Relationship between depression and coronary artery disease in an open female and male population of a middle-urbanized city of Western Siberia

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Aim. To assess the associations between depression and coronary artery disease (CAD) in an open female and male population of a middle-urbanized city of Western Siberia.

Material and methods. Two cross-sectional epidemiological studies were carried out on an open population of a middle-urbanized Siberian city among men and women aged 25-64 years old. The prevalence of CAD was assessed based on standard epidemiological methods. To determine the severity of depression, the algorithms of the WHO program MONICA-Psychosocial were used. The severity of depression was assessed as low, moderate, and high. On the basis of the algorithm, the levels of depression were established: low and moderate levels — no sign, high level — presence of a sign.

Results. In an open population of 25-64 years old, a moderately urbanized Siberian city, the prevalence of CAD according to extended and lax epidemiological criteria prevailed in men, while strict epidemiological criteria did not reveal significant differences in the male and female subpopulations. In the female subpopulation, a tendency towards an increase in the prevalence of a high level of depression was revealed due to its predominance in young age groups.

It has been shown that the depression increases the probability of detecting CAD in accordance with the expanded epidemiological criteria in men and women by 21,07 and 16,04 times, respectively.

Conclusion. When using epidemiological criteria for CAD in the presence of depression, the probability of detecting CAD is higher, both in men and women. At the same time, the highest odds ratios are characteristic for a certain type of CAD, the least — CAD by probable signs.

Keywords: epidemiological study, coronary artery disease, depression, open population, sex differences.

Introduction

Depressive disorders are one of the key psycho-social risk factors (PSF) for the development of cardiovascular diseases (CVD) [1, 2]. Depression has received the most attention from researchers over the past decades. Because of the overwhelming number of studies related to depression and CVD, recent US clinical guidelines include the screening and treatment of depression in patients with heart failure as the standard of care [3]. Depression is defined differently in CVD studies and can range from subclinical symptoms of depression to major depressive disorders [4, 5].

Associations of depression with CVD mortality were first identified in the middle of the last century, but only at the end of the 20th century, when studying mortality in populations with a high level of depression, data on a significant increase in cardiovascular and overall mortality were obtained, after which depression was recognized as an independent risk factor (RF) CVD. It has been shown that in patients with psychoemotional disorders, the pathophysiological mechanisms of the development of coronary artery disease (CAD) are manifested by the hyperproduction of coagulation factor IV and β-thromboglobulin, an increase in the levels of catecholamines in the blood and intracellular free calcium, which leads to an increased risk of CAD in due to increased thrombus formation [6]. In addition, psychological and social disorders in patients with CAD occur much more often than in the general population, causing complications of the disease, deteriorating health in general and reducing the quality of life [7, 8]. The results of a large clinical and epidemiological study to assess the prevalence of PSF in patients with CAD in the Russian Federation according

to KOMETA (Clinical-Epidemiological Program of Studying Psychosocial Risk Factors in Cardiological Practice in Patients with Arterial Hypertension and Ischemic Heart Disease) showed their relationship with traditional CVD RF [9].

In many studies, the prognosis of CAD development in connection with depressive manifestations has been studied, and it has been shown that, in the gender aspect, the prevalence of depression and other negative psychoemotional states in the general population in women in particular, significantly exceeds those in men [1, 10, 11]. With the most severe form of depression, a depressive episode, the highest risk of CVD complications is also noted [9]. In the Novosibirsk study, it was shown that death from cardiovascular causes in the group with depression was 2 times higher than in the general population [10]. As a result, the gender characteristics identified in relation to the CAD risks, depending on the high level of depression in Western Siberia at the level of a middle-urbanized city, are likely to be decisive for the possibilities of effectively changing the epidemiological situation of CVD in the region [12].

The aim of the study is to assess the associations between depression and coronary artery disease in an open population of a middle-urbanized city of Western Siberia in terms of gender.

Material and methods

On the open (unorganized) population of Tyumen, two cross-sectional epidemiological studies were carried out according to a single protocol among persons of both sexes — among men in 2010 and among women in 2016. Representative samples, stratified by sex and age, were formed in a computer version using the method of random numbers based on the list of names of the population of the Central Administrative District of the city. Initially, the information received was verified at the Tyumen Regional Address Bureau. The samples consisted of 1000 persons aged 25-64 (250 persons in each of the four decades of life). The criteria for enrollment in the population samples were males or females aged 25-64, registered and living in the Central Administrative District of Tyumen. The criteria for withdrawal from the population were refugees, students, soldiers and prisoners, which was established from the words of the subjects, the data

were not included in the analytical array. Invitations were sent to those included in the population samples to participate in cardiological screening; in the absence of a response to the first invitation, up to three reminder letters were sent with an interval of 7-10 days, or attempts were made by telephone or personal contact with the study participants. The response to the study among men was 85,0%, among women — 70,3% (Table 1).

The study was carried out in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the local Ethics Committee. Written informed consent was obtained from all participants prior to enrollment.

As part of cardiac screening, resting electrocardiography was performed in the supine position in 12 leads. The prevalence of CAD was established according to the criteria adopted in epidemiological studies. Based on the results of electrocardiography processing using the Minnesota code and analysis of the World Health Organization (WHO) questionnaire for angina pectoris, an epidemiological diagnosis of CAD was established: 1) according to strict criteria - a "definite" form of CAD (DCAD); 2) according to non-strict criteria — "possible" form of CAD (PCAD). Strict and non-strict CAD criteria collectively defined CAD according to extended epidemiological criteria.

To determine the severity of depression, the algorithm of the WHO program MONICA-Psychosocial was used [13]. A depression scale form (Mopsy test) consisting of 15 statements was proposed. To answer each statement, 2 gradations are provided: "agree", "disagree". The severity of depression was assessed as low, moderate, high. On the basis of the algorithm, the levels of depression were established: low and moderate levels — the absence of a sign, a high level — the presence of a sign.

For the statistical processing of the study results, the program IBM STATISTICS 21.0 was used. To conduct a correct comparative analysis with data from other epidemiological studies, the indicators were standardized using the direct method of standardization. When processing the data obtained, the age structure of the urban population of the Russian Federation in the range of 25-64 years was used to standardize the indicators. Results for categorical variables are presented as fractions (in %). When assessing the statistical significance between the sample fractions of the population in the two groups, the Pearson's chi-squared test (χ^2) with Yates' correction for continuity was used. In the case of comparing three or more groups, the analysis of contingency tables was initially used, according to the criterion of "maximum

Table 1

The structure of subjects according to the data of cardiac screenings

| Evaluation parameters	The number of subjects (male/female)	Age and sex groups, years (male/female)			
		25-34	35-44	45-54	55-64
Screening	850/703	177/122	228/207	231/159	214/215
CAD	130/75	4/3	19/16	36/22	71/74
DCAD	71/51	3/2	8/12	19/15	41/22
PCAD	59/24	1/1	11/4	17/7	30/12
High levels of depression	50/55	2/10	4/15	13/10	31/20

Note: PCAD — "possible" CAD, CAD — coronary artery disease, DCAD — "definite" CAD.
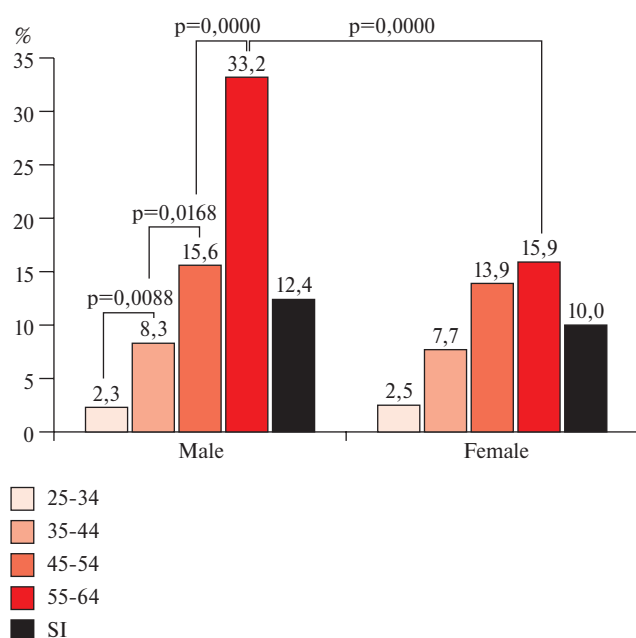
Figure 1 Prevalence of CAD according to extended epidemiological criteria in an open population of 25-64 years old, %.

Note: SI is an age-standardized indicator.
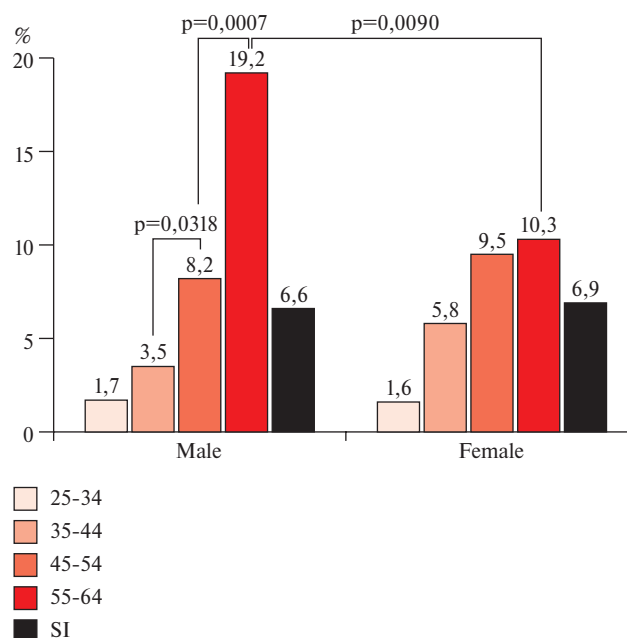
Figure 2 Prevalence of CAD according to strict epidemiological criteria in an open population of 25-64 years old, %.

Note: SI is an age-standardized indicator.
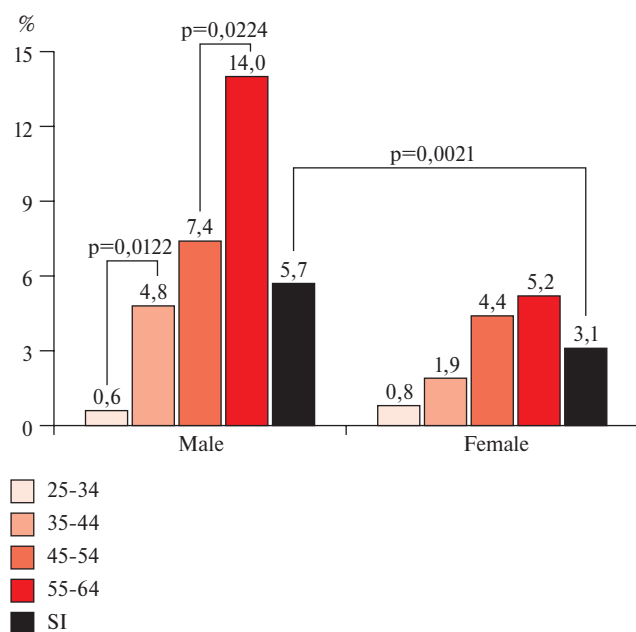
Figure 3 Prevalence of CAD according to non-strict epidemiological criteria in an open population of 25-64 years old, %.

Note: SI is an age-standardized indicator.
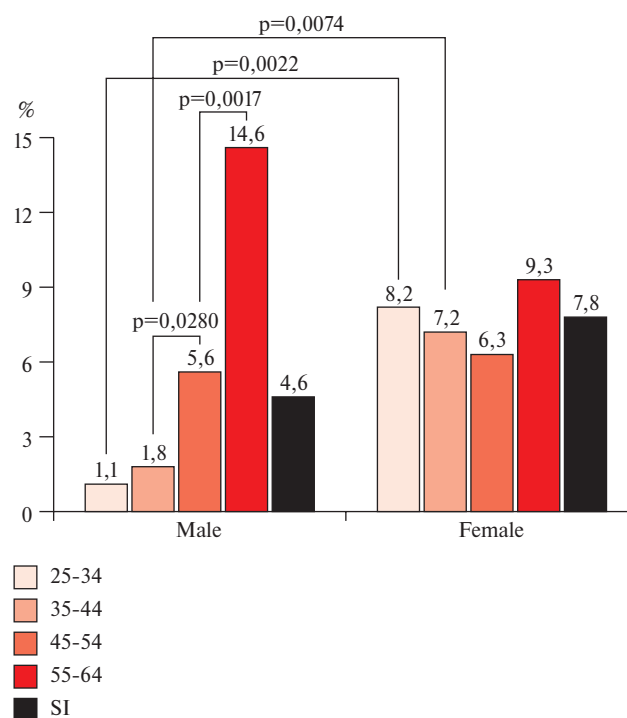
Figure 4 Prevalence of high levels of depression in men and women in an open population of 25-64 years old, %.

Note: SI is an age-standardized indicator.

likelihood chi-square", to establish statistically significant differences between the groups, followed by paired comparison of the groups. For the critical level of significance when testing statistical hypotheses, $p < 0.05$ was taken based on the number of degrees of freedom. When paired comparisons in four or more independent groups, to exclude the problem of multiple comparisons, i.e., to eliminate the error of the first kind, the Bonferroni correction was applied. Associations of high levels of depression with the prevalence of CAD, its "definite" and "possible" forms (DCAD and PCAD), were determined by calculating odds ratios (OR) and their 95% confidence intervals (CI). In each case, the statistical significance of OR was assessed based on the values of 95% CI. If the CI included one, i.e., its upper limit was >1, and the lower one was <1,

Table 2

Indicators of the association of depression and different forms of CAD
(epidemiological approach) in an open population of 25-64 years old

Presence/ absence of D	DCAD yes	DCAD no	OR	95% CI	PCAD yes	PCAD no	OR	95% CI	CAD according to extended criteria yes	CAD according to extended criteria no	OR	95% CI
Male												
D yes	32	18	39,84	19,61-80,90	3	47	1,06	0,31-3,65	35	15	21,07	10,76-41,26
D no	27	605			36	596			63	569		
Female												
D yes	19	49	26,53	10,63-66,26	6	50	5,88	2,05-16,86	25	43	16,04	8,04-32,00
D no	7	479			10	490			17	469		

Note: PCAD — "possible" CAD, D — depression, CI — confidence interval, CAD — coronary artery disease, DCAD — "definite" CAD, OR — odds ratio.

it was concluded that there was no statistical significance of the relationship between the factor and the outcome at a significance level of p>0,05.

Results

In an open urban population (on the model of Tyumen), the age-standardized CAD prevalence among men was 12,4%, among women it was significantly less — 10,0% (p=0,0074).

With increasing age, the prevalence of CAD according to extended epidemiological criteria increased significantly in the male subpopulation. In the age categories of the female subpopulation, the prevalence of CAD according to extended criteria was almost the same. Statistically significant differences in the prevalence of CAD in the gender aspect took place in the sixth decade of life — 33,2% in men and 15,9% in women (p=0,0000) (Figure 1). According to strict epidemiological criteria, the prevalence of CAD among men — age-standardized indicator (SI) =6,6%, and women — SI =6,9%, was practically the same (p=0,4233). The indicator significantly increased with age in men from the fourth to the fifth (p=0,0318) and from the fifth to the sixth decade of life (p=0,0007), remaining stable in women throughout the entire age range. Statistically significant differences in the prevalence of DCAD in the gender aspect were also established in the sixth decade of life — 19,2% in men and 10,3% in women (p=0,0090) (Figure 2). According to non-strict epidemiological criteria, the prevalence of PCAD in the male subpopulation increased significantly with age in the fourth (p=0,0122) and sixth decades of life (p=0,0224); in the female subpopulation, this tendency was not revealed. In the gender aspect according to PCAD SR, there were statistically significant differences with the priority for men compared with women — 5,7 and 3,1%, respectively (p=0,0021) (p=0,0021) (Figure 3).

The age-standardized indicator of high depression in the male subpopulation was 4,6%, in the female subpopulation — 7,8% (p=0,1294).

The high level of depression in men and women reached its absolute maximum in the 55-64 age group. In the age range, the high level of depression in men significantly increased from the fourth to the fifth — 1,8 vs 5,6% (p=0,0280) and from the fifth to the sixth decade of life — 5,6 vs 14,6% (p=0,0017), in women throughout the entire age period, the indicator remained practically the same. In the gender aspect, statistically significant differences in the prevalence of high levels of depression were noted at a young age with a priority for women — 25-34 years: 1,1% vs 8,2% (p=0,0022); 35-44 years: 1,8 vs 7,4% (p=0,0074) in men and women, respectively (Figure 4).

In an open urban population aged 25-64, associations between the prevalence of CAD and high levels of depression (OR) among men and women were determined. In both sexes, depression was significantly associated with the development of CAD. Thus, in the presence/absence of a high level of depression and the presence/absence of CAD according to extended criteria, OR =21,07 in the male subpopulation (95% CI: 10,76-41,26) and OR =16,04 in the female subpopulation (95% CI: 8,04-32,00) at a significance level of p<0,05. In the presence/absence of DACD and a high level of depression, OR =39,84 in the male subpopulation (95% CI: 19,61-80,90) and OR =26,53 in the female subpopulation (95% CI: 10,63-66,26).

Consequently, when using epidemiological criteria for defining CAD in the presence of depression, the chance of detecting CAD is higher in both men and women. At the same time, the highest OR indicators are characteristic for the registration of DCAD, the lowest — for PCAD (Table 2). The presence of depression increases the chance of defining CAD according to extended criteria by 21,07 and 16,04 times in men and women, respectively.

Discussion

In the scientific literature of the beginning of this century, it has been shown that in the pathogenetic chain of development of cardiovascular pathology,

depression is not so much a secondary psychoemotional reaction to CAD, but a proven independent RF of its development [1, 3, 6]. In addition, depression can be both a negative prognostic factor and provoke the development of CVD [4]. Previous works performed on the Tyumen population showed the importance of studying PSF and, in particular, negative psychoemotional states due to their high prevalence in the population, as well as their predictive value in relation to the development of CAD [11, 14].

The profile of psychoemotional RFs among women in the Tyumen population in the age aspect showed a significant prevalence of a high level of depression in not only middle-aged but also young age groups. This situation seems reasonable, since the prevalence of PSF in populations is interdependent and is determined by the combined interaction of factors of psycho-emotional stress and factors of chronic social stress, the prevalence of which, according to the results of previous studies, was very high in young women [15].

The results of global studies have demonstrated the effect of depression on severe complications of CAD, both directly under the influence of pathophysiological mechanisms, and indirectly, through the influence of behavioral RF of CVD. Depression can be aggravated by stressful events, while depression, as such, can provoke a reaction of the cardiovascular system to stress, eventually forming a vicious circle [4, 7]. At the same time, the possibility of changing the behavior and ways of the individual's response, including those that can reduce the risk of developing CAD, seems so far from a solution [8, 9]. The effectiveness of correcting and overcoming stress in society has not been studied enough, however, since PSF can be considered as internal resources subject to the person himself, the development of personal attitudes should become fundamental for a more positive attitude of the individual and an improvement in the quality of life [10].

In the presence/absence of CAD and a high level of depression in the Tyumen population aged 25-64, a high OR was revealed in men — 21,07, and the highest OR in the presence/absence of DCAD and a high level of depression in the male subpopulation was 39,84. The female subpopulation also showed a high OR in the presence/absence of CAD and DCAD and a high level of depression, although it is significantly lower than in men, despite the unfavorable situation regarding the prevalence of depression among Tyumen women. In accordance with the results obtained in this study, the scientific literature of the last decade has shown that despite the fact that depression is more common in female populations, men had a significantly higher relative risk of developing CVD at its high levels [2, 10]. In this respect, the results obtained on the Tyumen population are comparable with the data of global and domestic studies. At the same time, with regard to the OR obtained in the presence/absence of PCAD and a high level of depression, which is significantly higher and statistically significant in women compared to men, the situation can be justified by the greater emotional lability of women, and as a result, a higher risk of development "pre-illness" — "possible" forms of CAD.

Thus, in accordance with the European and world experience of carrying out preventive measures using a population strategy and a high-risk strategy, it is necessary to note the priority of the presented analysis of the results when constructing preventive programs using new social technologies of differentiated influence on high levels of PSF, taking into account gender characteristics [16].

Conclusion

In an open population of 25-64 years old, a moderately urbanized Siberian city, the prevalence of CAD according to extended and lax epidemiological criteria prevailed in men, while strict epidemiological criteria did not reveal significant differences in the male and female subpopulations.

In the female subpopulation, a tendency towards an increase in the prevalence of a high level of depression was revealed due to the prevalence of the indicator in the age categories of young age in the gender aspect.

It has been shown that the presence of depression increases the chance of detecting CAD according to extended epidemiological criteria in men and women by 21,07 and 16,04 times, respectively.

Relationships and Activities: none.

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