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ANALYSIS OF THE INCIDENCE AND STRUCTURE OF THE CARDIOVASCULAR SYSTEM DISEASES IN THE FAR NORTH MIGRANTS OVER THE PERIOD OF READAPTATION TO THE NEW CLIMATIC CONDITIONS

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The purpose of the study. To study the frequency and structure of cardiovascular diseases of the Far North migrants within the period of readaptation to the new climatic conditions.

Materials and methods. 145 migrants with stages II–III of arterial hypertension (AH) coming from the Far North arrived in the southern regions of central Siberia for permanent residence. The survey included questionnaires, clinical, instrumental, and functional and laboratory research methods.

Results. After moving to central Siberia, the hypertensive crisis is more common in people who lived in the Far North for 30 years or more. An increase in the hypertensive crisis frequency was observed in men, rather than women, whereas the stroke incidence in female migrants gets higher, but remains unchanged in male migrants. An increase in the incidence of diseases that complicate the hypertension progression was detected in the migrants during the period following the migration. An increase in the incidence of angina attacks and strokes as well as a trend towards an increase in the incidence of myocardial infarction and heart failure after moving to central Siberia is caused by an increase in the level of neurotic disorders associated with social and economic factors.

Conclusion. The identified patterns should be taken into account in the construction of prevention and rehabilitation programs for the Far North migrants along with an obligatory assessment of the adaptive and readaptive capabilities of the organism. Both the follow-up plan and the list of the required measures should be made individually, while taking into account the identified cardiovascular diseases, concomitant pathology and risk factors. Should the migrant be diagnosed with any cardiovascular diseases, they need to consult a cardiologist with the purpose of correcting both medicated and medication-free therapy for the readaptation period.

Keywords: *cardiovascular system; arterial hypertension; Far North; re-adaptation.*

Many people leave the Far North every year and move to other Russian regions with more comfortable climate. One of the prime factors associated with the migration process is health changes, especially in cardiovascular system [7, p. 12–15; 8, p. 129; 11, p. 123]. Cardiovascular system, as a high-reactive system, is one of the first to initiate adaptive reactions in the harsh climate [8, p. 129]. This factor definitely affects labor productivity and working ability. In extreme climate regions it can be the reason of negative migration, particularly in the Far North regions.

48% of deaths worldwide are due to cardiovascular deceases (CVD) [2, p. 123–125], while in Russia, according to the records for 2016, it is 47.4% [19, p. 717–718]. It has become especially important to study the difference in cardiovascular disease incidence in people of different country regions, including the Far North and Siberia [3, p. 23–29; 9, p. 55–57; 10, p. 92–95; 13, p. 73–76; 16, p. 61–69; 20, p. 109–110; 24, p. 138], as arterial hypertension (HTN) and ischemic heart disease (IHD) are on top of the list of the return migration reasons from the Far North. [7, p. 12–15; 11, p. 123; 12, p. 172].

Human activity in the Far North has to be performed with almost full mobilization of functional physiological reserves [8, p. 129]. Stable adaptation is related to a constant tension of the control mechanism, rearrangement of both the nervous and humoral systems, which are subject to gradual exhaustion [17, p. 43–51]. With very strong and long-lasting climatic influence or due to a weak body adaptation mechanism, misadaptation (disorder or failure of adaptation) might take place and morbid condition might be progressing [14, p. 361–367; 15, p. 76–83].

The psychophysiological mechanism of the readaptation stage has much in common with the adaptation stage, and the longer the stay in the changed conditions, the harder and longer it takes to adapt to the normal living conditions [7, p. 12–15; 11, p. 123; 18, p. 1275–1280].

It should be mentioned that, despite of the fact that there are just a few research works on readaptation of the Far North migrants who moved to the new location with a different climate, this issue is by far significant, and the solution is yet to be found as to which region is better to move to in terms of lesser readaptation costs for the Far North residents.

Research purpose: To study the frequency and structure of cardiovascular diseases of the Far North migrants during readaptation to the new climate.

Methods and materials: The research included 199 patients with stage II and III of arterial hypertension (AH) (according to RSC-2010, ESH/ESC-2009), average age of 66.05 (95% CI: 64.8-67.2). The survey sample was divided into main and control sets. The main set consisted of the Far North migrants (145 people, average age of 67.5 (95% CI: 66.8-68.8)), who used to live in the Far North and then moved to central Siberia (Krasnoyarsk and Minusinsk) for permanent residency. The control set consisted of 54 patient with AH, who lived in Krasnoyarsk (average age – 63.7± 1.4 year (95% CI: 62.7-71.4)). The sets were of the same age ($p=0.19$). The patients of both the main and control sets were divided according to their gender, residence time in the Far North and residence time in south regions of central Siberia (readaptation).

The patients' examination included general clinic methods, questionnaire survey, echocardiography, electrocardiography, 24-hour blood pressure monitoring, monitoring of change in propagation speed of pulse wave in arteries of muscular and elastic types, 24-hour holter monitoring, anthropometric method, serum lipids studying, glucose tolerance test.

The research fully complied with 'Ethical principles for medical research involving humans' developed by the World Medical Association (2000) following the Declaration of Helsinki as well as the Regulations of clinical practice in the Russian Federation ratified by the Ministry of Health of the Russian Federation, decree no. 266 (2003); the research was conducted upon receiving the patient's informed consent.

Statistical processing of the research results was performed by Statistica 6.1 software. The data was presented in form of average values and confidential interval. Two independent groups were compared using the Mann-Whitney U-test. The analysis of frequency difference in the two independent sets was performed using the Fisher's exact test with a two-sided confidence probability and χ^2 criterion with the Yates correction for continuity. Differences with $p < 0.05$ were considered statistically significant.

Results and discussion: According to the research data, the analysis of AH structure in the migrants, who moved to the new location has established that 33.8% of the examined have stage I AH, 52.4% have stage II AH and 16.6% have stage III AH. Risk I AH was found in 30.6% of the cases, risk III AH was found in 32.6% and risk IV AH was found in 36.7% of the cases respectively (Pic. 1). In men, risk II AH was found in 12.5% of cases, risk III AH – in 25% and risk IV AH – in 62.5% of cases. In women, these indices were as follows: 34.1%, 34.1% and 31.7% respectively.

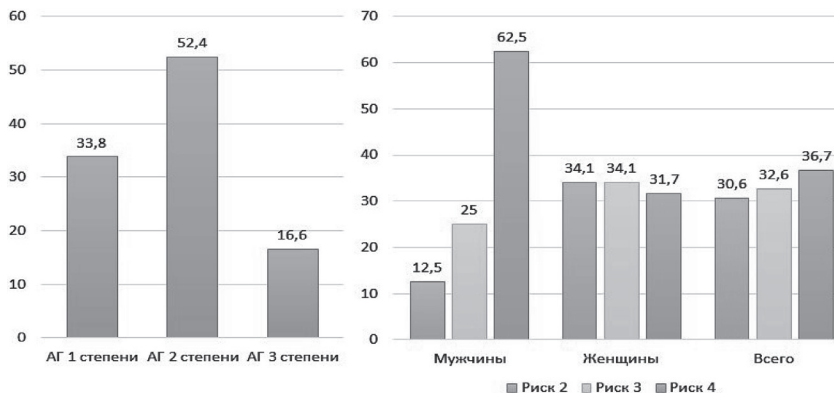


Fig. 1. Structure of arterial hypertension in the examined migrants from the Far North

An analysis was conducted on BP levels of the Far North migrants with AH depending on their residence time in the Far North. For this purpose the examined migrants were divided into 3 groups (1st group – 10 to 19 years (residence time), 2nd group – 20 to 29 years, 3rd group – over 30 years). There was a growth of SBP and DBP depending on the time the examined had lived time in the Far North. Statistically significant differences of SBP levels were found in those who had lived in the Far North for less than 20 years as well as people, who had lived more than 30 years ($p=0.001$). The difference between SBP levels in others groups was characterized as all but a tendency. There also was growth of DBP levels depending on the residence time. Statistically significant differences of SBP levels were found in the examined people who had lived in the Far North for less than 20 years and people, who had lived more than 30 years ($p=0.013$), as well as those who had lived there for 20 to 29 years ($p=0.05$) respectively.

Table 1.

Blood pressure levels of migrants depending on their residence time in the Far North

	Residence time in the Far North			<i>p</i>
	10-19 years	20-29 years	≥30 years	
SBP (mm Hg)	129,0 [121,27 - 136,73]	139,81 [134,21 - 145,41]	143,21 [139,19 - 147,23]	$p_{1-2}=0,013$ $p_{1-3}=0,001$ $p_{2-3}=0,389$
DBP (mm Hg)	79,32 [74,53 - 84,10]	85,37 [82,71 - 88,04]	86,98 [84,58 - 89,37]	$p_{1-2}=0,050$ $p_{1-3}=0,013$ $p_{2-3}=0,580$

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ПАД (mm Hg)	49,68 [43,04 - 56,33]	54,44 [50,52 - 58,36]	56,23 [53,33 - 59,14]	$p_{1-2}=0,061$ $p_{1-3}=0,020$ $p_{2-3}=0,451$
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The BP parameters of the Far North migrants were analyzed depending on the time of readaptation to the new climate. For this purpose, the examined migrants were divided into groups depending on the residence time after returning to south regions of central Siberia. 1st group included the examined people with residence time less than 5 years, 2nd group – 6 to 10 years and 3rd – over 10 years respectively. Linear dependence of SBP level increase on time of residence in the new climate was found (Table 2), and SBP levels of people 10 years after they had moved were higher ($p=0.02$) than SBP levels of people who had lived in the new climate for up to 3 years. There was no difference in DBP levels of people living up to 3 years and over 10 years, but people who had lived in the new climate for 3 to 10 years had slightly higher DBP levels, though considered all but a tendency.

*Table 2.***Blood pressure levels of migrants depending on their readaptation time**

	Terms of rehabilitation			<i>p</i>
	Up to 3 years	3 to 10 years	≥10 years	
SBP (mm Hg)	132,62 [126,65 - 138,59]	140,73 [135,69 - 145,78]	142,45 [137,60 - 147,31]	$p_{1-2}=0,050$ $p_{1-3}=0,019$ $p_{2-3}=0,597$
DBP (mm Hg)	85,24 [81,22 - 89,26]	86,04 [82,94 - 89,14]	85,17 [82,59 - 87,76]	$p_{1-2}=0,957$ $p_{1-3}=0,884$ $p_{2-3}=0,910$
ПАД (мм рт. ст.)	47,37 [42,63 - 52,13]	54,69 [51,41 - 57,99]	57,27 [53,70 - 60,85]	$p_{1-2}=0,019$ $p_{1-3}=0,001$ $p_{2-3}=0,365$

Depending on the external factors influence and functional systems persistence, as well as body responsiveness and residence time in current region, hypertensive disease assumes its qualitative behavior, which is why individual body features and different responsiveness to external factors determine different hypertensive disease progression [7, p. 12–15; 8, p. 129]. Changing of hypertensive disease qualitative behavior usually occurs after 10 years of living in high latitude areas. These kinds of patients have higher risk of neuroticism and hypertensive crisis which might proceed to unfavorable clinical outcome

[7, p. 12–15]. Apparently, patients with unfavorable progress of hypertensive disease have changes of responsiveness in high vegetative centers, which determine their high sensitivity to the Far North external factors changing [8, p. 129]. In rigorous climate, patients' function systems are always in state of tension.

There frequency of hypertensive crisis occurrence was studied in the Far North migrants with arterial hypertension both in the period of residence in the Far North and after moving to central Siberia. After moving to central Siberia the migrants from the Far with arterial hypertension (both men and women) were diagnosed with an increase in number of hypertensive crises (Pic. 2).

However, there was gender difference in the frequency of hypertensive crisis occurrence in the migrants of the Far North with AH within the period of residence in the Far North and after moving to central Siberia. Women had a higher value of hypertensive crisis occurrence when compared to men both before and after moving to the new climatic area.

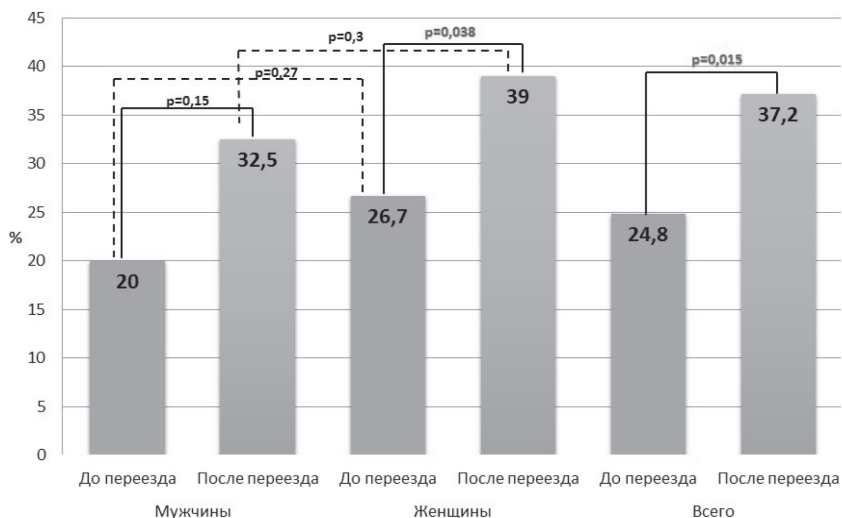


Fig. 2. Frequency of hypertensive crisis occurrence in the Far North migrants before and after moving to central Siberia

Upon carrying out the study, a tendency was established to reduction of the hypertensive crisis occurrence frequency depending on increase of the readaptation period. Women showed a tendency to reduction of the hypertensive crisis occurrence frequency with readaptation period of 3–10 years, but, on the

contrary, women with readaptation period over 10 years showed a tendency to an increased hypertensive crisis occurrence frequency. In general, both men and women, after moving to central Siberia, showed a tendency to an increased hypertensive crisis occurrence frequency depending on how the readaptation period was increased. However, the patients with the readaptation period less than 10 years showed a tendency to have the hypertensive crisis occurrence frequency reduced (Pic. 3).

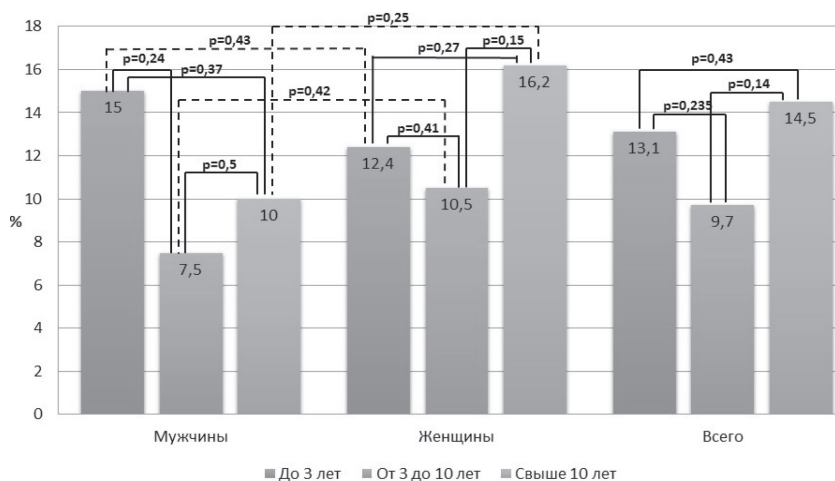


Fig. 3. Frequency of hypertensive crisis occurrence in the migrants of Far North depending on readaptation period

After moving to the new climate the migrants with AH from the Far North showed an increased occurrence frequency of the diseases that tend to complicate hypertension progression. For example, AH with PICS was found in 5.5% of cases (2.9% of female patients and 12.5% of male ones). CAD of the Far North migrants after moving to the new location was found in form of stenocardia in 22.8% of cases (24.8 % of female patients and 17.5% of male ones), complications in the form of MI were found in 9.7% of cases (9.5% of female patients and 10% of male ones) (Table 3). Cerebrovascular accident occurrence frequency was 10.3%, (11.3% of female patients and 7.5% of male ones). Cardiac failure was found in 6.9% of examined 4.8% of female patients and 12.5% of male ones).

In the analysis of occurrence frequency of the diseases that tend to complicate arterial hypertension progression of the Far North migrants before and

after moving to the new climate there has been found a statistically significant increase of heart strokes and cerebrovascular accidents frequency, as well as tendency to an increased occurrence frequency of myocardial infarction and cardiac failure after moving to central Siberia (Table 3).

Table 3.

Occurrence frequency of the diseases complicating hypertension progression in patients before and after migration

	MEN			WOMEN			TOTAL		
	before	after	<i>p</i>	before	after	<i>p</i>	before	after	<i>p</i>
Angina pectoris	22,5%	17,5%	0,39	7,6%	24,8%	0,0006	11,7%	22,8%	0,009
Myocardial infarction	12,5%	10%	0,5	2,9%	9,5%	0,04	5,5%	9,7%	0,13
Stroke	5%	7,5%	0,5	2,9%	11,4%	0,014	3,4%	10,3%	0,017
Heart failure	7,5%	12,5%	0,36	2,9%	4,8%	0,36	4,1%	6,9%	0,22

The Far North male migrants showed tendency to an increased occurrence frequency of cerebrovascular accidents and cardiac failures, and reduction of heart strokes and myocardial infarctions occurrence frequency after moving to central Siberia (Table 3), while female migrants showed a statistically significant increase of occurrence frequency of heart strokes, myocardial infarctions and cerebrovascular accidents after moving to central Siberia. Also, a tendency to an increased occurrence of cardiac failures cases after migration was found (Table 3).

Comparing occurrence frequency of diseases complicating arterial hypertension progress of the Far North male and female migrants, it was found that female patients showed fewer cases of heart strokes ($p=0.016$) and MI ($p=0.03$) before moving to the new climate as compared to male patients; cerebrovascular accidents and cardiac failures occurrence frequency was all but a tendency. After migration, there was tendency to an increased occurrence frequency of heart strokes and cerebrovascular accidents, as well as reduction of occurrence frequency of myocardial infarctions and cardiac failures in women as compared to men.

The higher level of neurotization coming from socioeconomic factors (job rotation, salary decrease, retirement, family psychological climate changing) may be what causes hypertensive crisis, increasing number heart strokes in migrants [7, p. 12–15; 11, p. 123]. In some cases, due to restructuring of morphofunctional systems along with exhausting of functional body systems, readaptation ends up in death, especially in patients over 50 y.o. [25, p. 337–339].

Conclusion: Summing everything up, it should be mentioned that after moving to central Siberia hypertensive crisis occurs more often in people, who lived in the Far North over 30 years. Men showed an increase of hypertensive crisis occurrence frequency, unlike women, that showed reduction of hypertensive crises occurrence frequency. After migration, cerebrovascular accidents occurrence frequency increases in women, but remains unchanged in men. After moving to the new climate, the migrants with AH from the Far North showed an increased occurrence frequency of the diseases that tend to complicate hypertension progression. There has been found a statistically significant increase of heart strokes and cerebrovascular accidents frequency, as well as tendency to an increased occurrence frequency of myocardial infarctions and cardiac failures after moving to central Siberia.

Readaptation of the Far North migrants is likely to be taken worse at the age of over 50 y.o. This group of people, especially those with CAD, needs doctors' careful attention upon moving to the new climate. At this age, CAD is usually combined with AH, so this group of patients should be regularly and properly treated.

Upon arrival to the new climate, the Far North migrants should be recommended to undergo examination to find out risks, study body weight component composition, diet tendencies as well as identify metabolic syndrome at an early stage. The follow-up plan and amount of required measures to be taken should be developed individually taking into account the diagnosed cardiovascular diseases, concomitant pathologies and risk factors. Should there be cardiovascular diseases found, one should be prescribed to see a cardiologist for a correct medicated and medication-free readaptation therapy.

The regularities, being found as a result of the conducted research, should be taken into account for developing prevention and rehabilitation programs for this kind of patients, along with an obligatory assessment of body's adaptive and readaptive ability levels, as inadequate adaptation and readaptation makes a great figure in the emergence of main noninfectious diseases, their prevention being a major unsolved problem in modern medicine. Thus, body's adaptive and readaptive ability levels assessment can be a great means to find a solution to one of the most significant problems of health diagnosis.

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