

**The concentration of products of lipid peroxidation in blood of rats during prolonged cold stress and using the phytoadaptogens mixture (M±m, n=10)**

Indicators, nmol / ml	The period of the experiment, day	Intactgroup	Controlgroup	The experimental group: cold+30 mg/kg of the mixture	The experimental group: cold+150 mg/kg of the mixture	The experimental group: cold+300 mg/kg of the mixture
Hydroperoxideoflipids	7th	17,63±0,46	31,13±0,81*	30,26±0,63	27,82±0,91**	23,83±1,5**
	14th	18,09±0,39	29,15±1,0*	28,5±1,3	28,85±2,5**	19,93±0,92**
	21st	17,03±0,51	30,25±0,9*	30,10±1,02	26,12±2,2**	22,97±0,41**
	28th	17,9±0,56	28,6±2,6*	28,4±2,3	25,3±3,2**	20,71±0,67**
Dieneconjugates	7th	91,77±1,6	112,77±2,3*	113,12±5,3	106,71±6,5**	89,16±2,39**
	14th	90,52±1,0	124,63±1,6*	120,46±2,5	116,52±3,5**	99,42±2,6**
	21st	86,6±0,5	119,56±1,4*	119,45±2,6	109,22±1,7**	95,42±2,1**
	28th	89,11±1,2	120,9±3,3*	119,16±5,3	106,41±2,1**	94,1±3,8**
Malonicdialdehyde	7th	0,7±0,9	2,72±0,18*	2,43±0,05	1,8±0,1**	1,0±0,07**
	14th	0,97±0,15	3,15±0,31*	3,08±0,13	2,47±0,3**	1,49±0,08**
	21st	1,13±0,1	4,57±0,12*	3,8±0,52	3,3±0,3**	1,74±0,01**
	28th	1,17±0,2	3,25±0,31*	3,25±0,52	2,61±0,35**	1,13±0,33**

\* - differences between intact and control groups (p<0,05); \*\* - differences between control and experimental groups (p<0,05).

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## EVALUATION OF THE INDICES OF HEMODYNAMICS IN THE ARCTIC ZONE RESIDENTS FROM THE POSITION OF «GOLDEN RATIO»

### ABSTRACT

The data of arterial pressure of 91 residents of the Arctic zone of the Republic of Sakha (Yakutia) from the position of «golden ratio» was investigated. It was revealed that the most harmonious blood pressure is found in the Chukchi and Yukagirs, and it is confirmed by the highest percentage of those with a diagnosis «healthy».

**Keywords:** arterial blood pressure, arterial hypertension, golden ratio.

**Introduction.** Currently arterial hypertension (AH) remains to be one of the most significant medical and social problems, as it is an important risk factor of cardiovascular diseases, mainly determining high mortality rates in our country and around the world in general.

The blood circulatory system in Russia accounts for more than a half of deaths and 46% of disabilities in Russia. According to the results of 2016,

cardiovascular diseases occupied the second ranked place in the structure of general morbidity of the adult population, meaning that it got 14.5% (3172 per 100000 of the total population), and the hypertensive heart disease got 674,6 per 100000 of the total population [5,8].

Based on the results of the conducted representative survey of the population of Sakha Republic in 2003, the prevalence rate of arterial hypertension

(AH) averaged  $0.3 \pm 0.8\%$ . Among the indigenous population of Yakutia, the incidence of AH is slightly less than in the non-indigenous population (22.9 and 27.7% respectively). However, the prevalence rate of AH suddenly increases to 29.3% and more in the indigenous population starting from the 6th decade of life [9].

Unfortunately, in recent years, despite all the health care efforts, the sickness

statistic of AH has been increasing, so for 2016-2017 the morbidity of AH in the Republic of Sakha (Yakutia) was 43.7% and 44.82% respectively [10].

It is known that the body functions in a state of dynamic equilibrium and the exits beyond its limits as the result of various kinds of influences or diseases of organs and systems are considered as violations of hierarchical interactions. These violations are either quickly compensated for, or they lead to the pathological process development, and individual links to the functional circulatory system with its full compensation are in a certain relationship. An assumption has been made that this relationship between individual elements obeys the rule of «golden ratio» [6].

The concept of the «golden ratio» (GR) has been used for a long time and is described by proportions – it is a division of the segment into two parts so that the length of the bigger part refers to the length of the smaller part in the same way as the length of the whole segment refers to the length of the larger part. The golden ratio and the golden proportion (which is the same thing), or harmonious division, is obtained if the whole segment refers to the one part as 1: 0.618, and the bigger part refers to the smaller as 0.618: 0.382.

It is revealed now that the golden proportion is the criterion of optimality in choosing the parameters of many physiological functions for the human body – blood levels, respiration, central nervous function. The structure of the heart and the relationship between the main indicators of its activity (systolic, diastolic, pulse arterial blood pressure, heart rate) also refer to each other in the proportion of GR. It is assumed that for healthy individuals deviations from ideal (1.618 or 0.618) are not more than 5 – 8%, even with significant (1.5 – 2 times) changes in hemodynamic parameters [1].

In 1998 the clinical value of the ratio of DBP to SBP was studied by V.V. Shkarin. The term «structural point of BP» (SPBP) was assigned to this ratio. It is known by now that SPBP is closer to the value of the Golden Ratio (GR) proportion – 0.618 [3].

Deviations from the golden proportion of the ratios of hemodynamic indices mentioned above are treated either as a process of structural and functional rearrangement of physiological systems, or as a state of dysregulation, decompensation of these systems, especially if it is recorded in a state of rest (sleep, rest, etc.).

Thus, even if the parameters of hemodynamics do not fit into the range of normal values, but their relationships are subject to the principle of GR, it is a sign of optimality, compensation, consistency

and harmony of the processes occurring in the human body [1].

**The purpose** of this study is to evaluate and analyze the indices of arterial blood pressure of residents of Andryushkino village, using the principle of «golden ratio».

#### Material and methods of research.

The data of arterial pressure of 91 residents of Andryushkino village (Nizhnekolymsky District, Republic of Sakha (Yakutia)) have been researched. The average age was 43.47±5.51 years old.

The values >25 and <30 kg/m<sup>2</sup> were considered overweight. The obesity was recorded with a body mass index (BMI) > 30 kg/m<sup>2</sup> (according to European recommendations III revision, 2003).

At the classification of arterial blood pressure (BP) levels mm Hg, the data from the National Clinical Guidelines (2009) [2] was used, so the optimal was <120 and <80 mm Hg, normal - 120-129 and / or 80-84 mm Hg, high normal - 130-139 and / or 85-89 mm Hg. Arterial hypertension (AH) of the 1st degree corresponded to 140-159 and / or 90-99 mm Hg, AH of the 2nd degree - 160-179 and / or 100-109 mm Hg, AH of the 3rd degree - ≥ 180 and / or ≥ 110 mm Hg.

The «structural point of BP» (SPBP) and the ratio of DBP / SBP were used for the evaluation of blood pressure indicators. By now, it is known that SPBP approaches the value of the golden proportion (GP) - 0.618 (harmonious ratio). The values of BP with SPBP in the range from 0.564 to 0.673 for healthy subjects were considered stable. For patients with arterial hypertension (AH), «disharmony» ranged from 0.549 to 0.687 (deviation of GP from 8% to 11%). The biggest differences from the proportion of the GR and «imbalance» (12% and higher) are characteristic for unstable states: borderline AH, severe forms of hypertension and, possibly, the crises form of hypertension [3].

Statistical processing of the obtained results was carried out using the SPSS software package (version 17). The data is presented in the form of  $M \pm m$ , where  $M$  is the mean value and  $m$  is the standard error of the mean value.

#### Results and discussion.

According to the results of anthropo-

metric data from the residents of Andryushkino village, the following average growth rates were received: Chukchi - 153.28±3.74 cm, Evens - 154.93 ± 3.0 cm, Yukagirs - 155.43 ± 4.06 cm, Yakuts - 156.13 ± 3.02 cm. Body weight: Chukchi - 63.17 ± 7.04 kg, Evens - 69.07 ± 7.39 kg, Yukagirs - 68.43 ± 9.35 kg, Yakuts 72.53 ± 6.40 kg. The body mass index (BMI), regardless of ethnicity, was at the level of excess body weight. Thus, for Chukchi - 26.69 ± 2.19, Evens - 28.88 ± 3.22, Yukagirs - 28.39 ± 4.01, Yakuts - 29.86 ± 2.73 (table 1)

During the study of hemodynamics, it was found that, depending on ethnicity, the average values of blood pressure are within the permissible normal values. The average values of the ratio / of DBP SBP (SPBP) and SBP / DBP were in the range of recommended norms, and the closest correlation of blood pressure to the «golden proportion» was found in Evens and Yakuts (Table 2). Harmonious blood pressure and SPBP (close to 0.618) were detected in 16.67% of the Chukchi and Yukagirs, 13.8% of the Evens, and 6.67% of the Yakuts. Disharmony was found in 77.77% of the Chukchi, 75.86% of the Evens, 78.57% of the Yukagirs, and 76.67% of the Yakuts. BP imbalance was detected in 5% of Chukchi, in 10.34% of Evens, and in 16.66% of Yakuts, but in Yukagirs it was not detected.

The analysis of hemodynamics from the position of the «golden proportion» on the established diagnoses showed that the average BP indices for all ethnicities diagnosed with «AH 2 risk 2» are within the permissible norm. Arterial pressure of Evens and Yakuts with diagnoses of «AH 3 risk 2» varied at the level of «moderate hypertension» (hypertension of the 1st degree, soft SBP - 140-149 mmHg and DBP - 90-99 mmHg). At the same time, within the diagnosis of «healthy» regardless of ethnicity, blood pressure was at the level of the «optimal pressure» category (SBP - 100-119 mmHg, DBP - 60-79 mmHg) according to the Russian clinical recommendations (2009) (Table 3).

It is generally believed that the damage to the body is caused by fluctuations in the upper pressure, however, according to Professor Katsudzo Nishi (2006), who lived at the beginning of the 20th century,

Table 1

#### Anthropometric data and indicators of hemodynamics depending on ethnicity

Indicator	Chukchis n=18	Evens n=29	Yukagirs n=14	Yakuts n=30
Height, cm	153,28±3,74	154,93±3,0	155,43±4,06	156,13±3,02
Body mass, kg	63,17±7,04	69,07±7,39	68,43±9,35	72,53±6,40
Body mass index	26,69±2,19	28,88±3,22	28,39±4,01	29,86±2,73
SBPmmHg	118,33±3,81	125,17±8,81	115,71±5,63	129,67±8,65
DBPmmHg	77,22±2,24	77,24±3,62	74,28±3,34	80,33±2,86
DBP/SBP	0,653±0,01	0,623±0,02	0,643±0,001	0,627±0,02

mmHg

Table 2

The ratio of DBP / SBP(SPBP) and percentage deviation from the number of «golden proportion»

Ethnoses	DBP / SBP(SPBP)	Deviation from the "golden proportion" in%	SBP/DBP	Deviation from the "golden proportion" in%
Chukchis, n=18	0,653±0,01	5,66	1,533±0,02	5,25
Evens, n=29	0,623±0,02	0,8	1,614±0,05	0,25
Yukagirs, n=14	0,642±0,01	3,88	1,557±0,03	3,77
Yakuts, n=30	0,627±0,02	1,46	1,609±0,07	0,55

Table 3

Hemodynamics indicators on diagnoses depending on ethnicity

Ethnoses	AH 2, risk 2				Healthy	
	SBPmm. m.c.	DBPmm. m.c.	SBPmm. m.c.	DBPmm. m.c.	SBPmm. m.c.	DBPmm. m.c.
Chukchis	124±3,66	80,0±0,00	-	-	116,15±4,04	76,15±2,67
Evens	130±11,54	80,0±5,77	141,81±10,07	82,56±2,72	110,71±5,53	72,14±4,14
Yukagirs	123,33±4,38	80,0±0,00	130,0±0,0	80,0±0,00	110,0±5,0	71,11±3,47
Yakuts	125,0±7,82	80,0±0,00	148,0±13,72	85,0±4,78	118,57±3,43	77,14±2,42

the relationship between upper and lower pressure is considered particularly dangerous, and vice versa. He considered the «golden ratio» of pressure, which is 7/11 (or close enough to it in the range of 6/11 – 8/11) to be a health indicator. At this ratio, upper and lower pressure numbers pose absolutely no danger to a person, even 274/174 mm Hg (0.635). But if this «golden ratio» is violated, for example, at a blood pressure level of 127/95 mm Hg. (0.748), there is a significant danger to health. And, of course, the greater the difference between the upper / lower pressure ratio and the «golden ratio» is, the higher the risk of developing cardiovascular diseases gets. It should be noted that this formula is applicable only towards the people over twenty years old [7].

In 2010, M.A. Karpenko, et al. (2010) examined the clinical significance of the quantitative analysis of ECG and arterial blood pressure using the «golden ratio» method. They found that when the ECG and BP values deviate from the optimal values by more than 15%, the probability of finding coronary heart disease (CHD) in the examined patients is 85% [5].

The closest to the GP harmonious ratio of DBP / SBP (SPBP) with the diagnosis of «AH2 risk 2» was found in Evens –  $0.617 \pm 0.01$  (SBP -  $130 \pm 11.54$ , DBP -  $80 \pm 5.77$  mm Hg), with the diagnosis of «AH3, risk 2» in the Yukagirs -  $0.615 \pm 0.01$  (SBP -  $130.0 \pm 0.0$  DBP -  $80.0 \pm 0.00$  mmHg). In all ethnic groups SPBP with the diagnosis of «healthy» was on the range of stable disharmony and amounted to  $0.656 \pm 0.01$  in the Chukchi,  $0.651 \pm 0.01$  in the Evens,  $0.646 \pm 0.02$  in the Yukagirs and  $0.651 \pm 0.01$  in the Yakuts. But at the same time, the occurrence of «healthy» diagnosis was higher for the Chukchi (72.22%) and for the Yukaghir (64.29%).

It is interesting that according to a large-scale study HOT (Hypertension Optimal Treatment), which included the study of 18.790 patients with AH, with the optimal blood pressure in terms of the lowest risk of death due to cardiovascular causes, the optimal blood pressure is considered to be  $138.8 / 86.5$  mm Hg. Calculation of SPBP from these data gives us a number of 0.6231, which is absolutely identical to the average value of SPBP, which was obtained from the study of a group of healthy individuals. The lowest risk of developing cardiovascular complications was established with blood pressure =  $138.5 / 82.6$  mm Hg. Wherein the SPBP is 0.5942, which is also within the range of SPBP  $\pm 1s$  [3].

Therefore, the assessment of indices of hemodynamics from the position of the «golden proportion» in examined residents of the Arctic zone revealed that the most harmonious arterial

blood pressure occurs in Chukchi and Yukagirs, and this is confirmed by the highest percentage of people with the diagnosis of «healthy». According to the obtained results among the patients of Andryushkino village with AH, stable blood pressure with the least risk of developing cardiovascular complications among patients is in the range of  $130.0 \pm 0.0 / 80.0 \pm 0.00$  mm Hg. (0.615). In conclusion, it can be noted that the stable the values of the «golden proportion» for blood pressure are maintained, the more effective the coronary circulation and the more stable state of the body's regulatory systems is.

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## METABOLIC INDICES OF BLOOD IN CONDITIONS OF COLD EXPOSURE

### ABSTRACT

We investigated 200 employees of the diamond mining company who worked in cold condition from 2 to 8 hours a day. Reliable correlations have been revealed to prove the effect of cold on weight, body mass index, waist volume and hip volume. Cold exposure increased expression of genes markers of browning. These results provide evidence pointing to PMBCs as an easily obtainable material.

**Keywords:** cold exposure, brown adipose tissue, lipid metabolism, obesity.

### Introduction

The discovery of brown adipose tissue caused great interest in studying the origin of this thermogenetic tissue underlying the fight against obesity and complications associated with it.

Cold exposure is one of the strongest stimulators of brown adipose tissue (BAT) activation. The process of activation of brown adipose tissue is manifested in the growth of beige adipocytes in the depot of white adipose tissue, this process is called browning.

It is known that mammals have two types of adipose tissue, white and brown. White adipose tissue mainly consists of white adipocytes, which are a storehouse of the excess fat, designed to store energy, in the form of a large lipid drop. BAT consists of multi-compartment adipocytes that specialize in fat oxidation, producing heat during thermogenesis, in response to cold stimulation or consumption of a high-calorie diet during stimulation with B-adrenergic receptors.

The thermogenetic activity of BAT is associated with the presence of the mitochondrial protein UCP1 and represents an important part in the energy expenditure of the critical and total energy balance. The main thermogenetic stimulus in cold exposure is the stimulation of the sympathetic nervous system by cold and the control of B-adrenergic antagonists caused by the oxidation of fatty acids in adipose tissue and thermogenesis in BAT by the mediocre growth of the size of the

BAT tissue, mitochondriogenesis, and expression of the UCP-1 protein and the activity of proteins to maintain body temperature [3, 5, 7, 15-17]. In addition, stimulation of B-adrenergic receptors by cold promotes such a process as browning, in which brown-like adipocytes (brite) form in the depot of typical white adipose tissue [1,4,5,6,7,10,25]. These adipocytes are called brite (brownish, beige, intermediate form between brown and white fat tissue), which prove specific gene expression and have some features characteristic of classical brown adipocytes, such as expression of UCP-1 protein in mRNA [1, 2, 9, 18, 19, 21, 22]. In the case of rodent studies, it is known that the Browning process can increase energy consumption and help maintain body weight [2,8,20]. Interest in the research of BAT appeared when the cases of active BAT in adults were proved [12]. At the moment, the main issue discussed by the world community is the possibility to activate or increase the mass of BAT in adults, since active BAT can play a significant role in controlling energy homeostasis and promote the development of drugs for the treatment of obesity.

Objective: to establish the usefulness of the use of peripheral blood mononuclear cells as a method for carrying out a study related to the activation of brown adipose tissue and the transition of white adipose tissue to brown tissue by analyzing the key markers of Browning in response to the main thermogenetic stimulus-the cold

exposure.

### Materials and methods

In 2016, biomaterial (blood) was collected for genetic and biochemical analyzes of 200 workers of the diamond mining company, mainly sinkers, who openly mined the diamond-bearing soil in the winter season. Workers spent on extraction from 4 to 9 hours a day depending on their professional duties.

The first group consisted of 76 workers, who conducted at low temperatures from 2 to 4 hours. The second group included 110 sinkers, the time of cold exposure was from 6 to 8 hours per day.

All subjects were examined for anthropometric measurements with determination of growth, body mass index (BMI), waist circumference (WC), hip circumference (HC), WC/HC ratio. The body mass index was calculated as the ratio of the body weight (kg) to the height (m). When evaluating the body mass index, the criteria of the World Health Organization (WHO) were used. The waist circumference was measured in a standing position midway from the lower edge of the costal arch to the crest of the abdominal bone. The hip circumference was measured in the standing position at the level of the greater trochanters of the femurs.

Glucose, total cholesterol, high-density lipoprotein (HDL), triglycerides (TG) were determined by the enzymatic method on an automated Labio 200 analyzer using Biocon kits (Germany).

Total RNA was isolated from the