

Estimation And Prediction of Ten-Year Survival Rate and The Risk of Cardiovascular Complications in The Population of Men and Women in Russian Region

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Received Date: September 09 2022 | Accepted Date: September 14 2022 | Published Date: September 22 2022

Citation: Mamedov M.N, Sushkova L.T, Kutsenko V.A. (2022). Estimation And Prediction of Ten-Year Survival Rate and The Risk of Cardiovascular Complications in The Population of Men and Women in Russian Region. *Journal of Heart and Vasculature*.1(1); 10.31579/jhv-2022/001

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Abstract

The aim: To evaluate the predicted ten-year survival rate and the risk of cardiovascular complications (CVD) in an unorganized population of men and women in the Vladimir region of Russia.

Material and methods. The cross-sectional population study included 1200 men and women aged 30-69 years from 5 cities of the Vladimir region. The response was over 80%. Overall, 1,004 people were included into the study. Of these, 346 men (34.5%) and 658 women (65.5%). Respondents were interviewed using a questionnaire that assessed socio-demographic indicators, behavioral risk factors, the presence of somatic diseases, medical records, and psychosomatic status. Routine instrumental and laboratory studies were performed. The European SCORE scale was used to assess cardiovascular risk. Charlson's comorbidity index was used to assess 10-year survival rate of study participants.

Results. In the surveyed population, arterial hypertension (AH) was detected in 38% of men and 43% of women. Coronary heart disease among men was registered three times more often compared with women: 15% and 5% ($p<0.0001$). Diabetes mellitus, chronic obstructive pulmonary disease and malignant tumors were detected in no more than 5% of cases. 67% of women had low to moderate cardiovascular risk (CVR). 19% of men showed high and 10% very high CVR, which turned out to be higher than in women (6% and 0%). The prevalence of the combination of two diseases was 32.6% in general – in 36.7% of men, and in 10% less of women. Overall, the combination of diseases was found in every fourth study participant (27%) ($p=0.002$). The combination of three diseases was seen in 12% of men, and 5.9% of women ($p<0.001$). Short ten-year survival (21%) according to the Charlson index was determined in less than 10% of men and women. Most respondents had 90% and 77% ten-year survival.

Conclusion. In an unorganized population of adults, high and very high CVR was found in every 4th man and only in every 16th women. A short ten-year survival rate according to the Charlson index was found in every 10th respondent, while at the same time, every second participant had an average ten-year survival rate.

Key words: prevalence; comorbidity of chronic noncommunicable diseases; cardiovascular risk; charlson index

List of abbreviations

AH - arterial hypertension

BP - blood pressure

CHD – coronary heart disease

CCI - Charlson Comorbidity Index

BMI - body mass index

INR - international normalized ratio

NMRC TPM - National Medical Research Center for Therapy and Preventive Medicine

OR - odds ratio

CVD - cardiovascular diseases

CVR - cardiovascular risk

CNCD - chronic non-communicable diseases

COPD - chronic obstructive pulmonary disease

HR - heart rate

ECG – electrocardiogram

WHO - World Health Organization

Introduction

According to the forecast of the World Health Organization (WHO), in the next decade, chronic non-communicable diseases (CNCDs) will be the main cause of disability and amortality among adults worldwide. Moreover, despite some changes mortality rate among working population, it is obvious that in the next decade, cardiovascular diseases (CVD) associated with atherosclerosis, neoplasms and chronic obstructive pulmonary disease (COPD) will retain their leadership [1].

On the other hand, the WHO shows that the life expectancy of the population is increasing. Along with this, the number of patients with comorbidity of somatic diseases is increasing that also affect their life quality. The term "comorbidity" was proposed in 1970 by the American epidemiologist and researcher Alvan R. Feinstein. By comorbidity, he meant the presence of a concomitant clinical picture. According to the modern definition, comorbidity is the coexistence of two or more syndromes (trans-syndromal comorbidity) or diseases (trans-nosological comorbidity) in one patient that are interconnected pathogenetically or coincided together [2].

Currently, the study of comorbidity is relevant due to the pandemic nature of CVD and its increasing prognostic value. According to Russian

scientists, the combination of three or more somatic diseases, adjusted for sex and age, increases the risk of primary endpoints development by 2-5 times compared with individuals with the presence of one disease. A linear relationship between age and comorbidity frequency of somatic diseases was determined. If at the age of 20 its frequency is less than 10%, then at the age of 80 it increases up to 80% [2].

Data from individual registries on the assessment of comorbidity of somatic diseases have been published in the literature [3,5]. The systematization of the principles of the management of patients with comorbidities is presented. However, to assess the significance of the comorbidity of somatic diseases at the population level, epidemiological studies are required, that would consider socio-demographic indicators such as gender and age. From this point of view, clinical studies have a number of limitations, since the results of the study can only be applied to certain cohorts.

The aim of this study is to assess the prevalence of major NCDs and their comorbidity in a random sample of men and women aged 30-69 years in the cities of the Vladimir region.

Material and methods

A cross-sectional population study was conducted from May 2018 to September 2020 in 5 cities of the Vladimir region (Vladimir, Kovrov, Murom, Yuriyev-Polsky and Vyazniki). From 6 medical institutions, 8 therapeutic sites were selected, then, according to the lists of the assigned population aged 30-69 years, every tenth respondent from each site was invited to the study. On average, out of 1500 people of the attached population, every tenth (1500:10 = 150; in total, 150 respondents per polling station). Thus, the study included 1200 people, men and women aged 30-69 years. The response to the study was over 80%. Overall, 1,004 people completed the survey - 346 men (34.5%) and 658 women (65.5%). Table 1 presents gender characteristics of study participants in 5 cities of the Vladimir region.

| Cities | Total, n | Men, n | Women, n |
|----------------|----------|--------|----------|
| Vladimir | 282 | 102 | 180 |
| Vyazniki | 62 | 13 | 49 |
| Kovrov | 195 | 60 | 135 |
| Murom | 315 | 128 | 187 |
| Yuriyev-Polsky | 150 | 43 | 107 |
| All cities | 1004 | 346 | 658 |

Table 1: Population size by city and gender

At the first stage, the respondents were interviewed using a questionnaire that assessed social status, family history, smoking status, alcohol consumption, other risk factors and comorbidities, records of medications taken, and psychosomatic status, including the presence of chronic stress.

All respondents underwent blood pressure (BP), heart rate (HR) at rest, anthropometric parameters (height, body weight, body mass index (BMI), waist circumference) measurement, as well as biochemical blood test (including total cholesterol and fasting blood glucose levels).

The risk of fatal cardiovascular complications (CVR) in the next 10 years was assessed using the European SCORE scale (in the absence of verified CVD). The following parameters were used to assess the risk: age, gender, smoking status, systolic blood pressure and total cholesterol level. Depending on the total score, the risk was assessed as follows: low risk <1%, moderate risk - from 1% to 5%, high risk - from 5% to 9%, and very high risk - 10-14% [6].

The determination of 10-year survival was carried out using the Charlson Comorbidity Index (CCI), which was calculated by summing up scores for age and somatic diseases. Depending on the severity of the disease, the CCI can vary from 1 (for example, myocardial infarction, diabetes mellitus (DM) without complications) to 4 points (for example, metastatic malignant tumors). In addition, 1 point was added for every 10 years of life after 40 [7]. The prognosis is defined as a percentage of survival: 99%, 96%, 90%, 77%, 53% and 21%.

Control of material collection and training of researchers.

The materials were carried out with the participation of primary care internists of the Vladimir region. The training on the protocol and filling of the questionnaire was performed, then the questionnaires were checked by independent experts in a selective mode. The results were processed centrally: at the Vladimir State University (Vladimir) and at the National

Medical Research Center for Therapy and Preventive Medicine (Moscow).

Statistical analysis.

Data entry was carried out in the Excel system of the MS Office package. Statistical analysis was carried out in the statistical analysis system SAS (Statistical Analysis System) and data analysis environment R 3.5.1. Qualitative indicators are described by relative frequency in percent. Quantitative indicators are described by the mean and standard error ($M \pm m$). Differences between two independent samples for continuous parameters were estimated using the Welch t-test. Comparison of prevalence was carried out by the test of equality of shares. Differences were considered significant at $p < 0.05$.

Results

According to the data obtained, 1004 respondents participated in the study, of which 34.5% were men and 65.5% were women. The largest number of respondents was selected from two large cities: Vladimir (28%) and Murom (31.4%). In the rest of the cities, a total of 40.6% of the respondents were included into the study. Men and women were comparable by age (52.9 ± 2.1 years and 53.7 ± 1.2 years, respectively). In general, the age range of respondents (both men and women) did not differ statistically between cities.

In the sample of people of working age, 28% of respondents had higher education. The groups differed significantly by the prevalence of higher education. The largest number of people with higher education is registered in the city of Vladimir (41% of men and 44% of women), which is 1.5-2 times higher than compared with other cities of the Vladimir region.

At the time of the survey, 68% of men and 56% of women were married, divorced and widowed women were twice as many as men.

Hereditary predisposition to CNCD was analyzed for CVD, DM, bronchial asthma and various oncological diseases. Hereditary predisposition to CVD (myocardial infarction and cerebral stroke) was registered in 19% of men and 26% of women (difference is significant, $p = 0.01$), type 2 diabetes was registered in 17% of men and 14% of women. 10% of men and 7% of women reported having bronchial asthma in their parents. Oncological diseases of various localization in the family history were detected in total in 5% of men and 6% of women. With the exception for CVD, there was no gender difference in genetic predisposition to other NCDs.

In the population, the analysis of the major NCDs prevalence reveals the highest rates for AH: 38% among men and 43% among women. Coronary heart disease (CHD) among men was registered three times more often than women: 15% and 5%, respectively ($p < 0.0001$). Type 2 diabetes in this sample was registered in 2.5% of cases on average (3% among men and 2% among women). COPD among men was detected 2 times more often than in women (no statistical significance: 4% and 2%). Cancer had comparable prevalence among men and women (average 3%). The presence of other somatic diseases was reported by 20% of men and 17% of women. Figure 1 shows the prevalence of NCDs in the analyzed population of men and women of working age.

An assessment of the risk of cardiovascular events was carried out according to the European SCORE scale. The results of the assessment of CVR in the analyzed population are presented in Table 2. Thus, 36% of women had low CV risk, moderate CV risk was determined in 31%. High CV risk was found in 6% of women, while a very high risk was not detected at all. Among men, the picture was somewhat different. Low cardiovascular risk was found in 16%, and moderate risk in every fourth. At the time of the survey, high cardiovascular risk was found in every fifth man, a very high risk in 10% of cases. Differences in all subgroups of CVR between groups of men and women are statistically significant.

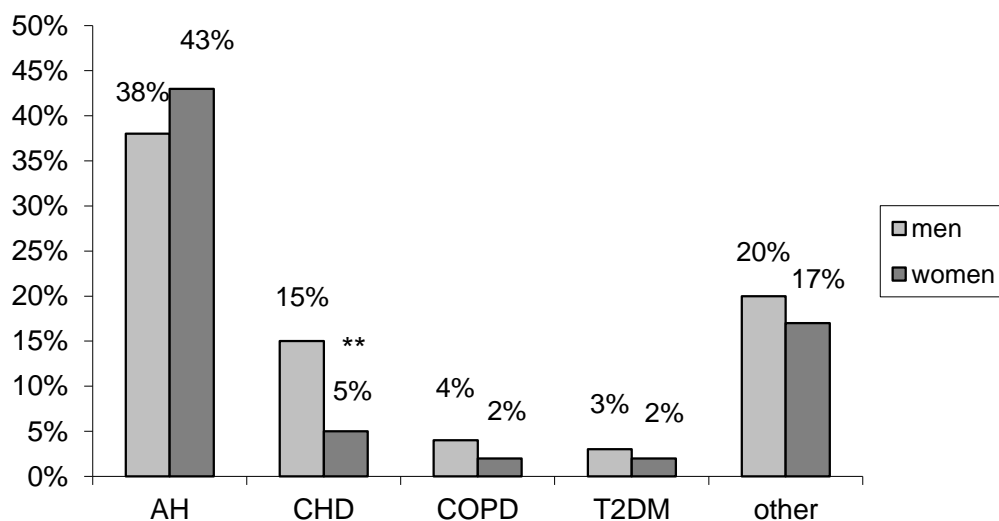


Figure 1: Prevalence of chronic NCDs in the analyzed population of men and women of working age

** $p < 0.01$ significant difference between men and women

| Gradation of cardiovascular risk | Men, n(%) | Women, n(%) | p-value |
|----------------------------------|-----------|-------------|---------|
| Low | 55 (16%) | 238 (36%) | <0.0001 |
| Moderate | 87 (25%) | 201 (31%) | 0.049 |
| High | 67 (19%) | 38 (6%) | <0.0001 |
| Very high | 35 (10%) | 1 (0%) | <0.0001 |

Table 2: An assessment of the cardiovascular risk

Note: Statistical difference *between* men and women

The analysis of the comorbidity of somatic diseases showed that in an unorganized population, the prevalence of a combination of two diseases was 32.6% - 36.7% among men, and in 10% less among women. Overall, the combination of diseases was found in every fourth study participant (27%) ($p=0.002$). The combination of three diseases among men was 12%, and among women - in 5.9% of cases ($p<0.001$). According to the survey results, the combination of four diseases was quite rare, but gender differed by gender (1.2% in women, 0.6% in men).

One of the main objectives of the study was to determine the ten-year survival based on the CCI. The prognosis of survival over 10 years

according to the CCI is presented in Table 3. In general, these indicators were comparable between men and women. In the analyzed population, every fifth respondent (23% of men and 25% of women) had a prognosis of 90% survival in the next 10 years, every fifth (20% of men and 22% of women) had a prognosis of 77% survival. At the same time, a survival rate of 53% over 10 years was found in 17% of men and 13% of women. Similar rates were obtained for 99% (14% among men and women) and 96% (16% among men and 17% among women) survival over 10 years. A short survival rate (21%) was found in less than 10% of men and women.

| Percentage survival rates over 10 years | Men, n (%) 346 | Women, n (%) 658 |
|---|----------------|------------------|
| 99% | 48 (14%) | 92 (14%) |
| 96% | 55 (16%) | 112 (17%) |
| 90% | 80 (23%) | 164 (25%) |
| 77% | 69 (20%) | 145 (22%) |
| 53% | 59 (17%) | 86 (13%) |
| 21% | 35 (10%) | 59 (9%) |

Table 3: Evaluation of 10-year survival according to the Charlson comorbidity index

Discussion

A population-based study among adults from 5 cities of the Vladimir region, randomly selected, was conducted to assess the predicted ten-year survival rate and risk of CVD. The Central Federal District in Russia is the leader in the prevalence of chronic NCDs and its complications. Thus, the adult mortality rate from CVD in 2016 in this region was 655.4 per 100 thousand people, which is 6.3% higher compared with average rate in Russia (616.4 cases per 100 thousand people). In general, mortality rates for oncology are three times lower, but a similar trend is observed: 218.6 cases per 100 thousand people in the central district, which is 6.5% more compared with average numbers in the Russian Federation (204.3 per 100 thousand people) [8]. Despite the fact that over the past 16 years the overall all-cause mortality rate in this district has decreased by 20.7%, the Central District ranks second among 8 federal districts in terms of adult mortality from NCDs. This positive dynamics of mortality reduction in the district is the result of the implementation of national health projects and the provision of high-tech assistive technologies. It is known that a family history of NCDs, along with behavioral risk factors, has an important prognostic value. In the present study, 51% of men and 53% of women have a hereditary burden for the main NCDs, while CVD associated with atherosclerosis and type 2 diabetes had the highest frequency in the family history.

Among NCDs, AH had the highest prevalence (according to the criteria of the European Society of Cardiology 2018) [9], which was detected in 38% of men and 43% of women of working age in the surveyed population. In general, in the large epidemiological study of the ESSE RF, carried out in 12 regions of the country (different in their climatic and geographical characteristics), this trend is confirmed. Within the framework of this national project, 20,652 (37.9% of men and 62.1% of women) residents of the Russian Federation aged 25–65 were examined. According to European guidelines from 2013 and 2018, AH was diagnosed in 10,347 (50.2%) patients - 3,987 (51.1%) men and 6,360 (49.7%) women. Recently, the use of antihypertensive therapy has significantly increased (up to 61%), however, in order to achieve target levels, even greater rise is needed that would also include the use of combination therapy [10].

One of the important parameters of the analysis was the assessment of the CVR in the next 10 years. This aggregate indicator is estimated based on the main risk factors for CVD. In the study population, 41% of men and

67% of women had low to moderate CVR. Among men, high CVR was three times more common than among women (19% vs. 6%). The total high and very high CVR among men was 29%, which is 6 times higher than in women. The ESSE RF study also demonstrated that the bulk of the population has low to moderate CVR. However, men are 6 times more likely to have high risk ($\geq 5\%$) than women (40.5% vs 7.4%), that shows significant gender difference. A ranked analysis of the regions showed that in Vologda, Voronezh and Tomsk more than a quarter of the population has a high or very high CVR. A low incidence of CV risk (10–15%) was found in Vladikavkaz and Samara. Of course, such factors as high blood pressure, total cholesterol and smoking also contribute to CVR, however they are not included into the SCORE risk calculator. These are, first of all, social indicators and the state of the environment [11].

Traditionally, CHD among CVD ranks second in prevalence in the population. In the present study, similar patterns were obtained. However, there are significant gender differences. Thus, the incidence of CHD among men is three times higher than among women (15% versus 5%). In another population-based study conducted in Tyumen in an open population involving 2000 people, aged 25–64 years, the prevalence of CHD in men was 12.4%, in women - 10.0% [12]. Obviously, the gender difference in this study may be due to the lack of verification of painless and other forms of CHD among women. In the population of cities in the Vladimir region, attention is also drawn to the low prevalence of type 2 diabetes and COPD, the frequency of which individually is no more than 5% of cases.

Assessment of the comorbidity of internal diseases and its gender characteristics is an urgent problem. In the local literature, most works are devoted to the study of the comorbidity of somatic diseases in individual cohorts. In previous clinical cohort studies, we have shown that >70% of patients with CHD have three or more comorbidities. According to the REQUAZA registry, among 1,000 outpatients with CVD, concomitant cardiovascular pathology was detected in 82% of cases, of which 50.4% were AH, CHD, and CHF [5]. Later, researchers in the course of a 6-year prospective follow-up concluded that individuals with the development of CVD at the age of <50 years are the target group for the prevention of cardiovascular multimorbidity and its progression [13]. In another domestic study ($n=993$), it was demonstrated that comorbidity serve as an independent predictor for the development of acute heart failure in myocardial infarction, and its combination is associated with the worst

hospital prognosis (1.5-3 times more compared to one disease), regardless of the primary treatment strategy [4].

In the present study of unorganized population, a combination of two diseases is the most common, it is detected in every third respondent, while a combination of three diseases occurs 3 times less. The comorbidity of somatic diseases has gender differences, in particular, among men it is detected significantly more often than in women.

Estimation of survival rate in case of comorbidity of somatic diseases is an important issue problem of modern medicine. In general, 5 scales for the prediction of comorbid conditions are described in the literature. The Charlson comorbidity index is widely used for the assessment 10-year survival prognosis. In the Scandinavian MADDEC study in individuals with acute coronary syndrome (n=1576), the HCI was compared with the hospital GRACE scale in three time ranges up to two years. It has been demonstrated that the predictive value of CCI increases in the long-term [14]. In a study involving newly diagnosed patients with AH, it was shown that the use of CCI effectively affects the prognostic model of survival rate [15]. In a Korean study of 228,000 people aged 65 years and older with type 2 diabetes without CV events, the CCI was used. The presence of comorbidities and low glucose levels were associated with high cardiovascular mortality [16].

In this study, every second respondent from the surveyed population had a 10-year survival rate from 77% to 90%, a low 10-year survival rate was found in every 10th respondent. Consequently, a high ten-year survival rate occurs in one in three adults. Obviously, up to 70% of adult men and women with comorbid internal diseases, with low and average ten-year survival rate need complex preventive interventions.

Research limitation

The article does not provide the values of risk factors, on the basis of which the risk assessment of cardiovascular complications was carried out, since these materials will be analyzed in subsequent publications.

Conclusion

In the unorganized population of adults in the cities of the Vladimir region, high and very high CVR is detected in every 4th man, which is 4 times higher compared with women. A combination of two diseases is detected in every third respondent. A short ten-year survival rate according to the ICH was found in every tenth respondent. Every second man and woman had an average ten-year survival rate.

Thus, the comorbidity of somatic diseases with a short and average ten-year survival rate requires complex preventive interventions.

Conflict of Interest:

There is no conflict of interest.

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