Since 2010 there are no registered cases of maternal mortality. This is also the result of the effectively organized three-level system of healthcare service for pregnant and parturient women; monitoring pregnant and parturient women. While there were 2 cases of the registered maternal mortality in the other regions of the Republic in 2018.

Conclusions. Having analyzed medical and demographic indicators for the period of 2000-2018 in the Arctic zone of the Republic of Sakha (Yakutia), we can constitute the following positive tendencies as:

1. High mean indices for the birth rate (18.4%);
2. Great portion of the normal delivery (66.2%);
3. Permanent decrease of the mean number in infant mortality rate to 2%;
4. No cases of maternal mortality;
5. Ways of effective organizing the healthcare service resources and positive indicators of its efficacy.

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INDICATORS OF THE CARDIOVASCULAR SYSTEM AND HEART RATE IN YOUNG MALE RESIDENTS OF MAGADAN REGION AT LOCAL EXPOSURE TO COLD

The aim of this work was to study the alterations of cardiohemodynamics and the variability of the heart rhythm at rest and under local cold effects in individuals with different initial types of autonomic regulation.

Methods: In 54 young male people aged 17 to 19, background records of cardiac rhythm and hemodynamics were registered both at rest (lying on the couch) and during immersion of the contact hand in a container with water at a temperature of 4 ° C for 4 minutes.

Results of the work. It was found that the analyses of heart rate variability in vagonormotonic young men can neither at rest nor at the peak of the cold test provide an opportunity to adequately analyze the changes in the cardiorhythm index in response to the test. Whereas in the differentiation of the examined subjects according to their initial types of autonomic balance it was shown that in the sample of young men with the initial normotonic type of autonomic regulation at rest, higher values of arterial blood pressure and heart rate were observed with a pronounced hypertensive reaction in response to the cold test. In this case, the pattern of changes in the indices of the heart rate variability at a cold test indicates a statistically more pronounced activation of the sympathetic link of the autonomic nervous system. In the meantime, in the vagotonics group, the local cold effect did not change the character of autonomic regulation of cardiac rhythm against the background of significant dynamics of systolic and diastolic arterial pressure.

Conclusions: The obtained results indicate that young men with a predominance of parasympathetic orientation in the heart rhythm regulation demonstrate high stability of autonomic regulation to the presented cold test, which was manifested by the absence of statistically significant shifts in all studied cardiorhythm indicators and may indicate the cold resistance of this contingent.

Keywords: young men, cold test, cardiovascular system indicators, heart rhythm.

The significant material on the physiology of humans and animals with various forms of adaptation to low ambient temperatures [4, 10, 14] has been available now. Cold test is one of the common tests used for functional assessment of the microvascular state. It is associated with the creation of local tissue hypothermia in the zone of its contact with a cooling object of a small area, the low temperature of which is maintained for the required period of time [11]. Analysis of the references indicates a sufficient degree of study of the structure of the peripheral component of vasomotor reactions to relatively short-term acute local cooling of various body segments, as well as neurohumoral and local mechanisms of vascular tone regulation [3]. Also, at a sufficiently high level, the physiological mechanisms of the response of the cardiovascular system to the cold have been studied [5]. Moderate general cooling usually leads to an increase in systemic arterial blood pressure, cardiac output, and heart rate, which is associated with increased sympathetic ANS activity and general vasospasm at the periphery of the body [9]. In this regard, the peculiarities of rearrangements of systemic cardio hemodynamic parameters and heart rate variability at rest and during local cold exposure in individuals with different initial autonomic regulation types were studied.

Materials and methods. In total, 54 young men aged 17 to 19 years old, students of Northeastern State University (Magadan) were surveyed. Background records of heart rate, hemodynamic parameters were carried out while lying on the couch. After that, another contact brush was immersed in a container with water at a temperature in the range of 4 Cº for 4 minutes.

The cardiac rhythm was recorded using the Varicard instrument and the VARICARD-KARDi software, taking into account the guidelines of the group of Russian experts [1]. The following indicators of HRV were analyzed: mode (Mo, ms) - the most common value of the R-R interval; the difference between the maximum and minimum values of cardiointervals (MxDMn, ms); the number of pairs of cardiointervals with a difference of more than 50 ms in% of the total number of cardiointervals (pNN50, ms); standard deviation of the complete array of cardiointervals (SDNN, ms); mode amplitude with a class width of 50 ms (AMo50%, ms); index of tension of regulatory systems (SI, standard units); the total power of the heart rate spectrum (TP, ms2), the power spectrum of the high-frequency component of heart rate variability in the range of 0.4-0.15 Hz (respiratory waves) (HF, ms2); spectrum power of the low-fre-

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quency component of heart rate variability in the range of 0.15–0.04 Hz (LF, ms2); the power of the spectrum of the very low-frequency component of heart rate variability in the range of 0.04–0.015 Hz (VLF, ms2). Systolic (MAP, mmHg) and diastolic (DBP, mmHg) blood pressure and heart rate (HR, beats / min) were recorded with a Nessei DS – 1862 automatic blood pressure monitor (Japan) at rest (lying) and at the peak of the cold test.

The types of autonomic regulation were determined at rest on the basis of the values of the following indicators: MxDMn, SI, TP, where the range of eutonia (normotonia) for MxDMn we considered equal to 200 to 300 ms, for SI - from 70 to 140 conv. units, for TP - from 1000 to 2000 ms2 [6]. If the studied indices of MxDMn and TP were below these ranges, then the autonomic balance was assessed as sympathotonic, with an increase in the values of this corridor - as vagotonic. On the contrary, relative to the SI, with an increase in its values of more than 140 services. units (taking into account 2 other indicators) vegetative balance was assessed as sympathetic, and a decrease of less than 70 const. units, - vagotonicheskoy. Due to the small number of sympathotonics in the sample, the functional indicators of young men of this type in this series of studies were not analyzed. The sample for statistical analysis included individuals with normotonic and vagotonic types of vegetative regulation. All examinations were conducted in a room with a comfortable temperature of 19-21 ° C, in the morning. The study was carried out in accordance with the principles of the Helsinki Declaration. The study protocol was approved by the Ethical Committee for Biomedical Research at the NESC of the Far-Eastern Branch of the Russian Academy of Sciences (No. 004/013 dated December 10, 2013). Prior to inclusion in the study, all participants received written informed consent.

The results were subjected to statistical processing using the software package Statistica 7.0. The check for the normal distribution of the measured variables was carried out on the basis of the Shapiro – Wilk test. The results of non-parametric processing methods are presented as a median (Me) and interquartile range in the form of 25 and 75 percentiles, and parametric methods as an average value and its error (M ± m). In the case of a comparison of related samples, the statistical significance of differences was determined using the t – Student criterion for dependent samples with a normal distribution and the non-parametric Wilconson test for samples with a distribution other than normal. When comparing unrelated samples, the statistical significance of differences was determined using Student's t-test for independent samples with a parametric distribution and the non-parametric Mann – Whitney test for samples with a non-normal distribution. The critical level of significance (p) in the work was taken to be 0.05; 0.01; 0.001 [2].

Results and discussion. The main indicators of heart rate variability in young men - wagon-monitors in the city of Magadan at rest and at the peak of the cold test are presented in table 1. The obtained results did not allow us to conduct an adequate analysis of the rearrangement of heart rate indicators in response to the sample, because of the different heart rate indicators. Based on this, we carried out differentiation of the examined group according to the initial type of vegetative balance, as a result of which two groups of young men were distinguished: the 1st group is normotonics (n = 19) and the 2nd group - vagotonics (n = 35).

From the above data it can be seen (Table 2) that the examined young people of the two groups, differing in the initial type of autonomic balance at rest, have a number of differences in both the background indicators of the heart rate and the indicators at the peak of the cold test. When analyzing the results, it was found that the group of normotonics with respect to the tested vagotonics in the background state is characterized by statistically significant differences in almost all analyzed characteristics of HRV, which causes differentiation according to the initial autonomic type.

It can be seen from the above data that at the peak of performing a cold test of a young man — normotonics, compared with vagotonics, they are characterized by lower values of MxDMn, RMSSD, pNN50, Mo, all spectral indices of heart rate: TP, HF, LF, VLF and higher HR and SI. Changes in the indices of heart rate variability for the cold test had pronounced differences in the two groups examined. Thus, representatives from the number of normotonics in response to the cold sample presented were characterized by a decrease in RMSSD, pNN50, Mo, TP, HF, LF, VLF against the background of an increase in HR and SI. In the group of young men - vagotonics, no one analyzed cardiac rhythm index in response to the cold test showed significant dynamics.

Table 3 presents the main indicators of the cardiovascular system in the young men examined by us at rest and at the peak of cold exposure, taking into account the initial type of vegetative balance. From the above data it can be seen that in young men – normotonics at rest, statistically significantly higher indices of systolic, diastolic blood pressure and heart rate were noted. Short-term cold exposure in representatives of the two groups caused a significant increase in systolic and diastolic blood pressure, where a more pronounced hypertensive reaction of MAP was characteristic of normotonics with a simultaneous increase in heart rate, and an increase in DBP was more pronounced in the vagotonic group.

Analysis of the dynamics of the main characteristics of heart rate variability revealed a number of differences in the response to short-term cold exposure in groups with differences in the initial type of autonomic balance: thus, in the group with the initial normotonic type of autonomic balance, marked dynamics of al-

Таблица 1

Indicators of the Heart Rate Variability at rest and under local cold effects (Vagonormotonic)

Изучаемый показатель	Stage of Experiment		Significance of difference
	at rest	local cold effects	
HR, bpm	65.3 (59.5;72.9)	68.2 (62.9;74.8)	p<0.001
MxDMn, ms	344.0 (303.0;447.0)	384.0 (324.0;450.5)	p<0.05
RMSSD, ms	63.5 (46.1;82.9)	58.8 (45.7;76.1)	p=0.25
pNN50, %	40.2 (21.2;57.2)	36.0 (21.4;46.7)	p<0.001
SDNN, ms	71.1 (53.7; 86.8)	75.7 (62.8;92.8)	p<0.01
Mo, ms	888.0 (825.0; 1034.0)	856.0 (766.5;962.5)	p<0.001
AMo50, ms	30.3 (23.2; 37.5)	27.5 (23.8;33.1)	p<0.05
SI, arb. units.	44.9 (28.6; 73.3)	46.1 (27.3;61.2)	p=0.17
TP, ms ^{2}	3463.2 (2540.0; 4893.6)	3968.4 (2527.0;4973.5)	p=0.41
HF, ms ^{2}	1466.5 (769.9; 2415.8)	1491.2 (790.5;2226.5)	p=0.40
LF, ms ^{2}	1171.0 (703.8; 1827.9)	1380.1 (931.3;2112.5)	p=0.18
VLF, ms ^{2}	647.3 (395.0; 839.6)	650.6 (391.9;1270.3)	p=0.08

Таблица 2

Indicators of the Heart Rate Variability at rest and under local cold effects with different initial types of autonomic regulation, Me (25; 75-percentile)

Studied parameter	Нормотоники		Significance of difference baseline-Local cold effects	Vagotonic		Significance of difference baseline-Local cold effects	Significance of difference baseline normotonic – baseline vagotonic	Significance of difference local cold effects normotonic – local cold effects vagotonic
	at rest	local cold effects		at rest	local cold effects			
MxDMn, ms	344.9 (272.2;374.1)	325.1 (263.4;401.0)	p=0.37	378.0 (328.0;479.1)	423.1 (353.0;496.0)	p=0.17	p<0.05	p<0.05
RMSSD, ms	57.8 (38.8;61.3)	36.1 (26.7;64.1)	p<0.05	71.1 (47.1;88.5)	65.8 (54.5;75.3)	p=0.33	p<0.05	p<0.05
pNN50, %	33.2 (15.5;38.3)	13.1 (6.8;30.3)	p<0.05	44.9 (21.6;59.9)	40.8 (30.4;48.2)	p=0.23	p<0.05	p<0.05
SDNN, ms	67.7 (53.6;71.2)	70.4 (47.5;94.6)	p=0.23	75.1(64.6;92.3)	81.2 (70.2;99.1)	p=0.22	p<0.05	p=0.55
Mo, ms	831.1 (751.6;912.4)	709.6 (657.7;715.1)	p<0.05	915.3 (791.2;979.3)	878.0 (773.0;962.0)	p=0.18	p<0.05	p<0.001
AMo50, ms	33.4 (28.1;37.1)	35.9 (18.0;52.2)	p=0.87	26.2 (22.3;37.5)	26.0 (20.5;30.6)	p=0.49	p<0.05	p=0.68
SI, arb. units	76.8 (39.8;80.7)	92.8 (30.7;146.9)	p<0.05	37.6 (24.2;67.3)	33.5 (24.5;48.6)	p=0.53	p<0.05	p<0.05
TP, ms ^{2}	3201.9 (2379.2;4670.1)	1814.9 (1003.1;4813.2)	p<0.05	3897.0 (3376.1;4938.8)	3969.9 (3097.4;4775.2)	p=0.96	p<0.05	p<0.05
HF, ms ^{2}	1523.6 (521.1;1862.0)	813.2 (342.9;2193.7)	p<0.05	2049.1 (829.2;2805.2)	1705.6 (1007.3;2279.7)	p=0.11	p<0.05	p<0.05
LF, ms ^{2}	1418.1 (908.3;1646.9)	853.6 (623.6;2026.3)	p<0.05	1200.1 (728.1;1882.5)	1299.9 (955.3;2051.5)	p=0.48	p<0.05	p<0.05
VLF, ms ^{2}	516.2 (477.7;677.1)	276.2 (157.2;577.3)	p<0.05	565.7 (379.1;1293.2)	712.0 (418.9;1187.8)	p=0.43	p=0.73	p<0.05

most all the studied heart rate characteristics in response to the cold trial. A decrease in the activity of parasympathetic regulation was noted, as evidenced by a statistically significant decrease in MxDMN, RMSSD, pNN50 and Mo, which was manifested against the background of an increase in the activity of the sympathetic division of the autonomic nervous system, as indicated by a statistically significant increase in SI and HR. Analysis of the spectral parameters of HRV indicates a decrease in all those leaving the total power of the spectrum and, accordingly, the TP index in response to the cooling of the hands of the representatives of the 1st group. Thus, a decrease in the HF component of the total spectrum power (by 43%) is a reflection of the decrease in the activity of the respiratory waves and the activity of the parasympathetic division of the ANS during the cold test. Such a decrease in parasympathetic activity during the trial, in accordance with the fundamental provisions of the theory of accented sympathetic-parasympathetic antagonism [17], is aimed at providing sympathetic activation (which is manifested in an increase in SI and HR), as the main function of the sympathetic nervous system is changing blood circulation [7].

Also, in response to this type of exposure, a decrease in the LF and VLF components of the general spectrum was observed in the subjects from the group of normotics. Currently, a decrease in LF components of the heart rhythm with an increase in blood pressure is considered as an indicator of baroreflex dysfunction, which, apparently, due to the activation of the sympathetic link and causes such a pronounced increase in the BPS, as well as an increase in heart rate in people from the number of normotonics. At the same time, a decrease in the load-bearing VLF indicates a post-load energy shortage [8].

Table 3 shows that at rest, the average blood pressure values of both systolic and diastolic and heart rate were significantly lower in the vagotonic group, which can be considered as a more economical and efficient mode of functioning of the cardiovascular system. It should be noted that in the group of normotonic values, the systolic blood pressure values in the lying position approached the upper limit of the norm, which indicates a high normal blood pressure in the representatives of this sample [19].

Conclusion. Thus, studies have shown that the pattern of cardiac rhythm rearrangements, indicators of the cardiovascular system in response to cold exposure depends on the initial type of autonomic balance. In the examined, characterized by the initial autonomic type of vegetative regulation in the process of short-term cold exposure, no significant dynamics of the heart rate characteristics was recorded against the background of increasing BPS and BPD with preservation of HR not different from background values. At the same time, in the group of normotonics, pronounced changes in the cardiovascular system parameters in the form of significant hypertensive SBP reactions and an increase in heart rate were combined with a decrease in the activity of the parasympathetic link and activation of the sympathetic link in the regulation of heart rhythm [13]. At the same time, a decrease in LF components of the

Table 3

Indicators of the cardiovascular system in baseline and under local cold effects with different initial types of autonomic regulation, M ± m

Studied parameters	Stage of Experiment		Significance of difference baseline-Local cold effects
	at rest	local cold effects	
Normotonic			
BPS, mm Hg	137.7±2.9 *	146.3±3.1*	p<0.05
BPD, mm Hg	71.8±3.1*	77.7±3.4*	p<0.05
HR, bpm	72.5±3.9*	81.9±3.1*	p<0.05
Vagotonic			
BPS, mm Hg	129.1±2.1	135.2±2.5	p<0.01
BPD, mm Hg	66.1±2.0	73.3±1.7	p<0.001
HR, bpm	65.6±2.8	67.3±2.7	p=0.67

* Significance of difference normotonic – vagotonic

heart rate with an increase in blood pressure and heart rate may indicate baroreflex dysfunction [15], and a decrease in VLF on the loading effect may reflect the presence of afterload energy deficit in response to the cold sample [8]. Reducing the activity of the parasympathetic link in the regulation of heart rate in the group of normotonics, based on the theory of accented sympathetic-parasympathetic antagonism [17], apparently aimed at providing sympathetic activation to ensure adequate blood circulation in response to the cold test [7]. According to a number of researchers, adaptive changes in the characteristics of heart rate variability during prolonged exposure to cold are manifested by a decrease in sympathetic activity and a concomitant increase in parasympathetic activation [12, 16] and the transition of vegetative balance towards parasympathetic dominance in the regulation of the cardiovascular system, which, according to the authors evidence of increased cold resistance [14, 18]. The results obtained are generally consistent with our data, where it is shown that boys with a predominance of parasympathetic orientation in the regulation of heart rhythm for the cold test presented demonstrate a high stability of autonomous regulation, which was manifested by the absence of statistically significant shifts for all studied heart rate index.

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