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Contribution of Cardiovascular Risk Factors to the Development of Coronary Heart Disease in Kazakhstan

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ABSTRACT

Coronary heart disease (CHD) has well-known risk factors. The prevalence and impact of these mainly depend on people's lifestyles, geography, as well as racial and ethnic predispositions, among other factors. The objective of this study is to compare the prevalence of cardiovascular risk factors among different European and Asian ethnic groups of patients in the Republic of Kazakhstan. The data from 1628 patients diagnosed with coronary angiography for coronary heart disease (CHD) were investigated. SPSS software was used for statistical processing, employing the Kruskal-Wallis test and Chi-square test. The number of patients diagnosed with acute coronary syndrome was 743, and the number of planned patients with stable angina was 885. Approximately 60% of the patients were conditionally categorized as Asians and 40% as Europeans. The gender composition of both groups was dominated by men. There is a general trend towards planned hospitalization in the Asian group (62% vs. 56%, p=0.009). For the specificity of Asian groups, the most significant risk factors were male gender, diabetes mellitus, and overweight. In the European group, the contribution of factors such as arterial hypertension and dyslipidemia (high LDL levels) were found to be more significant. The impact of smoking habits and family history were similar in both groups. In the European group, there was a greater tendency to hemodynamically significant coronary artery atherosclerosis compared to the Asian group (68 vs. 59%,

p<0.001), which is hypothesized to be due to overdiagnosis, or the predominance of non-obstructive coronary heart disease in Asian population. Cardiovascular risk factors such as arterial hypertension and dyslipidemia were more prominent in the development of CHD among Europeans, while in Asians diabetes mellitus and being overweight contributed more significantly. Accordingly, it is the above modifiable risk factors that should be given more attention in the prevention and treatment of populations at risk of CHD in Kazakhstan.

Keywords
Coronary angiography
Coronary heart disease
Ethnic group
Risk factors

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Introduction

Despite the intensive development of modern methods of diagnosis and treatment of ischemic heart disease and other atherosclerotic diseases, their prevention remains an important task. While modern treatments for CHD are becoming more effective prevention of CHD reduces both the physical toll of chronic disease and financial burdens. By promoting healthy behaviors to prevent CHD along with early intervention, complications, and healthcare costs would be minimized, benefiting both individuals and public health efforts in these countries.

The primary influence of risk factors in the prediction and epidemiology of cardiovascular diseases, in particular CHD, is known. According to the World Health Organization (WHO), it is estimated that 17.9 million deaths are due to cardiovascular disease, and this trend is expected to continue increasing due to inevitable lifestyle changes, the general increase in average age, and the prevalence of risk factors [1],[2]. Studies previously conducted in Kazakhstan and nearby countries have observed certain differences in the prevalence of risk factors depending on geographical, gender, or ethnic characteristics [3]-[6]. While ischemic heart disease is commonly found among all population groups in European and North American countries, in Japan, Peru, and Guatemala, it is a relatively rare disease. Previous studies have linked these inconsistencies to characteristics in the gene pool, cultural diets that encourage vegetables and seafood consumption, and an overall healthier lifestyle [7], [8].

Material and Methods

In the proposed cohort study, 1,628 patients diagnosed with coronary angiography were analyzed, including stable angina, acute coronary syndromes, and myocardial infarction

for the period of 2017 to the first quarter of 2019. The studies were conducted based on the "Central Clinical Hospital", a multidisciplinary hospital with a cardiology center with a catheterization laboratory and cardiac surgery unit.

The study sample population was drawn from patients admitted to the hospital who had been diagnosed with CHD. This selection criterion was deliberate since it allowed the analysis of the prevalence and potential predispositions of certain demographic factors–gender and ethnicity–among individuals already affected by the disease. By focusing on patients already diagnosed with CHD, the study sought to elucidate any discernible patterns or disparities in the prevalence of predisposing factors among individuals afflicted by the condition. The inclusion of both Asian and European ethnicities within the sample population enabled a comparative analysis, facilitating the examination of potential ethnic variations in the distribution of predisposing factors within the CHD patient cohort. This is especially relevant since Kazakhstan's population is mostly composed of European and Asian ethnicities.

The criteria for excluding patients from this study were the presence of severe concomitant pathology, including acute cerebral blood flow insufficiency in the previous six months, heart failure in functional class IV grading, acquired heart defects, pulmonary embolism, and signs of severe inflammatory diseases. These exclusions decreased the likelihood that the risk factors analyzed were caused by other conditions.

Patients who met the requirements were then classified by gender and conditionally divided into two ethnic groups (Asians and Europeans) spanning ages from 20 to 90 years. Ethnicity was determined by the national self-identification primary examination card of each patient. The overwhelming majority of patients by national composition are Kazakhs and Russians. In this study, Kazakhs–including Uighurs, Koreans, and Tatars–were conventionally grouped as Asians, while Russians, Germans, Ukrainians, Poles, and Turks were designated as the European group. Other race designations were excluded from this study to facilitate the interpretation of the results, and since most of Kazakhstan's population identify as either Asian or European in ethnicity.

For this study, the CHD risk factors were divided into two categories: Modifiable risk–such as weight, arterial hypertension, diabetes, dyslipidemia, and smoking–and non-modifiable risk factors–such as age, gender, and heredity. As such the following data was examined: Coronary angiography protocol, clinical and instrumental-laboratory examination data, history data, body mass index (BMI) measurements, standard blood pressure, echocardiography, electrocardiogram, biochemical analysis of blood, including lipid profile test] with determination of cardiovascular risk factors. The results were statistically processed using SPSS for Windows 10.0 software. The Kruskal-Wallis test was utilized to compare

the median values of the four groups to determine whether there were statistically significant differences in their medians. This non-parametric statistical test was chosen due to its ability to determine significant differences even when the data do not adhere to the assumptions of parametric tests, especially non-normality. Utilizing the Kruskal-Wallis test to identify any disparities in the variables studied could shed light on how demographic factors, such as gender and ethnicity could influence the prevalence of the main risk factors of CHD. Such insights could potentially inform targeted interventions or treatments tailored to specific demographic groups in Kazakhstan. For the convenience of the analysis of the conducted study, the summary tables are given, in which only the revealed differences are presented.

Results

It is known that the risk factors (RF) contribute to the development of coronary heart disease (CHD). The category of modifiable factors (lifestyle or behavioral risk factors) includes overweight, arterial hypertension, diabetes, dyslipidemia, and smoking; the category of non-modifiable includes age, gender, and heredity [9], [10]. This research presents the results of the statistical analysis of these factors, taking into account the main ethnic distinctions of the population in the Republic of Kazakhstan.

Table 1 describes data obtained from the Kruskal-Wallis test that assessed differences in various risk factors across gender and ethnic groups from the sample.

Table 1. Ethnic differences in risk factors

Variables	Groups	Average rank	Kruskal-Wallis Criterion	Credibility (p)
Age at the time of angiography	Male-European	814.74	106.803	0.000
	Female-European	1012.53		
	Male-Asian	687.16		
	Female-Asian	899.93		
Diabetes mellitus	Male-European	745.96	36.270	0.000
	Female-European	805.02		
	Male-Asian	835.88		
	Female-Asian	903.67		
Arterial hypertension	Male-European	817.04	16.072	0.001
	Female-European	886.92		
	Male-Asian	764.52		
	Female-Asian	849.61		
Body mass index	Male-European	765.21	34.192	0,000
	Female-European	861.21		
	Male-Asian	786.93		
	Female-Asian	941.07		

Table 2 shows the results concerning lipid metabolism disorders

Table 2. Ethnic differences in the lipid spectrum

Variables	Groups	Average rank	Kruskal-Wallis Criterion	Credibility (p=)
TG	Male-European	773.93	10.193	0.017
	Female-European	778.16		
	Male-Asian	848.90		
	Female-Asian	794.43		
LDL	Male-European	792.00	9.999	0.019
	Female-European	884.69		
	Male-Asian	789.65		
	Female-Asian	791.24		
Total Cholesterol	Male-European	777.56	24.706	0.000
	Female-European	915.38		
	Male-Asian	763.05		
	Female-Asian	850.50		
HDL	Male-European	750.88	40.603	0.000
	Female-European	846.09		
	Male-Asian	781.08		
	Female-Asian	877.95		

Table 3 shows the angiographic coronary artery data

Table 3. Comparative analysis of angiographic data

	No lesion/ less than 50%	Lesions more than 50%	p<0.01	χ^2 p=0.01
Asians	41%	32%	p< 0.001	6.635
European	59%	68%		14.973

Table 4 shows the comparative analysis of the hospitalization type.

Table 4. Comparative analysis of the hospitalization type

	Acute Coronary Syndrome	Stable angina	p<0.01	χ^2 p=0.01
Asians	56%	62%	p=0,009	6.635
European	44%	38%		6.995

A comparative analysis of the angiographic picture of coronary arteries in coronary artery disease in patients of different ethnic groups was carried out in Table 3 to compare the prevalence of their lesions about their hospitalization type shown in Table 4.

Discussion

A. Age and Sex

The incidence of coronary heart disease was found to increase with age. In men aged 20–29 years, the prevalence of coronary heart disease (CHD) ranged from 0.8% to 0.9%, whereas among those aged 60–69 years, it escalated significantly to a range of 12.8% to 22.9%. This sharp increase can be attributed to the natural effect aging has in the increased incidence of CHD [11]-[13].

Among many contradictory results, one thing is beyond doubt the predominance of male patients diagnosed with cardiovascular disorders [14], [15]. It has been established that the risk of cardiovascular diseases increases in men over 40 years old, while in women it usually occurs after menopause. Similarly, men up to 60 years old are most often affected by CHD, but after this age, the differences between men are women start to minimize. Thus, gender differences are most prominent observed at a young age and only begin to level out over the years [16]-[18].

In Table 1 the Kruskal-Wallis Criterion showed that early onset CHD tends to be more common among those of Asian ethnicity since their median age tends to be lower at the time of angiogram. Both Asian males and females have lower ranks compared to their European counterparts–687.16 for males and 899.93 for females–indicating an overall trend of earlier onset of CHD for individuals of Asian descent. Meanwhile, both European males and females have higher ranks–814.74 for males and 1012.53 for females–suggesting a later onset of CHD compared to Asians.

Additionally, the angiogram data suggests that early-onset CHD is more common among males compared to females. This conclusion is supported by the lower ranks–illustrating lower median ages–for males in both ethnic groups. Overall, the angiogram data in Table 1 suggests that early-onset CHD tends to be more common among males compared to females. Additionally, among ethnic groups, Asians tend to develop CHD at a younger age compared to the Europeans in the study. Thus, as discussed previously the risk of developing CHD occurs earlier in men of Asian origin and the latest in European women (Table 1). These findings suggest that special preventive measures and early screening for CHD to be targeted toward males and Asian populations in Kazakhstan.

B. Diabetes Mellitus

The following differences in the diabetes mellitus contribution were also observed: The results of the study showed that although diabetes is less common in the general population (only 22% of the worldwide population), it is undeniably an important risk factor in both groups. However, its contribution to the development of CHD in Europeans was lower than in Asians. By gender, diabetes significantly increased the risk of coronary heart disease and peripheral vascular disease in women, particularly Asian women (903,67) who had a higher prevalence than Asian men (835,88) and European women (805,02), as depicted in Table 1.

C. Arterial hypertension

As a risk factor, arterial hypertension was more prevalent in the European than in the Asian group. Gender-related, this factor had a greater contribution to the development of CHD in

women, especially in European women with their rank being higher than the other groups (886,92). In the male subgroup of Asian men, the contribution of arterial hypertension in the pathogenesis of CHD is the lowest (Table 1). Among cardiovascular risk factors, arterial hypertension stands out as one of the most common factors and has the maximum available opportunities for correction. Normalization of blood pressure is necessary because a decrease in blood pressure by 5-10 mmHg leads to a decrease in the frequency of myocardial infarction by 34-56% and coronary heart disease by 21-37% [19],[20].

D. Weight

Of all the risk factors being overweight played a crucial role since it's not only a major independent factor of cardiovascular disease, but also the starting mechanism of other risk factors, such as hypertension, and diabetes mellitus [21],[22]. The Body Mass Index (BMI) data indicates a gender disparity between the groups, with women with CHD of both ethnicities displaying a higher BMI average than men. According to the Kruskal-Wallis test being overweight emerged as a more significant risk factor for CHD development among women, particularly those of Asian descent–941.07 versus 861.21 in European women. For men in both groups, this factor might be relevant, but to a lesser extent since their ranks were closely in number–765.21 for European males and 786.93 for Asian males (see Table 1).

The increasing number of overweight patients can be regarded as a result of the interaction between modern lifestyle and genotypic features. Many gene-contributing factors are still under research, and we can assume that Asians have this developed genetic predisposition as well [23],[24]. In addition, the active urbanization process in Kazakhstan is significantly influencing not only the lifestyle but also the dietary habits of the Asian population. This urbanization, which has intensified rapidly in recent years, is increasing the susceptibility to sedentary lifestyles, as urban environments promote less active physical activity. This rapid urbanization is also leading to many dietary changes as individuals prioritize work or other activities over traditional healthy meals¬–"eating on the go" [25]. In contrast, Kazakh Europeans experienced the effect of urbanization much earlier providing them with a longer time to adapt their systems [26].

E. Lipid metabolism disorders

Lipid metabolism disorders were observed in all four groups and have some differences. Hyperlipidemia is characterized by elevated levels of lipids in the blood, and it has been linked to coronary artery disease and stroke. Asians are more prone to hyperlipidemia, especially men [27]. The Kruskal-Wallis test showed that high levels of low-density lipoproteins (LDL) have a greater contribution to the development of coronary heart disease in European women (884,69) than in Asian women (791,24) and men of both races (792,00 European men and

789,65 Asian men). High cholesterol and low high-density lipoprotein (HDL) are more common among Europeans, with European women being more prevalent than Asian women (Table 2). In the male category, hypercholesterolemia with lower levels of HDL is predominantly found in European males rather than Asian males. There is no doubt in the significance of dyslipidemia as an important risk factor in both cohorts, but its contribution to ischemic heart disease in Asians is lower than in Europeans contradicting previous studies [28]. It can be assumed that the lower significance of dyslipidemia in the Asian group might be due to a specific hereditary factor, influenced by the region's historical development. It has been noted that Asian (in particular, Kazakh) people's lifestyles have changed: quality and nature of nutrition, rhythm of life, etc. Therefore, the question of the real ratio of genetic and social components remains relevant and requires further study based on molecular genetic research.

F. Smoking

There was no significant difference found in the risk factor of smoking, either. For both racial cohorts, this factor is equally important in the development of CHD. Hopefully, given the current strong advocacy for healthy lifestyles and the harms of smoking in our society and the world, smoking will lose more of its contribution to the pathogenesis of cardiovascular disease and many other diseases in the future [29]. It is worth noting that this risk factor is only a "bad habit".

G. Hereditary risk factors

In contrast to monogenic diseases–caused by an abnormality in a single gene–CHD is a polygenic or multifactorial disease, which involves abnormal variations in multiple genes and environmental factors, each of which contributes a small amount to the overall risk of developing the disease. These pathologies are interesting since certain interactions between genes and environmental factors could trigger the disease, however, in many cases, individuals can live with these predispositions but never develop the disease. Accordingly, the issue of family predisposition to the development of CHD as a polygenic disease occupies a large place in epidemiological studies. However, the Kruskal-Wallis test showed no statistically significant disparities between any of the groups–neither ethnicity nor gender–in the risk factor associated with hereditary genes. It can assumed that the absence of significant differences in family history with CHD in the observations of this study was because of the same influence of environmental factors, which after some time leads to the "equalization" of the initial hereditary differences in the initial heterogeneous groups, which requires a more in-depth molecular-genetic analysis.

H. Angiographic Coronary Arteries

According to the 2018 ESC EACTS Guidelines on myocardial revascularization, Hemodynamically significant coronary is defined as FFR ≤0.80, iwFR ≤0.89, or more than 90% stenosis if FFR measurements were not performed in a major coronary vessel. However, in our study, a 50% stenosis cutoff was used for defining significant lesions, which is still debatable and more lenient than the standard cutoff. It is essential to note that the use of a 50% cutoff may result in identifying a broader range of coronary artery disease severity. This could explain the observed differences between European and Asian patients and highlight the need for further functional assessments to determine the true hemodynamic impact. This criterion was chosen due to the availability of the data to include a wider range of patients since complying with the stringent ESC definition would limit the number of patients which would hinder our analysis.

The data showed that the European group had a greater tendency to hemodynamically significant lesions of coronary artery atherosclerosis in comparison with Asians (68 vs. 59%, p <0.001), which is probably associated with hyperdiagnosis or the high prevalence of coronary heart disease (CHD) in the Asian group. Another explanation may be the greater atherogenic significance of risk factors such as arterial hypertension and dyslipidemia. However, given the use of the 50% cutoff in the stenosis lesions, it is important to consider these findings in the context of potential overestimation of hemodynamic significance. Further research utilizing more stringent criteria like FFR or iwFR may be warranted to validate these results.

Conclusion

Summing up the results of the comparative analysis of various risk factors of ischemic heart disease in the population of Kazakhstan, we can conclude that there are ethnic features of the impact of some risk factors. In the Asian male sample diabetes mellitus and excess weight are significantly more important in the composition of risk factors for CHD in comparison with the European male sample. At the same time, arterial hypertension and dyslipidemia are found to be factors that contribute to the risk for coronary heart disease in the European population than in the Asian ethnic group, regardless of gender. According to the angiographic data collected, there was a greater tendency to have atherosclerotic coronary artery lesions in the European group than in the Asian group, which, however, requires further investigation to gather stronger correlations. Furthermore, it is important to note that the study was constrained by a small sample size, which restricts the generalizability of its findings to the broader population of Kazakhstan. Ultimately, none of the risk factors should be considered as a single independent predictor of coronary heart disease in Kazakhstan's population since it

has been established that CHD is a polygenic disease, but the findings in the study can serve as an indicator of which factors should be addressed in specific populations.

Conflict of Interest

The authors declare that there is no conflict of interest.

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