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Research article

FACTORS AND LEVEL OF THE TOTAL CARDIOVASCULAR RISK FOR PEOPLE IN THE NORTH-EASTERN RUSSIA

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In northern regions, cardiovascular pathology tends to be more aggressive, is likely to occur at a young age already and often results in disability and even mortality among people who have not yet reached the retirement age.

The aim of this study was to assess the structure and age-specific dynamics of basic factors able to cause cardiovascular diseases in men living in northern regions and the total cardiovascular risk.

We conducted a one-center experimental cross-sectional comparative one-sample study of 116 men living in the north of the Magadan region. The complex study program included questioning, anthropometric examination, laboratory biochemical tests and molecular-genetic screening of candidate genes of essential hypertension (AGT (rs 4762), AGTR1 (rs5186), ADD1 (rs4961), NOS3 (rs2070744), and ACE (rs4340)). Genotyping was performed using real-time polymerase chain reaction. The total cardiovascular risk was calculated using the SCORE scale.

The structure of basic risk factors that can cause cardiovascular diseases in men in the Magadan region includes both modifiable (smoking, obesity, essential hypertension, and dyslipidemia) and non-modifiable ones (climatic-geographic and genetic risk factors) in various age groups. With age, risk factors exert stronger influence on each other thus aggravating the clinical course of cardiovascular diseases and increasing risks of fatal cardiac events. This is especially important for northern regions where people are exposed to such non-modifiable risk factors as extreme climate. Moderate risk of cardiovascular diseases (according to the SCORE scale) was established for all men living in the North already at a young age. Therefore, a key task is to develop a strategy for active prevention of cardiovascular pathology that covers public at large starting from younger age groups.

Keywords: *total cardiovascular risk, genetic risk factors, SNP, cardiovascular prevention, essential hypertension, dyslipidemia, obesity, North.*

Cardiovascular diseases (CVDs) have long been persistently occupying leading places as regards their prevalence not only in Russia but across the globe as well. Most variable measures have been actively implemented to reduce cardiovascular mortality but despite that cardiovascular incidence and mortality rates in young people (younger than 45 years) continue to grow. In 2005–2007, incidence of acute myocardial infarction was 4.3 % in this age group but it grew up to 5.7 % in 2012–2014 and it should be noted that 90 % of patients with this diagnosis were males [1].

CVDs belong to a large group of multifactorial diseases that are caused by combined effects of hereditary and non-hereditary factors. Cardiovascular risks can be altered by modifying burden of some of these factors. The National Russian recommendations on cardiovascular prophylaxis establish that 'factors able to create elevated cardiovascular risks include dyslipidemia, smoking, abdominal obesity, psychosocial factors, and diabetes mellitus; factors able to mitigate them include consuming sufficient amounts of fruit and vegetables and regular physical activity' [2]. Some risk factors for CVDs, such as age, gender, and genetics, cannot be modified, but many others, including hypertension, obesity, diabetes, dyslipidemia, smoking, and air pollution, can be prevented or corrected [3]. RF modification can considerably (up to 75 %)

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prevent premature incidence and mortality caused by diseases of the circulatory system [4, 5].

Many various scales have been developed and are actively used to quantify total cardiovascular risk, for example, Framingham Risk Scale, SCORE (Systematic Coronary Risk Evaluation), PROGRAM (Prospective Cardiovascular Munster Study) and others [6]. Use of these scales makes it possible to analyze the whole set of likely risk factors and predict cardiovascular events in future.

In 2023, the WHO Western Pacific Office adopted the Regional Action Framework for Noncommunicable Disease Prevention and Control in the Western Pacific region aimed at promoting and encouraging responsible health behaviors among people living in the region [7]. Promoting healthy lifestyles among population and encouraging people to give up bad habits is a powerful prevention tool able to considerably reduce risks of cardiovascular pathology, diabetes mellitus, and obesity.

In Russia, the Federal Project 'Fighting against Cardiovascular Diseases' has been implemented within the Healthcare National project for a long time. Its major goal is to implement active CVDs prevention at the state level. However, despite the whole wide range of implemented prevention activities, etiological RF, pathogenetic RF and RF causing premature cardiovascular deaths are still prevalent in Russia. And it is absence of any traditions of keeping healthy lifestyles and responsible health behaviors among Russians that can be considered the main reason for wide CVDs prevalence [8].

It is especially vital to resolve health issues of working age population and to preserve labor potential in the Arctic region and areas close to it since there are plans for their active development for the period up to 2035 fixed by the President Order No. 645 dated October 26, 2020. Cardiovascular pathology is known to be more aggressive in northern regions, its onset usually occurs at younger ages and it often results in disability or even premature death among people who have not yet reached the retirement age [9–12]. Men are the most vulnerable population group in this respect. According to B.A. Revich with colleagues (2023), on average, over 2000–2021, cardiovascular mortality among men was higher than the national average in all regions in the Arctic, excluding the Yamal Nenets Autonomous Area. Thus, it was more than 30 % higher in the Murmansk region and Chukotka, more than 20 % higher in the Arkhangelsk region, Magadan region and Karelia, and more than 15 % higher in the Komi Republic and the Nenets Autonomous Area [13].

Higher mortality rates in the North can be due to extremely uncomfortable natural and climatic, geomagnetic and social-demographic conditions. In addition to that, burden of CVDs caused by metabolic risk factors is considerably higher for men than women, which might be associated with protective effects of female hormones and higher prevalence of such risk factors among men [3]. Epidemiology of CVDs and their RF as well as cardiovascular mortality is known to have considerable regional peculiarities [4].

Given all aforementioned, active CVDs prevention for people in the North aimed at creating the most effective mechanisms of health protection and promotion is among primary tasks of contemporary healthcare. J.S. Berger with colleagues suggested selective use of various prevention measures according to the total cardiovascular risk. It is important to reveal a target group with high and extremely high cardiovascular risks among relatively healthy asymptomatic people since they are likely to need some drug correction as well [14].

The aim of this study was to assess the total cardiovascular risk, structure, levels and age-specific dynamics of basic factors able to cause cardiovascular diseases in men living in northern regions.

Materials and methods. To achieve the study goals, the continuous sampling method was employed to create a sample of 116 men living in the North (their average age was 39.4 ± 12.30 years). The study participants were mostly Caucasians; they were considered tentatively healthy and were not relatives; they all had been born in the Magadan region and

lived there ever since, that is, were representatives of the 1st to 3rd generation of the local population. All study participants gave their informed written consent to take part in it and to have their personal data analyzed. The research was conducted in conformity with the ethical principles stipulated by the WMA Declaration of Helsinki (2013) and approved by the Ethics Committee of the "Arktika" Scientific Research Center of the Far East Branch of the Russian Academy of Sciences (the report No. 002/021 dated November 26, 2021).

The examined sample was divided into two age-specific groups, Group 1 made of men aged 20–40 years (59 people) and Group 2 made of men aged 40–65 years (57 people). Data on basic risk factors identified for men living in the Omsk, Ryazan, and Krasnodar regions were used as comparison indicators to identify regional peculiarities in the structure of cardiovascular risk factors typical for men living in the North [15–21]. All examined cohorts were comparable in terms of sex (men), age (20–64 years), ethnicity (Caucasians) and the range of analyzed indicators. All participants took part in questioning aimed at identifying family medical history and presence of CVD RF; they also took part in anthropometric, biochemical and molecular-genetic examinations. Whole blood taken in the morning on empty stomach from the ulnar vein was used as the test material in biochemical and molecular-genetic screening.

Anthropometric examination was conducted prior to lunchtime. The following somatic data were obtained for each participant: body height (cm); body weight; waist circumference; chest circumference. Body mass index (BMI) was calculated according to the conventional procedure (BMI = body weight (kg) / squared height (m) (kg/m^2)). Conventional WHO criteria were employed to identify BMI-specific groups where BMI < 18.5 kg/m^2 is considered underweight; BMI = 18.5–24.9 kg/m^2, normal weight; BMI = 25.0–29.9 kg/m^2, overweight; and BMI > 30 kg/m^2 is considered obesity [22].

To identify functional peculiarities of the cardiovascular system, we measured the participants' blood pressure (BP), systolic (SYS mm Hg) and diastolic (DIA mm Hg), and heart rate (HR, bpm). BP ≥ 130 / 85 mm Hg was considered as elevated normal blood pressure (ENBP). Essential hypertension (EH) was diagnosed at BP values ≥ 140 / 90 mm Hg [23].

The following lipid metabolism indicators were identified in all participants: total cholesterol (TCS, mmol/l), triglycerides (TG, mmol/l), high density lipoproteins cholesterol (HDL, mmol/l) and low density lipoproteins cholesterol (LDL, mmol/l). Atherogenicity index (AI) was calculated per the following formula: AI = (TCS – HDL) / HDL[1]. The following dyslipidemia criteria were employed in accordance with the Russian Recommendations of the 7th Revision issued in 2020 [24] and National Cholesterol Education Program (NCEP) expert report [25]: hypertriglyceridemia at TG > 1.7 mmol/l; hypercholesterolemia at TCS > 5.2 mmol/l; hypoalphacholesterinaemia at HDL < 1.03 mmol/l and at LDL > 3 mmol/l meant the high level of this indicator.

Several SNP of EH candidate genes were examined as genetic cardiovascular risk factors including AGT (rs4762), AGTR1 (rs5186), ADD1 (rs4961), NOS3 (rs2070744), and ACE (rs4340). Genome DNA was extracted for molecular-genetic testing by the standard phenol-chloroform method. The following genotyping was accomplished by the real-time polymerase chain reaction (PCR) using the commercial kits SNP-Screen (Syntol, Russia).

The total cardiovascular risk was calculated using the SCORE scale, which covers sex, age, SYS, smoking status and total cholesterol. The scale is based on results obtained by cohort studies with more than 205 thousand participants that were conducted in 12 European countries, Russia included. The resulting score is likelihood of death due to cardiovascular disease in the next 10 years given in percent. De-

[1] Klimov A.N., Nikul'cheva N.G. Obmen lipidov i lipoproteidov i ego narushenie: rukovodstvo dlya vrachei [Lipid and lipoprotein metabolism and its disruption: guide for physicians]. Saint Petersburg, Piter Kom Publ., 1999, 512 p. (in Russian).

pending on the resulting risk level (in percent), a patient is assigned into one of the following categories: below 5 % means low risk and 5 % and above means high risk. The relative risk scale was used additionally to the SCORE scale for the age group of 20–39 years [26].

The data were statistically analyzed using Statistica 7.0 software package. Quantitative data were given as $M \pm m$ (M is simple mean and m is error of mean). Inter-group differences were estimated using Student's t-test (differences were considered significant at $p < 0.05$). Frequencies of genotypes and alleles were estimated based on the Hardy – Weinberg equilibrium and compared using Pearson's χ^2 test (the equilibrium holds at $p > 0.05$).

Results and discussion. The following risk factors were established for the examined cohort made of male residents of the Magadan region: smoking, elevated normal blood pressure and essential hypertension, obesity (BMI 30 or above), dyslipidemia, significant frequency of genes that increase cardiovascular risks in the gene pool of the examined northern residents.

Smoking men accounted for 16.4 % in the analyzed cohort; higher prevalence of smoking was detected in Group 1 (people aged 20–40 years), 16.9 % against 15.8 % in Group 2 (people aged 40–65 years). However, we believe these figures to be greatly underestimated due to personalized methods applied to perform questioning. Therefore, the results do not give the actual situation with prevalence of smoking in our region. As reported by Yu.V. Barbaruk [27], anonymous questioning established that 42 % of Magadan region residents older than 15 years smoked regularly. Some researchers believe that the Magadan region is among those with the highest number of smokers; however, we compared the same indicators in other regions (the data are given in Figure 1) and as a result, prevalence of smokers in the Magadan region (42 %) turned out to be similar to that established in the Ryazan region (49.2 %) [18] and Krasnodar region (51.6 %) [21] and considerably lower ($p < 0.001$) than prevalence of smokers in the Omsk region (76.8 %) [15].

EH prevalence was established to be 37.72 % in the analyzed sample and this was quite similar to EH prevalence established in other Russian region (Figure 1). Analysis of age-specific dynamics in this factor revealed that the proportion of men with ENBP was 20.34 % (per SYS) and 5.08 % (per DIA) among men younger than 40 years (Group1). In addition to that, despite quite young age of people in this group, prevalence of stage 1 EH amounted to 8.47 % (per SYS) and 11.84 % (per DIA). The proportion of people with ENBP per SYS was a bit lower in Group 2 (aged 40–65 years) and amounted to 14.55 % but it was significantly higher per DIA, 16.36 %. The proportions of men with EH per both SYS and DIA grew significantly in Group 2 and amounted to 29.09 and 27.28 % respectively.

Tension in the cardiovascular system functioning was estimated in two analyzed groups of male northern residents as the sum of frequency of people with ENBP and stage 1 EH per SAS and DIA. As a result, its prevalence amounted to 45.73 % in Group 1 (people aged 20–40 years); it was significantly higher in Group 2 (people aged 40–65 years) where it was 87.28 %. We believe that higher frequency of ENBP and EH and generally higher prevalence of elevated BP in Group 2 (men aged 40–65 years) reflects age-specific dynamics and can also be due to significantly higher body weight in this group.

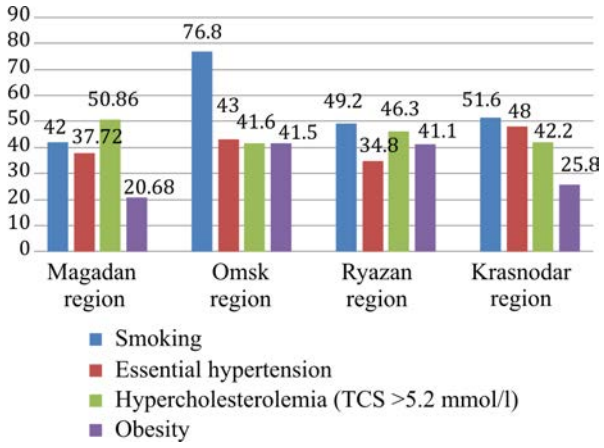

Figure 1. Prevalence of main cardiovascular risk factors in several Russian regions, %

The average BMI value is 26.9 ± 0.38 in the analyzed group of male northern residents, which is classified as overweight. Forty-one point seven percent of the examined men turned to be overweight. Obesity prevalence is 21.8 % in the analyzed population and the figure is comparable with its prevalence in the Krasnodar region and considerably lower than obesity prevalence in the Omsk (p = 0.001) and Ryazan regions (p = 0.002).

Analysis of sex-specific dynamics of unhealthy body weight in the analyzed group of male northern residents established overweight in 32.76 % among men from Group 1 (20–40 years old); Class 1 obesity was detected in 12.07 %; Class 2 obesity, in 3.45 %. Issues of unhealthy weight tend to aggravate with age in the analyzed cohort and there is a significant growth in BMI values deviating from its safe range. Thus, overweight was identified in 47.37 % of men from Group 2 (aged 40–65 years); Class 1 obesity, in 22.81 %; Class 2 obesity, in 5.26 %.

Hypercholesterolemia prevalence was the highest in the cohort of male Magadan region residents in comparison with their peers from the Omsk, Ryazan and Krasnodar region and amounted to 50.86 % (Figure 1). The reference group included populations from regions with various climatic and geographic conditions, including those located in the southern and central parts of Russia. The Magadan region is located in the north-eastern Russia and is considered an Arctic area. We believe that such a high proportion of people with elevated TCS levels in blood may indicate that metabolism of Caucasian immigrants had to adapt to this new environment and switch from its traditional protein-carbohydrate variant to a 'northern' or protein-lipid one. It is reported in literature sources that this switch usually leads to growing TCS levels in blood and energy support for adaptation is predominantly provided by lipids[2]. Table 1 characterizes lipid profile indicators in the examined groups of northern residents.

Analysis of age-specific dynamics of lipid profile established that total cholesterol levels, low density lipoproteins and AI values were already at the upper limit of the safe range already in young northern residents and the issue only aggravates with age. We established high prevalence of dyslipidemia in the analyzed groups of male northern residents (Figure 2).

The following RFs were identified in the structure of dyslipidemia prevalence in Group 1 (young men): hypercholesterolemia (30.51 %), elevated LDL levels (30.51 %), hypoalphaholesterolemia (8.48 %), and hypertriglyceridemia (10.71 %) Dyslipidemia prevalence was significantly higher in Group 2 (men aged 40–65 years) and more than a half of men in it had hypercholesterolemia (59.65 %), elevated LDL levels (61.40 %), hypoalphaholesterolemia (10.53 %), and hypertriglyceridemia (29.82 %). Atherogenicity index (AI) is widely used in calculating risks of deaths caused by atherosclerosis-associated

Table 1

Lipid profile indicators in the analyzed groups of northern residents ($M \pm m$)

	Total cholesterol, mmol/l	High density lipoproteins, mmol/l	Low density lipoproteins, mmol/l	Triglycerides, mmol/l	Atherogenicity index, arbitrary units
Group 1 (aged 20–40 years)	4.98 ± 0.14	1.31 ± 0.04	3.21 ± 0.12	0.99 ± 0.08	2.70 ± 0.11
Group 2 (aged 40–65 years)	5.75 ± 0.13	1.33 ± 0.05	3.79 ± 0.11	1.43 ± 0.10	3.60 ± 0.17
Significance of differences	p = 0.000	p = 0.691	p = 0.001	p = 0.001	p = 0.000

[2] Kaznacheev V.P., Kulikov V.Yu., Panin L.E., Sokolov V.P., Lyakhovich V.V., Shorin Yu.P., Mayanskii D.N. Mekhanizmy adaptatsii cheloveka v usloviyakh vysokikh shirot [Human adaptation mechanisms in high latitudes]. Leningrad, Meditsina Publ., 1980, 200 p. (in Russian).

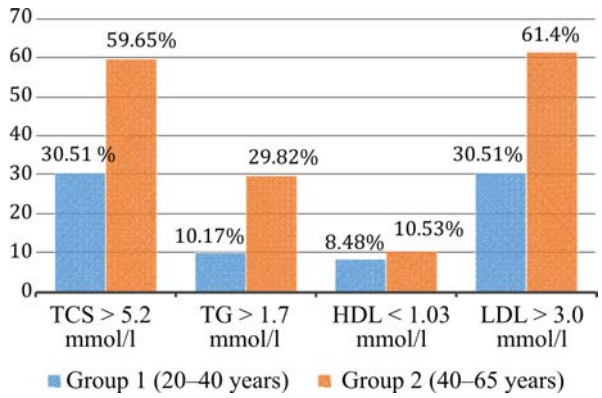

Figure 2. Dyslipidemia prevalence in the analyzed groups of male northern residents

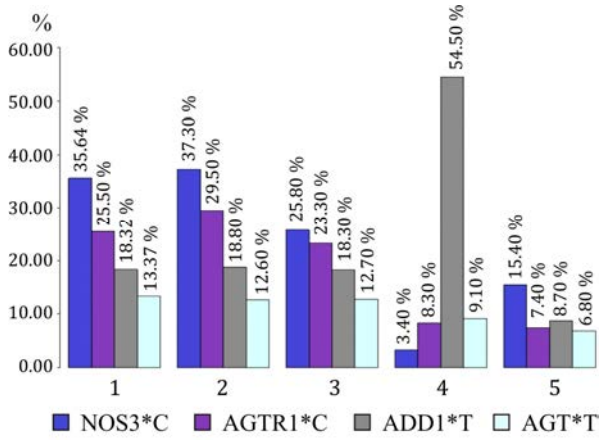

Figure 3. Prevalence of EH candidate genes in various populations: 1, northern male residents of the Magadan region; 2, Caucasian population; 3, American population; 4, Asian population; 5, African population

diseases as an effective prognostic marker. Comparative analysis of the Group 1 and 2 established this indicator to be higher than its reference level in Group 2 (men aged 40–65 years) and was also significantly higher than in Group 1 (men aged 20–40 years).

The present study is the first to analyze such a non-modifiable risk factor as prevalence of genes that increase cardiovascular risks. Frequency of alleles and genotypes in two analyzed groups corresponds to the Hardy – Weinberg equilibrium ($p > 0.05$). We established that frequency of alleles creating elevated risks of essential hypertension is *ADD1**T = 15.6 %, *AGT**T = 17.26 %, *AGTR1**C = 24.22 %, *NOS3**C = 33.63 % and *ACE**D = 49.54 % in the general male population in the Magadan region. Frequency of genes involved into blood pressure regulation has certain ethnic peculiarities; given that, we compared the analyzed population made of male northern residents with some basic world populations[3] (Figure 3). The analyzed population was found to demonstrate the Caucasian type of gene frequency as per the analyzed polymorphisms.

Table 2 provides data obtained by genetic-molecular testing performed in the analyzed groups.

Although genetic risk factors cannot be modified, they should be always considered when assessing the total cardiovascular risk. It is noteworthy that we did not establish any authentic differences in prevalence of the analyzed polymorphisms between the male northern population of the Magadan region and Caucasians living in much more comfortable environment. We believe this indicates that

Table 2

Prevalence of EH candidate genes in the analyzed groups of male northern residents

Gene	Frequency of alleles (in %) that increase cardiovascular risks	
	Group 1 (20–39 years old)	Group 2 (40–65 years old)
*AGTR1*C* (rs5186)	26.36	25.93
*AGT*T* (rs4762)	20.00	17.59
*NOS3*C* (rs2070744)	28.18	30.56
*ADD1*T* (rs4961)	14.29	16.98
*ACE*D* (rs4340)	43.64	55.56

[3] National Library of Medicine: The National Center for Biotechnology Information. Available at: https://www.ncbi.nlm.nih.gov/snp (February 01, 2024); ALFRED – the ALlele FREquency Database. Available at: https://alfred.med.yale.edu/ALFRED/index.jsp (February 01, 2024); SNPedia: Database catalogs of single nucleotide polymorphisms. Available at: https://www.snpedia.com/index.php/SNPedia (February 01, 2024).

early CVD onset and progressing in the North may be caused by a predominant contribution made by much more uncomfortable natural, climatic and geomagnetic environmental factors as well as peculiar lifestyles and not only by genetic RFs.

The 10-year cardiovascular risk was calculated per the SCORE scale using the parameters of the analyzed population obtained in the present study. The results were as follows:

– moderate risk (1–4 % per the SCORE scale) was detected in 100 % of the cases in Group 1 (people aged 20–39 years);

– 61.40 % of the respondents in Group 2 (people aged 40–65 years) had moderate risk (1–4 % per the SCORE scale) of fatal cardiovascular events over the next 10 years;

– frequency of high (5–9 % per the SCORE scale) and very high (> 10 % per the SCORE scale) risk of fatal cardiovascular events over the next 10 years amounted to 17.54 and 7.02 % respectively in Group 2 (people aged 40–65 years).

Smoking is a significant cardiovascular risk factor; this fact is evidenced by the total cardiovascular mortality risk growing fivefold in case this RF is present in the age group younger than 50 years [28]. The problem remains the most acute in our country since the population in Russia is among 'the most smoking' ones across the globe [29].

Elevated systolic blood pressure (SYS) or essential hypertension (EH) are the most significant risk factors of not only CVD-related disability but also cardiovascular mortality, both in Russia and all over the world [30]. The global trend of growing essential hypertension prevalence is obviously determined by not only population ageing but also growing influence of lifestyle-related risk factors including unhealthy diets and hypodynamia. According to the ESSE-RF-2 Study data, practically half of the Russian working age men (49.1 %) have EH [31]. Analysis of cardiovascular mortality rates gives evidence of their considerable variability per RF regions. For example, in 2021, the standardized cardiovascular mortality rate was 457.5 per 100 thousand people in Moscow whereas it was somewhat higher in the Magadan region equaling 583.8[4].

Obesity is not only a cardiovascular risk factor but also a factor that can influence or even aggravate other risk factors, including essential hypertension, dyslipidemia and diabetes mellitus, by various pathways [32–34]. Over the last 50 years, obesity prevalence has grown up to a global non-communicable pandemic since practically each fifth adult on the planet is overweight. In Russia, incidence of obesity-related EH has been growing among working age men (!) [2]. Thus, 14.3 % of Russian men aged 25–34 years are obese and the proportion grows steadily with age reaching 36.3 % by the age of 55 years [35].

Some experts report a strong positive correlation between TCS and LDL levels (within a wide range of concentrations) and cardiovascular risks[5]. The number of deaths associated with elevated LDL levels in patients with CVDs is predicted to reach 3.1 million by 2029 [2]. According to the ESSE-RF-2 Study data, the total cholesterol level is higher than 5 mmol/l in more than a half of the Russian population [36].

All the foregoing risk factors were present, though with various intensity of their manifestation, in the analyzed groups of male northern residents.

To verify the study findings, we analyzed the mortality structure due to diseases of the circulatory system in the analyzed groups of male northern residents living in the Magadan region over 2016–2019 (2020 and 2021 were excluded from the analysis due to the COVID-19 pandemic). The analysis was performed for the

[4] Demograficheskii ezhegodnik Rossii 2021: stat. sb. [The Annul Russia Demography Bulletin 2021: statistical data collection]. Moscow, Rosstat, 2021, 167 p. (in Russian).

[5] Neaton J.D., Blackburn H., Jacobs D., Kuller L., Lee D.J., Sherwin R., Shih J., Stamler J., Wentworth D. Serum cholesterol level and mortality findings for men screened in the Multiple Risk Factor Intervention Trial. Multiple Risk Factor Intervention Trial Research Group. *Arch. Intern. Med.*, 1992, vol. 152, no. 7, pp. 1490–1500.

following blocks: deaths caused by hypertensive diseases (ICD-10 codes 110–114); deaths caused by ischaemic heart diseases (ICD-10 codes 120–125) with separate analysis of deaths caused by myocardial infarctiona (ICD-10 codes 121–122); as well as prevalence of deaths caused by cerebrovascular diseases (ICD-10 codes 160–169). The analyzed data were stratified by age with a 10-year step (Figure 4).

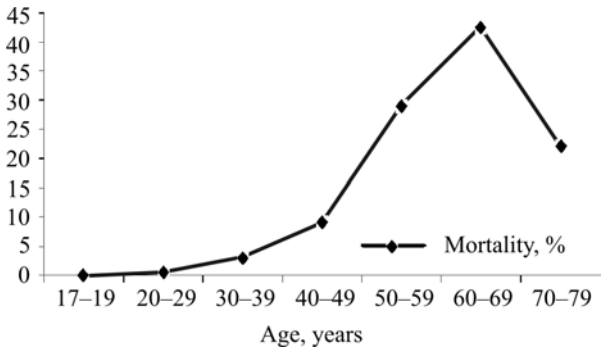

Figure 4. Age-specific cardiovascular mortality among men in the Magadan region in dynamics

The analysis of this mortality graph shows that cardiovascular mortality among males in the Magadan region starts to grow exactly in the age group of 20–29 years (the mortality rate is 0.6 %); an apparent growth in cardiovascular mortality occurs in the age group of 40–49 years (9 %) and the peak is reached in the age group of 60–69 years (the cardiovascular mortality is 42.4 %). The calculated data and the data on actual cardiovascular mortality rate seem to be quite consistent.

Conclusion. Modifiable cardiovascular risk factors identified for male northern residents of the Magadan region include smoking, obesity, EH, and dyslipidemia. All the examined male northern residents had moderate cardiovascular risk (1–4 % per the SCORE scale) already at a young age (20–40 years); with age, some men appeared to have high (5–9 % per the SCORE scale) and very high (> 10 % per the SCORE scale) cardiovascular mortality risk for the next 10 years with their prevalence being 17.54 and 7.02 % respectively.

Very high hypercholesterolemia prevalence (50.86 %) in male northern residents may be considered a regional peculiar cardiovascular risk factor. This is consistent with the concept described by V.P. Kaznacheev and others about occurrence of ‘northern’ metabolism as an adaptation response in immigrants to the specific climatic conditions in the North[6] . Another regional risk factor is a significant growth in BMI values deviating from their safe range with age.

The study findings on prevalence and age-specific dynamics of cardiovascular risk factors in male northern population emphasize the necessity to implement active prevention of cardiovascular diseases, which should start already at a young age and be aimed at reducing cardiovascular mortality. Prevention activities should be based on modifying all existing risk factors, active promotion of healthy lifestyles among population and creating suitable conditions for pursuing them.

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Competing interests. The authors declare no competing interests.

[6] Kaznacheev V.P., Kulikov V.Yu., Panin L.E., Sokolov V.P., Lyakhovich V.V., Shorin Yu.P., Mayanskii D.N. Mekhanizmy adaptatsii cheloveka v usloviyakh vysokikh shirot [Human adaptation mechanisms in high latitudes]. Leningrad, Meditsina Publ., 1980, 200 p. (in Russian).

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