research is determination of the physiological standards for regions with a wide seasonal range and temperature range. In future researches it's necessary to rate influence of photoperiodism and the temperature factor on the degree of these fluctuations. This data can expand our perception of the physiology of adaptation to environmental conditions, as well as to influence the management strategy of patients with subclinical hypothyroidism in the Arctic.

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## MORPHOLOGICAL AND FUNCTIONAL FEATURES OF THE MICROCIRCULATION STATE IN CAPILLARY BED AND THERMAL IMAGING OF THE BODY OF YOUNG MALE NORTHERNERS RESIDING DIFFERENT CLIMATIC AND GEOGRAPHICAL ZONES OF MAGADAN REGION

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The research involved 364 young men aged 17-21, permanently residing in the coastal (the city of Magadan, n = 217) and continental (the settlement of Susuman, n = 47) climatic zones of Magadan region. Morphofunctional parameters of the microcirculatory bed vessels, as well as thermographic characteristics of different parts of the body were studied. It was found that the residents of Susuman were characterized by smaller arterial diameter and bigger diameters of the venous and transitional sections of the capillaries as compared with those from Magadan. At the same time, significantly higher average temperatures were observed in Magadan subjects through all the analyzed areas of the thermographic picture than it could be seen with examinees from Susuman.

**Keywords:** young men, North-East, microcirculation, thermography.

Capillaroscopy is a method of non-invasive investigation of the microcirculatory blood flow [1]. It is created to diagnose functioning of human cardiovascular system in its peripheral parts, the skin and mucous membranes. Capillaroscopy provides the most useful way to promptly visualize the skin capillary blood circulation, and assess density and blood flow rate in capillaries, which gives reliable information about the structural and functional parameters of the capillaries in real time and under real physiological conditions [16]. The most important link in the bloodstream is the capillary system, which provides organs and tissues with

all vital substances. Large vessels deliver these substances. They come into tissues through capillaries with simultaneous extraction of metabolic products from the tissues and transferring them to the bloodstream [1]. Microcirculation blood flow maintains health of tissues and organs by delivering oxygen and nutrients [17]. In addition, it regulates blood pressure and tissue perfusion, as well as the body thermal state [18]. Microcirculatory vessels also support functioning and homeostasis in cells. It should be noted that average values for some microcirculation parameters, in particular those characterizing adaptation to the North extremes, remain unclear, which suggests the need for more detailed study of the microcirculatory bed.

Another interesting and easy-to-use method for assessing peripheral blood circulation is thermography [6]. It helps to study skin temperatures, which describe intensity of metabolic processes, since any changes in metabolism or blood circulation affect skin temperatures, and therefore can be seen in the thermogram [2]. Maintaining skin temperature and, consequently, heat balance is represented there as heat production equal to heat loss. Based on this, infrared imaging is of great importance when studying physio-

logical adaptation of the body. This method has proven to be useful for thermal imaging of the body (skin) surface, as well as for monitoring of the body thermoregulation response under different conditions [18].

The body microcirculation system and thermal imaging map formation under the chronic influence of the cold factor is undoubtedly a problem for the modern science that studies adaptation processes. In this regard, visualization and objective assessment of capillary blood flow with both video capillaroscopy and thermography may be useful for the North residents in prognostic and diagnostic terms.

Based on the above, the objects of this work was studying functional state of microvessels and thermal images of the body in the North inhabitants under different environmental extremes of coastal or continental climatic zones in order to identify and justify the use of these assessment methods in providing mechanisms for adaptive changes.

**Materials and methods.** A random sample was made up of 364 males aged 17-21 permanently residing in coastal (Magadan, n=217) and continental (Susuman, n=47) climatic zones of Magadan region. The structure of capillaries and microcirculation was studied in the epon-

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