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Research Article

Prevalence of Early Ischemic Heart Disease and its Associations with Risk Factors and Socioeconomic Variables in the 25–44-Year Age Group in Nobosibirsk -

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ABSTRACT

Aim: The aim of this study was to investigate the prevalence of early Ischemic Heart Disease (IHD) in accordance with standardized epidemiological criteria in the 25 – 44-year age group in Novosibirsk (Russia) and to identify associations with some risk factors and socioeconomic factors.

Materials and methods: A cross-sectional populational medical examination was conducted on a random sample of the 25–44-year age group in Novosibirsk. A total of 1457 people were analyzed (653 males and 804 females). Epidemiological IHD diagnosis was made according to validated epidemiological (Rose angina questionnaire) and functional criteria (recording of an ECG interpreted via the Minnesota Code). The evaluated IHD modifiable risk factors were cigarette smoking, elevated body mass index, increased waist circumference, the presence of arterial hypertension, low physical activity, and elevated blood levels of low-density lipoprotein cholesterol, non–high-density lipoprotein cholesterol, and triglycerides. Socioeconomic factors were assessed too: marital status, occupation type, education, health self-rating, and economic status.

Results: The prevalence of IHD in the study population was found to be 3.36 % (49 subjects): 2.8 % (18 subjects) among males and 3.9 % (31 subjects) among females. All quantitative data on IHD risk factors were higher in males than in females. The prevalence of IHD risk factors (except for increased waist circumference) was higher among males than females. The prevalence of IHD risk factors (except for cigarette smoking) was not different between IHD and no-IHD groups in the study population. Smoker prevalence was 1.66 - fold higher (p = 0.031) in the no-IHD group than in the IHD group. Multivariate logistic regression analysis uncovered an inverse association of cigarette smoking (independently of age, sex, and other risk factors) with the relative risk of early IHD in the study population. Furthermore, in males, the relative risk of IHD (regardless of age) directly correlated with heavy manual labor (Odds Ratio [OR] = 3.495, Confidence Interval [CI] 1.306 – 9.353, p = 0.013) and unfavorable marital status (divorced or widowed; OR = 4.976, CI 0.944 – 26.228, p = 0.058). Meanwhile, these two factors inversely correlated with cigarette smoking (OR = 0.202, CI 0.060 – 0.672, p = 0.009).

Conclusion: In males aged 25 – 44 years in Novosibirsk, the relative risk of early IHD is directly associated with heavy manual labor or unfavorable marital status, and these factors are inversely associated with smoking. This correlation needs further research

Keywords: Epidemiological Study; Definite Ischemic Heart Disease; 25-44-Year-Old Population; Risk Factors; Socioeconomic Factors; Smoking

ABBREVIATIONS

AH: Arterial Hypertension; BMI: Body Mass Index; BP: Arterial Blood Pressure; CI: Confidence Interval; CVD: Cardiovascular; Disease; ECG: Electrocardiogram; HDL-C: High-Density Lipoprotein Cholesterol; IHD: Ischemic Heart Disease; LDL-C: Low-Density Lipoprotein Cholesterol; MC: Minnesota Code; MI: Myocardial Infarction; non-HDL-C: non–High-Density; Lipoprotein Cholesterol; OR: Odds Ratio; RF: Risk Factor; TG: Triglyceride; WC: Waist Circumference; WHO: World Health Organization

INTRODUCTION

According to data from the World Health Organization (WHO), Ischemic Heart Disease (IHD) continues to be the leading cause of morbidity and mortality in industrially developed and developing countries and is responsible for ~⅓ of all deaths among people older than 35 years [1,2].

The IHD is considered early or premature if it develops before age 55 years in males and before age 65 in females [3]. Other terminology may be used in various studies (IHD at a young age, IHD at a very young age, or premature development of IHD), whereas the age limit of the study population varies from 35 to 65 years, thus complicating comparisons of the findings [4–7].

In recent years, IHD prevalence among the young has been increasing, and this is an important socioeconomic problem because of early disability and early deaths. Patients presenting with IHD at a younger age differ from elderly IHD patients in the structure of risk factors, clinical manifestations, and in the prognosis. Virtually all young patients with IHD have at least one traditional risk factors of this disease [8,9].

The present study was aimed at investigating the prevalence of IHD according to standardized epidemiological criteria in the age group of 25 – 44-year-olds in Novosibirsk and at identifying associations of IHD with some of its risk factors.

MATERIALS AND METHODS

Ethics approval and consent to participate

The study protocol was approved by the local Ethics Committee of the Institute of Internal and Preventive Medicine (a branch of the Institute of Cytology and Genetics, the Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia). All methods were performed in accordance with the relevant guidelines and regulations. Written informed consent to the medical examination and analysis of personal data was obtained from each patient.

Selection and Description of Participants

During 2014 – 2015, a cross-sectional population medical examination was conducted on a random sample of people from the Novosibirsk, which is a capital of Western Siberia. To compile the population sample, we used a database of the Novosibirsk Territorial Fund of mandatory health insurance, from which (by means of a random number generator) 2500 subjects of both sexes aged 25 – 44 years were selected. It is known that young age groups are among the least responsive to invitations to a medical examination; therefore, methods of gradual epidemiological stimulation were employed: postal invitations, telephone calls, and announcements in mass media. The response rate was 58.3 %. At our Screening Center, 1457 people underwent the medical examination: 653 males (45 %) and 804 females (55 %). All the participates provided informed consent to the medical examination and analysis of personal data.

The screening was carried out by a team of physicians, who had been trained in standardized epidemiological methods of medical-examination–based screenings. The medical-examination program included collection of demographic and social data, questions about

cigarette-smoking and alcohol-drinking habits, a socioeconomic questionnaire, nutritional survey, collection of chronic-disease and medication history, the Rose angina questionnaire, anthropometric-data collection, three-time measurement of arterial Blood Pressure (BP), spirometry, ECG recording with interpretation in accordance with the Minnesota Code (MC), and assessment of other parameters.

The BP measurement was performed thrice with a 2 min interval on the right arm in a sitting position after a 5 min rest by means of a digital BP monitor, and the average of the three measurements was recorded. The body mass index (BMI) was determined via the following formula: body weight (kg) divided by the height squared (m^2). Participants were assumed to be smokers if they smoked at least one cigarette a day.

One-time blood collection from the medial cubital vein was carried out in the morning after a 12h fast. Indicators of lipid metabolism were measured by the enzymatic method using standard reagents from TermoFisher on a KoneLab 30i automatic biochemical analyzer (Finland).

The following socioeconomic factors were evaluated: marital status (married, single, divorced, or widowed), the occupation type (sedentary job, standing work, manual labor, or heavy manual labor), education level (grammar school, a high school diploma, or a college degree), health self-rating (good, fair, or bad), and economic status (employed, student, or unemployed).

Age, gender and heredity (IHD family history) were assessed as unmodifiable risk factors. The following IHD modifiable risk factors were assessed [10]: cigarette smoking, elevated BMI (> 25 kg/m^2), increased waist circumference (WC) ≥ 94 cm in males or ≥ 80 cm in females, arterial hypertension (AH; ≥ 140 / ≥ 90 mmHg), low physical activity(< 3.5 h/week), an elevated blood level of low-density lipoprotein cholesterol (LDL-C;≥ 116 mg/dL or ≥ 3 mM), an elevated blood level of non–high-density lipoprotein cholesterol (non-HDL-C; ≥ 130 mg/dL or ≥ 3.4 mM), and elevated blood concentration of triglycerides (TGs; ≥ 150 mg/dL or ≥1.7 mM).

The epidemiological diagnosis of IHD was made via validated epidemiological (using the Rose angina questionnaire) and functional criteria (ECG recording with interpretation using the MC). We used the following definition of IHD on ECG based on the mentioned Minnesotta Code classification System for electrocardiographic findings (WHO guidelines):

- ECG changes indicative of new ischaemia (new ST-T changes or new left bundle branch block (LBBB)–Minnesota codes: ST-depression 4.1; 4.2; ST-elevation 9.2; LBBB 7.1);
- Development of pathological Q waves in the ECG (Minnesota codes: 1.1.1 through 1.2.5 plus 1.2.7), 17 including no unequivocal pathological Q waves in the first ECG or in event set of ECG(s) followed by a record with a pathological Q wave or any Q wave in leads V2–V3 ⩾02 s or QS complex in leads V2 and V3 or Q wave ⩾0.03 s and ⩾0.01 mV deep or QS complex in leads I, II, aVL, aVF or V4–V6 in any two leads of a contiguous lead grouping (I, aVL, V6: V4–V6: II, III, aVF).

Statistics

Statistical analysis was carried out in the SPSS software for Windows (version 17). Normality of distribution of values was assessed using Kolmogorov-Smirnov and Lilliefors, and Shapiro-Wilk's W tests. Quantitative values of characteristics presented as median, Confidence Intervals (CIs), and lower and upper quartiles. The following methods of group comparison were used: the Mann–Whitney U test for a comparison of medians, Wilcoxon's test, one-way ANOVA with Dunnett's test for a multigroup comparison, calculation of the Odds Ratio (OR) by means of contingency tables, OR calculation in a logistical regression model, the χ^2 test, and *t* - test. The 95 % level of statistical significance was assumed.

RESULTS

The prevalence of IHD in the study population (25 – 44-year-olds) was 3.36 % (49 subjects). Among 653 males, IHD was detected in 18 subjects (2.8 %), and among 804 females, in 31 subjects (3.9 %). No significant difference in IHD prevalence was found between males and females (p = 0.247). No statistically significant association of the IHD family history with the presence of early IHD was found (p = 0.229).

We analyzed quantitative data on the studied risk factors depending on the presence of IHD in the study population (25 – 44-year-olds in Novosibirsk; Table 1). Significant differences between the two groups (with and without IHD) were not found. There were no significant differences in the quantitative data on the analyzed risk factors depending on the presence of IHD either in the male subpopulation or in the female subpopulation.

As presented in Table 2, in the study population, the prevalence of the IHD risk factors (except for cigarette smoking) was not different between the subjects with and without IHD. The prevalence of smokers was 1.66 - fold higher (p = 0.031) in the group without IHD than in the group with IHD. Having analyzed this result, we found that in the male population (653 subjects), the prevalence of smoking was 1.6 - fold higher (without significance, p = 0.113) among people without IHD (635 subjects) than among those with IHD (18 subjects), whereas in the female population (773 subjects), the prevalence of smoking was 1.55 - fold higher (without significance, p = 0.184) among people without IHD (773 subjects) than among those with IHD (31 subjects). Thus, the prevalence of smokers among males and females with IHD, albeit statistically insignificantly, was somewhat lower than that in the groups without IHD.

As shown in Table 3, there were no significant differences in age between the males and females. All quantitative data on the analyzed IHD modifiable risk factors were higher in males than in females.

As depicted in Table 4, the prevalence of the studied IHD modifiable risk factors (except for increased waist circumference) was higher among males than among females.

Subsequent multivariate logistical regression analysis identified an inverse association of smoking (independent of age, sex, and other analyzed risk factors) with the relative risk of IHD in the study population (25 – 44-year-olds in Novosibirsk; Table 5). This "paradoxical result" can be explained by an above-mentioned finding (Table 2) that it was the IHD group where the prevalence of smoking was statistically significantly lower 1.66 - fold relative to the no-IHD group.

Because none of the analyzed risk factors (except for smoking) manifested an evident correlation with the relative risk of IHD, and because cigarette-smoking analysis yielded the "paradoxical" result, next we studied the relation of IHD with socioeconomic factors. The multivariate logistical regression analysis of socioeconomic factors was performed in relation to the risk of IHD in the study population (25 – 44-year-olds in Novosibirsk) and in its male and

female subpopulations. Statistically significant results were obtained only in the male population. We noted age-independent correlations of the occupation type and of marital status (which are associated with cigarette smoking: OR = 0.202, CI 0.060 – 0.672, p = 0.009) with the relative risk of IHD among 25 – 44-year-old males. For instance, among divorced non-smoking males, the probability of IHD presence was 5-fold higher (OR = 4.976, CI 0.944 – 26.228, p = 0.058), whereas among non-smoking males occupationally engaged in heavy manual labor, it was 3.5-fold higher (OR = 3.495, CI 1.306 – 9.353, p = 0.013).

Therefore, among 25 – 44-year-old males in Novosibirsk, the relative risk of IHD (namely, early IHD, manifesting itself before 45 years of age) is directly associated with heavy manual labor and unfavorable marital status but inversely correlates with smoking.

DISCUSSION

There is evidence of high prevalence of IHD (according to epidemiological criteria) and its risk factors in the population of Novosibirsk, a capital of Western Siberia. In this city, a young

Table 1: Quantitative data on risk factors depending on the presence of IHD in the Novosibirsk population of 25–44-year-olds (Me (25%; 75%))

Variable	Whole study population (n=1457)	Absence of IHD (n=1408)	Presence of IHD (n=49)	p value
Age, years	37.0 (31.6; 41.7)	37.0 (31.6; 41.7)	39.0 (32.2; 43.1)	0.107
BMI, kg/m^2	25.2 (22.1; 29.1)	25.2 (22.1; 29.1)	24.9 (22.2; 28.4)	0.853
WC, cm	85.4 (76.0; 95.6)	85.5 (76.0; 95.9)	84.0 (75.2; 95.0)	0.718
Systolic BP, mmHg	119.0 (110.0; 129.0)	119.0 (110.5; 129.0)	119.5 (105.7; 133.7)	0.759
Diastolic BP, mmHg	78.0 (71.5; 86.0)	78.0 (71.5; 86.0)	78.0 (70.0; 85.7)	0.744
Physical activity, h/week	0 (0; 3.0)	0 (0, 3.0)	1.0 (0; 2.0)	0.838
LDL-C, mg/dL	120.2 (97.0; 143.0)	120.0 (96.8; 143.0)	124.0 (107.2; 140.2)	0.117
Non-HDL-C, mg/dL	139.0 (113.0; 166.0)	139.0 (113.0; 166.0)	144.0 (120.0; 172.0)	0.223
TGs, mg/dL	83.0 (60.0; 122.0)	84.0 (61.0; 123.0)	74.0 (54.0; 112.0)	0.731

BMI - Body Mass Index; BP - Arterial Blood Pressure; IHD - Ischemic Heart Disease; LDL-C - Low-Density Lipoprotein Cholesterol; M - Mean; non-HDL-C - non–High-Density Lipoprotein Cholesterol; TG – Triglyceride; WC - Waist Circumference

Table 2: The prevalence of risk factors depending on the presence of IHD in the Novosibirsk population of 25–44-year-olds

Variable	Absence of IHD (n=1408)	Presence of IHD (n=49)	p value
Smoking	34.0%	20.4%	0.031
BMI > 25 kg/m^2	51.5%	49.0%	0.420
WC ≥ 94 cm in males, ≥80 cm in females	43.4%	49.0%	0.265
AH ≥140/≥90 mmHg	18.2%	22.4%	0.276
Physical activity <3.5 h/week	80.2%	81.6%	0.489
LDL-C ≥ 116 mg/dL	54.7%	61.7%	0.214
Non-HDL-C ≥ 130 mg/dL	60.1%	66.0%	0.260
TGs ≥ 150 mg/dL	17.0%	12.8%	0.297

AH - Arterial Hypertension; BMI - Body Mass Index; IHD - Ischemic Heart Disease; LDL-C - Low-Density Lipoprotein Cholesterol; non-HDL-C - non–High-Density Lipoprotein Cholesterol; TG – Triglyceride; WC - Waist Circumference

Table 3: Quantitative data on risk factors of IHD among males and females 25–44-year-olds in Novosibirsk (25%; 75%)).

Variable	Males (n=653)	Females (n=804)	p value, males/ females
Age, years	36.7 (31.5; 41.4)	37.2 (31.7; 41.9)	0.259
BMI, kg/m^2	26.3 (23.3; 29.3)	24.3 (21.4; 28.6)	<0.001
WC, cm	91.6 (84.0; 100.0)	79.0 (71.1; 88.5)	<0.001
Systolic BP, mmHg	125.0 (117.0; 134.0)	113.5 (106.0; 122.5)	<0.001
Diastolic BP, mmHg	82.5 (76.0; 90.0)	74.5 (68.5; 81.5)	<0.001
Physical activity, h/week	1.0 (0; 3.25)	0 (0; 2.0)	<0.001
LDL-C, mg/dL	125.2 (102.0; 147.4)	115.8 (95.2; 138.9)	<0.001
Non-HDL-C, mg/dL	147.0 (123.0; 176.0)	133.0 (108.2; 156.0)	<0.001
TGs, mg/dL	98.0 (68.0; 150.0)	74.0 (54.0; 103.0)	<0.001

BMI - Body Mass Index; BP - Arterial Blood Pressure; LDL-C - Low-Density Lipoprotein Cholesterol; non-HDL-C - non–High-Density Lipoprotein Cholesterol; TG – Triglyceride; WC - Waist Circumference

Table 4: The prevalence of IHD risk factors among males and females 25–44-year-olds in Novosibirsk

Variable	Males (n=653)	Females (n=804)	p value
Smoking	44.5%	24.6%	<0.001
BMI > 25 kg/m^2	60.2%	44.3%	<0.001
WC ≥ 94 cm in males, ≥ 80 cm in females	42.1%	44.8%	0.163
AH ≥ 140/ ≥ 90 mmHg	28.1%	10.4%	<0.001
Physical activity < 3.5 h/week	75.0%	84.5%	<0.001
LDL-C ≥ 116 mg/dL	61.0%	49.9%	<0.001
Non-HDL-C ≥ 130 mg/dL	68.6%	53.3%	<0.001
TGs ≥ 150 mg/dL	25.2%	9.7%	<0.001

AH - Arterial Hypertension; BMI - Body Mass Index; LDL-C - Low-Density Lipoprotein Cholesterol; non-HDL-C - non–High-Density Lipoprotein Cholesterol; TG – Triglyceride; WC - Waist Circumference

Table 5: The relative risk of IHD in relation to the risk factors of IHD, among 25–44-year-olds in Novosibirsk

Variables and IHD risk factors	OR	95% CI		p value
		lower limit	upper limit	
Age	1.036	0.986	1.088	0.157
Sex	1.141	0.617	2.110	0.674
Smoking	0.432	0.203	0.921	**0.030**
BMI, kg/m^2	1.207	0.571	2.168	0.530
WC, cm	1.201	0.670	2.153	0.539
AH	1.117	0.477	2.265	0.647
Physical activity	0.983	0.463	2.086	0.965
LDL-C, mg/dL	1.284	0.699	2.361	0.420
Non-HDL-C, mg/dL	1.239	0.658	2.332	0.506
TGs, mg/dL	1.206	0.765	2.389	0.542

AH - Arterial Hypertension; BMI - Body Mass Index; CI - Confidence Interval; IHD - Ischemic Heart Disease; LDL-C - Low-Density Lipoprotein Cholesterol; non-HDL-C - non–High-Density Lipoprotein Cholesterol; OR - Odds Ratio; RF - Risk Factor; TG – Triglyceride; WC - Waist Circumference

population (25–44 years of age) was last analyzed during the WHO project MONICA in the 1990s [11-13].

Our results were obtained via a medical examination of the 25–44-year-old age group in Novosibirsk during 2014–2015. The results showed that at present, the prevalence of IHD in the study population (3.36%) and in its male (2.8%) and female (3.9%) subpopulations is not high.

It is known that more than half of young adults even at the age of 18–24 years have at least one risk factor of IHD [14].

We studied quantitative data on IHD risk factors and data on the prevalence of IHD risk factors, such as smoking, elevated BMI, increased waist circumference, AH presence, low physical activity, and elevated blood levels of LDL-C, non-HDL-C, and TGs in older subjects: 25–44 years. The prevalence of the aforementioned risk factors in the study population ranged from 25% to 85%. All quantitative data on the analyzed risk factors of IHD were higher in males than in females. In addition, the prevalence of the studied IHD risk factors turned out to be higher among males than females, except for the "increased waist curcumference" risk factor (indicating abdominal obesity), whose prevalence was not significantly different between males (42%) and females (45%). As for the excess body weight in general, it was found to be 1.3-fold higher among males than among females.

While discussing this result, we should point out that obesity occurs more often among patients with early development of IHD and is an independent predictor of coronary atherosclerosis at a young age, as revealed in some studies. In particular, this pattern was demonstrated in a comparison of the prevalence of risk factors among patients hospitalized with acute MI at age younger and older than 50, in a registry containing 1199 patients [15]. The link of obesity with atherosclerosis at a young age was demonstrated in a study on autopsies of 3 000 subjects aged 15–34 years who died of non-cardiological causes [16]. In the Framingham study, it was shown that the contribution of obesity to the development of IHD in middle-aged people may be as high as 23% of the cases among males and 15% of the cases among females [17].

In our study population, the prevalence of the analyzed IHD risk factors (except for cigarette smoking) was found to be not different between the groups with and without IHD. The prevalence of smokers was 1.7-fold higher in the no-IHD group than in the group with IHD. Our multivariate logistical regression analysis also uncovered an inverse association of smoking (independent of age, sex, and other analyzed risk factors) with the relative risk of IHD in the study population (25–44-year-olds in Novosibirsk). We explain this finding, which contradicts known classical data, by the insufficient number of IHD cases (a total of 49 subjects, 18 males and 31 females) in our study.

Indeed, all the data from the international literature point to a rather significant role of smoking in IHD development and complications. It is believed that smoking is the most prevalent risk factor of early IHD. According to Cole J.H. and coworkers, the number of smokers among IHD patients under 45 years ranges from 60% to 90%, whereas among patients older than 45 years, from 24% to 56% [18].

In a meta-analysis including 14 international randomized studies on IHD, among 76716 MI patients with ST segment elevation, 35527

patients with unstable angina pectoris/MI without ST segment elevation, and 10215 patients who underwent percutaneous coronary interventions, researchers analyzed the prevalence of 4 risk factors (smoking, diabetes mellitus, AH, and hyperlipidemia) depending on sex and age. In the majority of younger patients, at least one risk factor was noted, with the most frequent one being smoking: 72% frequency among subjects younger than 45 years, both in males and in females [8].

In a study on a registry intended for observation of 892 patients with acute MI with ST segment elevation who underwent their first percutaneous coronary intervention, there were 78% of smokers among the patients aged 18 to 34 years, and 23% of smokers in the whole study population; the percentage of smokers decreased with the increasing age at MI diagnosis [19].

Kafadar D. and colleagues have examined 235 patients with coronary-angiography–verified coronary atherosclerosis. Active smokers showed the highest mean levels of TGs in the blood, whereas nonsmokers were reported to have the highest mean HDL-C concentrations [20].

Christus T. and coworkers have examined 200 males younger than 35 years with IHD diagnosed by coronary angiography and concluded that the main risk factor in this population is cigarette smoking [5].

As compared with the total number of publications about the adverse impact of cigarette smoking on the development of CVDs in the world literature, there are only a few papers where the results defy the traditional findings, for example, the study by Li G. and colleagues [21]. They examined a Chinese population aged 20–80 years (1248 subjects) and concluded that sex- and age-adjusted BP is lower in smokers than in nonsmokers or former smokers. There was no significant dose-dependent influence of smoking on sex- and age-adjusted BP. Furthermore, smoking cessation was significantly associated with a higher risk of hypertension.

Because none of the risk factors analyzed by us, except for smoking, manifested an apparent association with the relative risk of IHD, and because the cigarette smoking analysis yielded the "paradoxical" result, we then investigated the link of IHD with socioeconomic factors whose influence on IHD development has been actively discussed in the last decades [22].

We performed a multivariate logistical regression analysis of the socioeconomic factors in relation to the risk of IHD in our study population (25–44-year-olds in Novosibirsk) and in its male and female subpopulations. Statistically significant results were obtained only in the male subpopulation. We identified age-independent associations of the occupation type and marital status (which correlated with smoking), with the relative risk of early IHD in males aged 25–44 years. It was found that among divorced males aged 25–44 years, the probability of the presence of early IHD is 5-fold higher, whereas among males occupationally engaged in heavy manual labor, it is 3.5-fold higher.

Our results are consistent with data from other studies. For example, the influence of marital status on the frequency of CVDs and prognosis after CVD was assessed in a meta-analysis of 34 studies involving more than 2 million participants. In comparison with married participants, the absence of marriage (never married, divorced, or widowed) correlated with a higher risk of CVDs, IHD, death from IHD, and death from stroke. Divorce was associated with a higher risk of IHD both in males and in females [23].

Leisure time physical activity is a widely recognized protective factor against cardiovascular mortality. Participants of a prospective epidemiological study on MI (PRIME; n = 9758; age 50 to 59 years), who did not have IHD at the beginning of the study, were observed for 5 years: the researchers registered 167 cases of severe IHD and 154 cases of tension angina pectoris. A beneficial effect of leisure time physical activity was noted among the subjects who did not report high-intensity activity, in France and Northern Ireland. By contrast, increasing the level of leisure time physical activity was associated with a higher risk of tension angina pectoris in both countries [24].

In the CORDIS study, investigators analyzed the influence of leisure time physical activity and of heavy physical activity associated with one's job (occupational heavy manual labor) on cardiovascular mortality among males (4819 subjects) during 22-year prospective observation. It was occupational heavy manual labor that posed the highest risk of death, including IHD-related mortality. Those authors concluded that heavy manual labor at one's job is bad for health [25].

Thus, our data suggest that among 25–44-year-old males in Novosibirsk, the relative risk of IHD (namely, early IHD, manifesting itself before 45 years of age) directly correlates with occupational heavy manual labor and unfavorable marital status but is inversely associated with smoking. In our opinion, these results undoubtedly require further research.

CONCLUSION

Early detection of IHD, especially early IHD, presenting before 45 years of age, is highly important for programs on secondary prevention of IHD. Generally, the results obtained indicate a low prevalence of early IHD in the 25-44-year-old population of Novosibirsk. The results also indicate that there is no significant influence of CVD risk factors, other than cigarette smoking, on the risk of early IHD in this population. It is interesting to note the influence of occupational heavy manual labor and unfavorable marital status associated with smoking on the risk of developing early IHD in a young population. The results obtained, obviously, are an incentive for further study of early IHD and the features of its risk determination in a young population.

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Ethics Approval and Consent to Participate

The study protocol was approved by the local Ethics Committee of the Institute of Internal and Preventive Medicine (a branch of the Institute of Cytology and Genetics, the Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia). All methods were performed in accordance with the relevant guidelines and regulations. Written informed consent to the medical examination and analysis of personal data was obtained from each patient.

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Authors' contributions

Yuliya I. Ragino: study conception and design and critical revision of the manuscript

Natalya A. Kuzminykh: wrote the main manuscript text, collection of the clinical data, drafting of the manuscript

Liliia V. Shcherbakova: statistical analysis

Viktoriya S. Shramko: analysis and interpretation of the biochemical data, participation in discussion

Diana V. Denisova: collection of the clinical data, revision of the manuscript and participation in discussion

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