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THE STRUCTURED SPOT OF BLOOD PRESSURE FROM THE PERSPECTIVE OF THE "GOLDEN RATIO" PROPORTION

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The analysis of blood pressure indicators for residents of the Republic (Yakutia) from the position of the golden ratio using the structural spot of blood pressure (SSBP) - the ratio of DBP / SBP with a value close to the value of the golden ratio (ZP) - 0.618 (harmonious ratio) was performed. Existing blood pressure standards (120/80 mmHg) are not always acceptable for all categories of the population, especially for older people. Therefore, each person needs an individual approach. It has been established that SSBP opens up new possibilities in terms of the proportion of the golden ratio in predicting the stability of the course of blood pressure during functional studies in patients with arterial hypertension.

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

Introduction. In recent decades, essential arterial hypertension (EH) and coronary heart disease (CHD) have firmly taken the leading place in the structure of cardiovascular and overall population morbidity. Arterial hypertension (AH) is significant because it is the most important risk factor for cardiovascular diseases, mainly affecting the statistics of complications, disability and high mortality in the world community. More than half of the deaths in the Russian Federation are due to circulatory system diseases. According to the statistics of the general morbidity rate of the adult population in 2017, the index of hypertensive heart and kidney disease was 264.3 per 100,000 of the total population [10].

In recent years, the prevalence statistics of AH in the territory of the Sakha (Yakutia) Republic continues to grow. Therefore, in 2016-2017, the prevalence of AH was 43.7 and 44.82%, respectively. According to the latest statistics, the number of deaths from circulatory system diseases from January to December 2018 in Yakutia was 355.0 per 100,000, and 325.6 from January to February 2019 [5, 19].

According to the synergetics theory, the human body is a multi-level hierarchically organized complex system. Different levels interact with each other in different ways and thereby determine the state of dynamic equilibrium [6,15].

The state of dynamic equilibrium supports the functioning of the organism, and a change of this state as a result of external influences or diseases leads to disturbances in hierarchical interactions. These disorders are either quickly compensated or lead to the development of the pathological process [3].

Thus, the circulatory system can also be viewed as a multi-level hierarchically complex system and at the level of its constituent subsystems that determine the balance of the body. One of the displays of such structural and functional balance is a correspondence with the “Golden ratio” rule [17,18].

The rule of the golden ratio has been known to mankind for a long time and has found application both in science and art. Pythagoras introduced the concept of the gold division into science. The “golden ratio” is known as proportions: the division of the AC interval into two parts, so that the length of the bigger part AB is to the length of the smaller part BC in the same way as the length of the whole interval to the length of AB (AB: BC = AC: AB). The golden ratio is made if the whole is to the one part as 1:0.618, and most to the lesser as 0.618:0.382 [17, 18]. Also, the concept of the “golden ratio” is described by the proportions found by using the value that is the universal quotient of dividing a larger number by the next smaller number in the gold series of Fibonacci numbers (1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89 etc.; that is 89:55 = 1.618 ...) [17,18].

In recent years, scientists have actively studied the relationship of the golden ratio with the heart function and hemodynamic indices. V.D. Tsvetkov was the first to show the role of the golden ratio and Fibonacci numbers in the organization of the cardiac systems, he found that the golden numbers are the guarantors of the optimal heart activity, the most economical in terms of energy and living matter [7, 18]. Moreover, it was researched that the ratio of heart rate variability to the diastolic interval was 1.618, which is the golden ratio [8, 21]. Similar studies were conducted to find out whether diastolic and systolic blood pressure is consistent with this ratio [22].

Deviations from ideal indices (1.618 or 0.618) among healthy people are considered to be no more than 5–8%, even with the changes of hemodynamic indices by 1.5–2 times [1].

In 1998 V.V. Shkarin and E.V. Gurvich studied the clinical value of diastolic (DBP) and systolic (SBP) blood pressure (BP) ratio. This ratio has the term "structured spot of blood pressure" (SSBP). Currently, it is known that SSBP is approaching the value of the “golden ratio” proportion - 0.618. Regardless of BP indicators, SSBP aims for a constant value [3, 4].

V.G. Bochkov developed a universal table of the quality zones of the systems

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functioning, depending on the value of indices similar to SSBP for any biological system, applicable for BP, too [4].

The purpose of this study was to assess and analyze the structured spot of blood pressure in residents of Yakutia from the perspective of the "golden ratio".

Materials and methods. The study used the existing database of biomedical expeditions of the Yakut Science Centre of Complex Medical Problems from 2008-2018, including data on 1959 people. Blood pressure data of 12 regions of the Republic of Sakha (Yakutia) was analyzed. Districts were divided by socio-economic zones: Northern (Arctic) - Anabarsky, Verkhnekolymsky, Srednekolymsky; Eastern - Ust-Maysky, Oymyakonsky (Tomtor, 2018), Oymyakonsky (Ust-Nera, 2008); Western – Vilyuysky; Southern - Lensky, Aldansky; Central - Megino-Kangalasky, Ust-Aldansky, Yakutsk.

The body mass index (BMI) was calculated by the formula: BMI = body weight in (kg) / height (m)^2 [16]. For overweight took the values were > 25 and < 30 kg / m^2. Obesity was recorded with a BMI ≥ 30 kg / m^2 (according to European recommendations of the III revision, 2003). During the classification of blood pressure levels of mm Hg. data from VNOK (2009) [2] was used, so the optimal was <120 and <80 mm Hg, normal 120–129 and / or 80–84 mm Hg, high normal 130-1139 / or 85–89 mm Hg; Grade 1 hypertension corresponded to 140–159 and / or 90–99 mm Hg, grade 2 hypertension - 160–179 and / or 100–109 mm Hg, 3rd degree hypertension - ≥ 180 and / or ≥110 mm Hg. For the assessment of blood pressure indices, the "structured spot of blood pressure" (SSBP) and the ratio of DBP/SBP was used. It is now known that SSBP is approaching the value of the golden proportion of the RFP - 0.618 (harmonious ratio). The values of blood pressure with SSBP in the range from 0.564 to 0.673 among healthy people were considered stable. In patients with arterial hypertension (AH), "disharmony" ranged from 0.549 to 0.687 (the deviation of GP from up to 8% - 11%).The greatest differences from the GR proportion, "imbalance or disbalance" (12% and above), which are characteristic of unstable states: borderline arterial hypertension, severe forms of AH, possibly crisis forms of AH [3].

Statistical processing of the results was performed using the SPSS application package (version 17) and Microsoft Office Excel 2003.The accuracy of differences between average indices was assessed using Student's t-test, Wilcoxon–Mann–Whitney (Z) and Kolmogorov–Smirnov nonparametric test. Differences were considered statistically significant at p <0.05.

Research results. According to the blood pressure data of the studied population, the structured spot of blood pressure was calculated as the clinical value. At the moment, it has been shown that SSBP is approaching the value of the proportion of the golden ratio = 0.618 [4].

The results of anthropometric indices close to the golden proportion (GP) in terms of blood pressure and SSBP are presented in Table 1. With the indices of SSBP equal to (0.615-0.618), the residents of Tomtor village, Oymyakonsky District had the shortest height (1,547 ± 0,03), and the residents of Yakutsk are the tallest 1,731 ± 0.06 m (p <0.05). The body weight of the residents of the Srednekolymsky District corresponded to 81.10 + 7.24 kg and was the highest indicator in the compared groups, and the residents of the Megino-Kangalasky district had the smallest weight - 61.42 + 7.36 kg (p <0.05). Body mass index (BMI) showed as overweight almost in all groups. Obesity was observed in residents of the Verkhne- and Srednekolymsky districts (30.83 + 3.06, 31.59 + 4.32 respectively), as well as in the Oymyakonsky District, Ust–Nera village (32.89 + 3.00) (Table 1).

The results of the obtained blood pressure (BP) data and SSBP in the surveyed residents by district are presented in Table 2. The average indices of blood pressure and SSBP in the districts were SBP 129.94 + 0.544 mm Hg, DBP 81.10 +, 297 mm Hg. at a harmonious SSBP of 0.629 + 0.00. A SSBP close to the golden proportion (0.618) was found in the residents of Anabarsky (0.615 + 0.00) and Ust-Aldansky (0.619 + 0.00) districts, where blood pressure corresponded to SBP 135.45 ± 2.29 mm Hg. and 134.05 + 1.59, DBP 82.13 ± 0.82 and 81.92 + 0.76 mm Hg respectively (Table 2).

With age, there is a tendency of increased blood pressure and decreased SSBP, while significant differences in pressure and SSBP have been observed since the age of 30. High pressure, exceeding normal values, begins at the age of 50 and reaches the highest value in the age group of 80-89 years old (Table 3). It should be noted that from the surveyed population, only 1.61-3.23% of the population had a harmonious (0.615) SSBP indices, close to the GP (0.618) (Table 3).

The surveyed population was divided into 2 groups: the 1st group included res-

Table 1

Anthropometric measurements and BMI among the examined residents with the SSBP indices close to the Golden proportion (0,615-0,618)

DISTRICT	Height, m	Weight kg	BMI	SBP, mm Hg	DBP, mm Hg	SSBP
Anabarsky n=16 (13.11%)	1.62 ±0.05	74.41 ±8.30	29.35 ±3.59	130.0 0±.00	80.0 0±.00	0.615 0±.00
Lensky n=13 (9.15%)	1.61 ±.04	68.25 6±.30	26.25 ±2.49	128.1 3±.65	78.84 2±.19	0.616 ±0.00
Megino-Kangalasky n=12 (6.15%)	1.53 ±0.04	61.42±7.36	26.31± 2.69	130.00 ±5.73	80.00 ±3.44	0.615 ±0.00
Oymyakonsky 2018 (Tomtor village) n=3 (1.62%)	1.55 ±0.03	62.33 ±11.43	26.14 5±.14	121.67 ±10.97	75.00 ±6.58	0.617 ±0.00
Srednekolymsky n=4 (8.51%)	1.67 ±0.02	81.10 ±7.24	31.59 ±4.32	130.75 ±12.43	80.50 ±7.52	0.616 ±0.00
Ust-Aldansky n=16 (4.97%)	1.61 ±0.05	68.68 ±4.65	26.49 ±1.61	132.50 ±8.90	81.56 ±5.46	0.616 ±0.00
Ust-Maysky n=8 (5.63%)	1.59 ±0.04	73.87 ±9.23	29.25 ±4.11	129.12 ±14.47	79.38 ±8.77	0.615 ±0.00
Vilyuysky n=4 (5%)	1.59 ±0.05	63.25 ±13.73	25.026 ±4.84	125.75 ±15.64	77.50 ±9.35	0.617 ±0.00
Verkhnekolymsky n=7 (8.05%)	1.65 ±0.05	83.57 ±9.53	30.83 ±3.06	119.14 ±6.48	73.57 ±3.85	0.618 ±0.00
Yakutsk n=13 (3.54%)	1.73 ±0.06	83.23 ±7.45	27.79 ±2.10	130.00 ±0.00	80.00 ±0.00	0.615 ±0.00
Aldansky n=15 (8.93%)	1.67 ±0.05	77.13 ±8.40	27.60 ±2.53	133.33 ±6.56	82.00 ±3.94	0.615 ±0.00
Oymyakonsky 2008 (Ust-Nera village) n=7 (6.94%)	1.59 ±0.48	83.80 ±5.19	32.89 ±3.00	121.57 ±6.67	75.00 ±3.97	0.617 ±0.00

Table 2

The indices of BP and SSBP by districts

Districts	n	SBP, mm Hg	DBP, mm Hg	SSBP
Anabarsky	122	135.45±2.29	82.13±0.82	0.615+0.00
Lensky	142	137.64+2.19	81.77+0.86	0.604+0.00
Megino-Kangalasky	195	117.79+1.44	73.59+0.81	0.627+0.00
Oymyakonsky 2018 (Tomtor Village)	185	144.52+2.02	90.19+1.02	0.632+0.01
Srednekolymsky	47	126.32+2.54	78.50+1.62	0.625+0.01
Ust-Aldansky	322	134.05+1.59	81.92+0.76	0.619+0.00
Ust-Maysky	142	132.26+1.97	85.34+1.25	0.648+0.00
Vilyuysky	80	130.76+2.34	82.71+1.57	0.634+0.00
Verkhnekolymsky	87	129.57+2.77	77.53+1.26	0.605+0.06
Yakutsk	367	123.30+0.96	77.99+0.70	0.632+0.00
Aldansky	168	125.80+1.10	82.05+0.71	0.653+0.00
Oymyakonsky 2008 (Ust-Nera village)	101	125.13+2.00	80.96+1.17	0.649+0.00
Overall	1959	129.94+0.54	81.10+0.29	0.629+0.00

idents who did not have high blood pressure, the 2 group included people diagnosed with arterial hypertension. When comparing the average indices of SSBP by districts in the 1st group with harmonious SSBP, residents of the Verkhnekolymsky district amounted to mean 0.609 ± 0.05, and disharmonious SSBP was found among residents of Yakutsk 0.631 ± 0.06. In group 2, harmonious SSBP (0.614 ± 0.07) was observed in the residents of Tomtor village, Oymyakonsky District and Megino-Kangalasky (0.609 ± 0.05) District. Residents of Lensky District turned out to have a disharmonious SSBP (0.566 ± 0.07).

When analyzing data by districts, harmonious SSBP was observed among the population of Ust-Aldansky, Anabarsky and Lensky districts, and when comparing across SSBP zones, harmonious indices were found among residents of the Arctic (Table 4). Within the zone by districts, a significant difference was found in the Northern (Arctic) zone - between Anabarsky and Verkhnekolymsky districts - p <0.04 (according to Kolmogorov). The eastern zone - between Ust–Maysky and Oymyakonsky (Ust-Nera, 2008) districts - p <0.05. Southern zone - a significant difference was observed between Lensky and Aldansky, p <0.001, the Central zone - Magino-Kangalassky district and Yakutsk, p <0.001. Also, the difference in SSBP indices between the zones was significant: between the Northern and Eastern, Northern and Western (p <0.02), Western and Southern, (p <0.001), Southern and Central zones (p <0.02) (Table 4).

Results of the comparative analysis of the groups 1 and 2 are presented in table 5. Indices of blood pressure of the 1st group were within the limits of the permissible rate, harmonious SSBP was detected in 70 people, which amounted to 3.57% (Table 5). In group 2, blood pressure was higher than normal - SBP144.36 ± 0.88 and DBP 89.15 ± 0.51, however, it should be noted that disharmonic SSBP was 0.619 ± 0.00, which is very close to the golden proportion (0.618). Thus it is possible to confirm the statement of K. Nishi that the main indicator of health is the ratio of upper (SBP) and lower (DBP) pressure, which is 7/11 (or quite close to this value within 6/11 - 8/11), as it is approaching the golden ratio (0.618). Meanwhile, in group 2, harmonious SSBP (0.615) was indicated in only 1.84% of people. Harmonious SSBP in group 1 was significantly different from all other indices of SSBP and blood pressure of group 2 (χ 2 = 0.000, p = 0.001) (Table 5).

Table 3

The indices of BP and SSBP in relation to age

Age	N	SBP, mm Hg	DBP, mm Hg	SSBP	with SSBP (0,615) in %	P<0,05
20-29	247	112.07+3.83	73.29+2.35	0.635+0.00	3.23	-
30-39	360	118.32+0.84	76.13+0.57	0.644+0.00	2.5	+
40-49	417	125.79+0.95	80.73+0.63	0.643+0.00	2.63	+
50+59	574	135.88+0.98	84.83+0.54	0.629+0.00	2.09	+
60-69	249	147.32+1.69	87.43+0.87	0.599+0.00	1.61	+
70-79	75	153.28+3.03	86.40+1.31	0.572+0.00	2.66	+
80-89	19	154.42+6.04	84.742.99	0.555+0.02	-	+
90 + y. o.	1	160	80	0.500	-	-

In the study of SSBP, depending on the classifications of blood pressure, the following results were obtained. Out of the total number of people studied, hypotonia was detected in 75 people (3.84%) with an average BP of 94.06 / 61.75 mm Hg, SSBP was disharmonious. 578 people (29.57%) had optimal pressure, BP was 108.65 / 70.4 mm Hg, SSBP was disharmonious. Normal blood pressure was observed in 401 people (20.51%), blood pressure was 123.56 / 81.35 mm Hg, and SSBP was disharmonious. High normal blood pressure was present in 262 people (13.40%), blood pressure was 131.97 / 90.59 mm Hg, SSBP was disbalanced. Moderate hypertension was detected in 378 people (19.34%), blood pressure was 145.61 / 90.47 mm Hg, SSBP was disharmonious. Hypertension of moderate severity occurred in 169 people (8.44%), blood pressure ranged 165.70 / 94.87 mm Hg, SSBP was disbalanced. 92 people (4.71%) appeared to have severe hypertension, BP 192.33 / 103.04 mm Hg, SSBP was disbalanced (Table 6). Unbalanced SSBP (0.542) occurred in all classifications of blood pressure, however, the highest incidence was observed in people with moderate (16.57%) and severe hypertension (64.13%). Harmonious SSBP (0.615) is observed only in residents with high normal pressure. SSBP was disharmonious in all classifications of blood pressure and the largest numbers had residents with hypotension (50.67%) (Table 6). With an increased blood pressure and BMI, a decrease in SSBP and remoteness from the golden proportion (0.618) was observed, and a strong inverse correlation was noted between them (r = -0.854, p <0.05) (Table 6).

When the heart is working in the vessels, hydrodynamic pressure is created, which is caused by the resistance of the vessel walls. For an adult, a conventionally normal blood pressure is: the maximum (systolic) -100 - 140 mm Hg. and the minimum (diastolic) - 70 - 90 mm Hg.

Thus, the range of possible BP in humans is 0–100–140 mm Hg. We divide this range in relation of 1.61:1, we get 100 / 1.618 = 61.8 mm Hg. 140 / 1.618 = 86.5 mm Hg., which is very close to the parameters of diastolic pressure. With

Table 4

The indices of SSBP by districts, divided by the socio-economic zones

Socio-economic division of districts by zones	Group 1 (without AH)	Group 2 (with AH)	Total amount
Northern (Arctic)			
Anabarsky	0.654±0.03 n=64	0.573±0.05 n=58	0.615±0.04 n=122
Verkhnekolymsky	0.609±0.05 n=60	0.598±0.08 n=27	0.606±0.06 n=87
Srednekolymsky			0.625±0.05 n=47
TOTAL			0.615±0.05
Eastern			
Ust-Maysky	0.655±0.04 n=72	0.641±0.07 n=71	0.648±0.06 n=143
Oymyakonsky 2018	0.674±0.05 n=55	0.614±0.07n =130	0.632±0.07 n=186
Oymyakonsky 2008	0.662±0.03 n=55	0.641±0.04 n=56	0.650±0.04 n=101
TOTAL			0.643±0.04
Western			
Vilyuysky	0.642±0.05 n=52	0.621±0.06 n=28	0.635±0.06 n=80
TOTAL			0.635±0.06
Southern			
Lensky	0.642±0.04 n=71	0.566±0.07 n=71	0.604±0.07 n=142
Aldansky	0 . 6 5 7 ± 0 . 0 3 n=117	0.644±0.05 n=48	0.653±0.04 n=165
TOTAL			0.628±0.05
Central			
Megino-Kangalasky	0.637±0.03 n=30	0.609±0.05 n=65	0.628±0.04 n=195
Ust-Aldansky	0.646±0.03 n=170	0.588±0.06 n=152	0.619±0.06 n=322
Yakutsk	0.631±0.06 n=251	0.633±0.06 n=116	0.632±0.06 n=367
TOTAL			0.626±0.05n=1959

Table 5

The indices of BP and SSBP among the examined residents without AH and with AH

	Indices	SBR, mm HG	DBR, mm HG.	SSBR	%
Group 2 (without AH)	Stable disharmony (0.564-0.673) n=732	116.24±0.53	74.14±0.03	0.638±0.00	37.37
	Lower disbalance (from 0.564 and lower) n=96	118.57±1.85	63.45±0.81	0.537±0.00	4.9
	Higher disbalance (from 0.673 and higher) n=232	116.81±1.05	82.79±0.35	0.709±0.00	11.84
	Harmonious. close to GP (0.618) n=70	126.13±1.27	77.60±0.62	0.619±0.00	3.57
Group 2 (with AH)	Stable disharmony (0.549-0.687) n=535	144.36±0.88	89.15±0.51	0.619±0.00	27.31
	Lower disbalance (from 0.549 and lower) n=152	170.70±1.56	86.01±0.95	0.505±0.00	7.76
	Higher disbalance (from 0.687 and higher) n=106	134.46±1.37	96.24±0.98	0.716±0.00	5.41
	Harmonious. close to GP n=36	131.11±1.95	80.69±1.19	0.615±0.00	1.84
	Total n=1959				100%

hypertensive disease or with increased physical exertion, blood pressure rises. The maximum possible systolic pressure in humans can reach 230 mm Hg. The limiting value of blood pressure differs from normal systolic by 1.618 times: 140 * 1.618 = 226.5 mm Hg. From this we can conclude that the ratio of blood pressure with the golden proportion is obvious.

It is believed that the fluctuations of the upper pressure are harmful to the body. However, as it was written above, Professor Katsuzo Nishi (2006), lived in the early 20th century, the ratio between upper and lower pressure and vice versa considered to be especially dangerous disruptions. He considered the "golden ratio" of blood pressure, which is 7/11 (or rather close to this value within (6/11 - 8/11)), as an indicator of health, which should be aligned with. With this ratio, practically any figures of upper and lower pressure are absolutely not dangerous for a person, even 274/174 mm Hg (0.635). But if this "golden ratio" is violated, for example, at the level of BP of 127/95 mm Hg (0.748), there is a significant health hazard. And, of course, the greater the difference between the ratio of upper/lower pressure and the "golden ratio" is, the higher the risk of developing cardiovascular diseases. It should be noted that this formula is applicable only to people over 20 years of age [9].

O.V. Tatarinova (2014) in a result of a 7-year prospective observation of residents of Yakutia over 60 years old with a minimal risk of death, revealed that in both sexes, the SBP was 148.3 ± 24.2 and the DBP was 87.4 + 11.7, BMI - 26.7 ± 5.1. Let's make the calculation from the point of view of the Nishi's golden proportion: 87.4 x11 = 961.4 / 148.3 = 6.48, which is an indicator of health in the "golden ratio", SSBP turned out to be disharmonious - 0.589. Our obtained results upon the age gradient above 60 years old correspond with the data of O.V. Tatarinova (Table 3) [14].

M.A. Karpenko et al. (2010) researched the clinical value of quantitative analysis of ECG and BP using the "golden ratio" method and found that if the ECG and blood pressure values deviate from the optimal values by more than 15%, the probability of having CHD in the examined patients is 85% [6].

It is interesting how according to a large-scale HOT study (Hypertension Optimal Treatment), which included the study of 18,790 patients with hypertension, the optimal blood pressure in terms of the lowest risk of death due to cardiovascular causes, is considered to be BP = 138.8 / 86.5 mm Hg. The calculation of

Table 6

The indices of SSBP in relation to the qualification of BP

Classification of BP	SBP, mm Hg	DBP, mm Hg	SSBP	SSBP (0,542)	SSBP (0,615) harmonious	SSBP (0,667)
Hypotonia lower than 100/60 n=75	94.06 ±2.30	61.75 ±1.70	0.657 ±0.01	(1.33%) n=1	-	(50.67%) n=38
Optimal BP 100-119/60-79 n=578	108.65 ±1.37	70.40 ±1.91	0.649 ±0.02	(14.19%) n=82	-	(5.53%) n=32
The norm 120-129/80-84 n=401	123.56 2±.39	81.35 ±2.43	0.659 ±0.02	(1.74%) n=7	-	(53.87%) n=216
High normal BP 130-139/85-89 n=262	131.97 ±1.21	90.59 ±16.73	0.688 ±0.13	(262%) n=5	(35.87%) n=94	(8.6%) n=22
Moderate hypertension (1st degree AH) 140-159/90-99 n=378	145.61 1±.30	90.47 ±1.88	0.622 ±0.01	(2.91%) n=11	-	(6.08%) n=23
Hypertension of intermediate severity (2nd degree AH) 160-179/100-109 n=169	165.70 ±1.59	94.87 ±3.07	0.573 ±0.02	(16.57%) n=28	-	(1.18%) n=2
Severe hypertension (3rd degree hypertension) Higher than 180/ Higher than 110 n=92	192.33 ±5.07	103.04 ±4.53	0.537 0±.02	(64.13%) n=54	(1.08%) n=1	(3.26%) N=3
TOTAL=1955				193 (9.87%)	95 (4.85%)	336 (17.19)

SSBP from these data gives the number of 0.6231, absolutely identical to the average value of SSBP, which was obtained from the study of a group of healthy individuals, and according to Nishi, the ratio of blood pressure was 6.85. The lowest risk of developing cardiovascular complications was found at BP = 138.5 / 82.6 mm Hg. SSBP in this case is equal to 0.5942, which is also included in the range of SSBP ± 1s [3].

Thus, the existing norms of blood pressure (according to WHO: 120/80 mm Hg) do not apply to all people, especially the elderly. Therefore, an individual approach is necessary for each patient, taking into account the proportion of the “golden ratio”. Analysis of the values of the structural constant of blood pressure opens up new possibilities in terms of predicting the stability of arterial hypertension, and determination of the structured spot of blood pressure will be appropriate during functional studies in patients with arterial hypertension and coronary heart disease.

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STUDY OF THE LACTATE LEVEL IN THE BLOOD SERUM OF ATHLETES TRAINING IN THE CONDITIONS OF THE FAR NORTH

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The article presents the results of studies of the lactate level, physical performance and lipid peroxidation in highly skilled athletes in the Far North. We examined 85 men of Yakut nationality, including 60 highly qualified athletes (candidates for masters of sports (kmc) and masters of sports (ms)), aged 17 to 21 years old, the first group consisted of free-style wrestlers -30 people, the second - boxers 30 people.

The control group consisted of young students engaged in physical exercises at least twice a week. It was shown that the level of lactate depended on the level of physical performance of athletes and the accumulation of lipid peroxidation products. The highest values of lactic acid were noted at the recovery stage.

Keywords: lactate, lipid peroxidation, physical performance, athletes, Far North.

Introduction. The level of lactate (lactic acid) in the blood serum, and the intensity of free-radical processes in the body are one of the criteria characterizing the fitness of athletes and show their tolerance to physical exertion [3, 4, 6]. With intense physical exertion, active forms of oxygen are formed leading to a significant increase in lipid peroxidation (LPO), which has a negative effect on muscle activity [5]. In conditions of high energy production in anaerobic mode, lactate is a carrier of energy from those places in which it is impossible to transform energy, due to increased acidity, to those places in which it can be transformed into energy (heart, respiratory muscles, slowly contracting muscle fibers, others muscle groups). Lactate plays a special role in maintaining the body's ability to perform strenuous physical work.

It has been established, that with intense physical exertion in the muscles a large amount of lactic acid is formed, which inhibits their contractility and causes muscle fatigue [3, 5]. The importance of individual metabolites of anaerobic glycolysis, lactate (lactic acid), is currently being widely studied.

Material and research methods. A survey of 85 men of Yakut nationality was conducted, of which 60 athletes of high qualification (candidates for masters of sports (cms) and masters of sports (ms)), aged 17 to 21 years old. The first group consisted of free-style wrestlers -30 people, the second – boxers (30 people). The control group consisted of 25 young students, of the same age, engaged in physical education at least twice a week. All examined according to the results of an in-depth medical examination were practically healthy.

The research material was heparinized blood and serum. Blood was taken - in the morning on an empty stomach from the cubital vein. The study was approved by the decision of the local Ethics Committee at the Yakutsk Research Center for Complex Medical Problems.

The intensity of lipid peroxidation was determined by spectrophotometric method [8]. The level of lactate in the blood serum was determined during ongoing examinations in a state of relative rest, on a semi-automatic analyzer "Screen Master" (Italy).

The overall physical performance of the PWC170 was determined using a Neurosoft bicycle ergometer (Ivanovo). The subjects performed two loads of moderate intensity with a pedaling frequency of 60 rpm on a bicycle ergometer, separated by a 3-minute rest interval. Each load lasted 5 minutes [2].

Statistical processing of the obtained data was carried out using the package of applied statistical programs STATIS-

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