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CARDIOVASCULAR MORTALITY AND ITS PREDICTORS IN THE REPUBLIC OF TATARSTAN (RUSSIA)

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Abstract:

Cardiovascular diseases remain the main cause of death in the population around the world. The US and Western European countries have tendency to reduction in cardiovascular mortality in recent decades. At the same time, in the Russian Federation, cardiovascular mortality is more than two times higher as compared to the US. Cardiovascular disease in the Russian Federation is the cause of at least 50% of all deaths.

Objective: To evaluate the cardiovascular mortality in rural and urban areas of the Republic of Tatarstan of the Russian Federation during 2002-2007. To identify the predictors of cardiovascular mortality.

Materials and methods: The first phase of the study was carried out in 2002. Cardiovascular diseases were diagnosed, and the risk factors were evaluated. Re-examination was conducted in 2007. The study involved total 2,353 persons.

Results: cardiovascular mortality in the Republic of Tatarstan in 2002-2007 was 821.64 per 100,000 population. In the mortality structure, cardiovascular disease accounted for 66.67%.

The most significant predictors of cardiovascular mortality are chronic heart failure and diabetes mellitus.

Keywords: Epidemiology of cardiovascular diseases, cardiovascular mortality, predictors of cardiovascular mortality.

1. Introduction.

Cardiovascular diseases are the leading cause of death in adults and older people in most developed countries and many developing countries. In Europe, cardiovascular diseases accounts for 49% of all deaths (30% of all premature deaths before the age of 65 years) [1]. In 2008, more than 616,000 people in the United States died of heart disease. Cardiovascular diseases account for nearly 25% of all deaths [3]. During last 20 years, the prevalence of

cardiovascular diseases have increased significantly primarily due to the aging of the population [1]. Heart diseases resulting in disability contribute to the growth of health care costs. Costs for treatment of cardiovascular diseases are estimated in the European Union at 169 billion euros per year [2]. Along with smoking, the main risk factors for cardiovascular diseases are the elevated cholesterol levels and blood pressure [4]. Among the most significant risk factors, a physical inactivity is found in 53% of the US population, obesity - in 34%. High blood pressure has been registered in 32%. In North America, 21% of population are smokers, 15% have a high cholesterol level and 11% are diagnosed with diabetes [5].

Regular reports of the UN World Health Organization pay attention to the differences between countries in both the levels and trends in mortality from cardiovascular diseases, especially from coronary heart disease. An analysis of mortality data indicates a significant increase in cardiovascular diseases in the Central and Eastern Europe [6,7].

Since the 70-s of the last century, cardiovascular mortality has been continuously growing in the USSR and Russia [8]. During the last few years, cardiovascular mortality in the Russian Federation is almost 3 times higher than in the US, and the mortality from CHD is 2 times higher. An acute coronary syndrome is the cause of at least 28% of deaths [9].

2. Materials and research methods

A prospective cohort study was conducted in the Republic of Tatarstan during 2002-2007. The Republic of Tatarstan area of 67,836 square kilometers is located in the center of the European part of Russia at a distance of 797 kilometers east of Moscow. In 2016, the number of population of the republic was 3,868,000 people. Population density - 57.02 inhabitants/km^2. The urban population is 76.41%. Tatarstan is one of the most economically developed regions of Russia, and the sixth in terms of production volumes.

A representative sample was created mechanically, based on the total population of the Republic of Tatarstan. Based on the information of the State Statistics Committee of the Republic of Tatarstan for 2001 the data were obtained on population aged 10 years and older, and on the ratio of urban and rural population in the regions and the cities of the Republic of Tatarstan.

The cities with a population of more than 200 thousand people aged over 10 years had their urban areas distributed by simple randomization. The study was conducted in 12 centers (Table 1), each of which had 4 randomized outpatient units, each having 25 families selected. Thus, 100 families underwent examination in each area. Total 2556 respondents were surveyed.

Table 1. The composition of phase I respondents of the survey, 2002.

No.	Center	% of urban population	Number of the surveyed, pers.	% of the surveyed
1	Tukaevsky district	0%	251	9.8%
2	Yelabuzhsky district	0%	203	7.9%
3	Nizhnekamsky district	27.11%	225	8.8%
4	Zelenodolsky district	39.05%	207	8.1%
5	Zainsk city	99.3%	239	9.4%
6	Naberezhnye Chelny city (2 districts)	99.39%	493	19.3%
7	Kazan city (3 districts)	99.96%	540	21.1%
8	Almetyevsk city	100%	181	7.1%
9	Nizhnekamsk city	100%	217	8.5%
	Total		2,556	100.0%

Re-examination of the respondents was conducted in 2007. The survey of residents was conducted at addresses selected in the first stage. The observation involved the participants of the first phase, as well as new residents living at the selected addresses. In addition to the examination of the cardiovascular system and the survey of respondents about the risk factors of cardiovascular diseases, the number of deaths and causes of death was estimated too. Subject to those who died, moved home and dropped out for other reasons, the second phase of the study involved 2,353 respondents (Table 2). The loss amounted to 7.94%. The respondents were undergoing their examinations during March - May in the day time interval of 8.00 to 14.00 hours. The season and the time of the survey of the respondents is due to the need to exclude a systematic error.

Table 2. The composition of phase II respondents of the survey, 2007.

No.	District	% of urban population	Number of the surveyed	% of the surveyed
1	Tukaevsky district	0%	249	10.6%
2	Yelabuzhsky district	0%	203	8.6%
3	Nizhnekamsky district	27.11%	223	9.5%
4	Zelenodolsky district	39.05%	207	8.8%
5	Zainsk city	99.3%	205	8.7%
6	Naberezhnye Chelny city (2 districts)	99.39%	417	17.7%
7	Kazan city (3 districts)	99.96%	524	22.3%

8	Almetyevsk city	100%	110	4.7%
9	Nizhnekamsk city	100%	215	9.1%
	Total		2,353	100.0%

The evaluation of cardiovascular mortality was conducted in the Republic of Tatarstan, its cities and rural areas. The predictors of general mortality were determined.

Statistical data analysis. Data entry, editing and descriptive statistical analysis were carried out in MS Access program, a detailed analysis was carried out in the statistical analysis and information extraction system SAS (Statistical Analysis System) [10]. The generalized variance-covariance analysis was used to assess the effects of variables on continuous performance or binary variables (as the main effects, an individual, "visit", gender, age, education and other potential predictors of outcomes were considered). As the main mean in the survival analysis and evaluation of the prognostic value of indicators, the Cox proportional hazards method was used, including an option with an incremental selection of signs. The standard tests of significance were applied: t-Student test (two-sample and paired), χ-square test, Fisher's exact test for analysis of variance, and nonparametric tests (Wald, signs, Wilcoxon, log-rank, etc.) in the survival analysis. 95% confidence intervals were determined for the states of prognostic variables for odds ratios and relative risks.

3. Results obtained:

Cardiovascular disease as a cause of death during the observation period (2002-2007) were found in 4.93% (4.85% of men and 3.93% of women). Cardiovascular mortality was 821.64 per 100,000 population. There is an increase observed in cardiovascular mortality in the following age groups: less than 1% under the age of 30 years, followed by a sharp increase up to 19.07% at the age of 70-79 years, and 44.12% at the age of 80-89 years. Diagram 1.

Diagram 1. 5-year cardiovascular mortality in the Republic of Tatarstan, 2002-2007,

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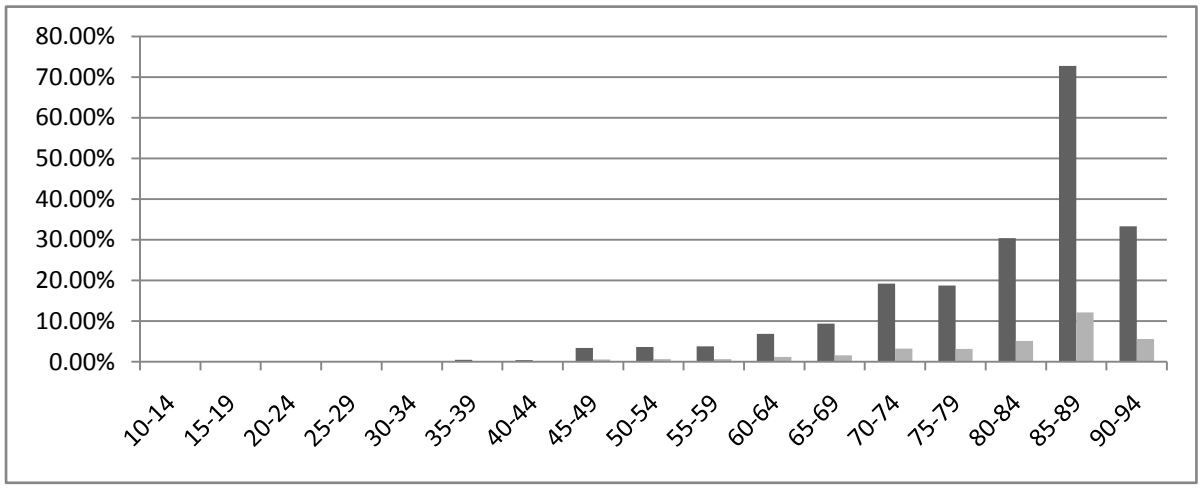


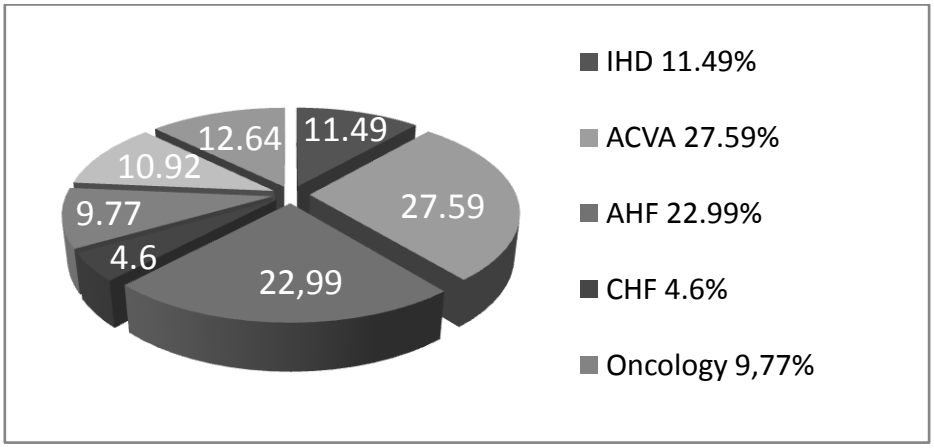
In Kazan, the capital of the Republic, 2.53% of the subjects (2.37% of men and 2.64% of women) died from cardiovascular causes during the period of observation. Cardiovascular mortality was 604.32 per 100,000 population. In other cities of the Republic of Tatarstan, 3.94% of the subjects (4.64% of men and 3.37 of women) died. In rural areas, cardiovascular diseases caused deaths in 7.20% of the subjects (7.83% of men and 7.09% of women), which was significantly greater (p = 0.029), than in the cities. Cardiovascular mortality in rural areas was 1,293 people per 100,000 population. In some rural areas, cardiovascular mortality reached 1449.27 people per 100,000 population.

The conducted analysis of the relative risk of cardiovascular death (Risk Ratio) adjusted for age and gender shows that the relative risk of cardiovascular mortality in urban areas of the Republic of Tatarstan is insignificantly higher than in Kazan. RR = 1.65 (95% CI 0.89-3.03, p=0.105). At the same time, rural areas showed a significant increase in RR for cardiovascular death, which was 2.66 (95% CI 1.4-5.03, p=0.003).

It was revealed that those district residents who died from cardiovascular causes often had symptoms of chronic heart failure: heart failure symptoms such as weakness, were diagnosed in 68.3% of respondents, while 60.4% had shortness of breath. At the same time, CHF symptoms in the survived respondents occur more rarely: dyspnea was detected only in 6.46%, and fatigue - in 10.3% of patients. Swelling of the lower extremities were in 18.81% of the deceased, while the survived respondents had swelling found only in 7% of patients.

Myocardial infarction was the cause of death in 11.49% of the surveyed, an acute cerebrovascular accident - in 27.59%. Men are more likely to die from myocardial infarction than women (16.28% and 6.82%, respectively), while women die more often from acute cerebrovascular accident (35.23% and 19.77%, respectively). Acute heart failure, as a cause of death, was recorded in 22.99% of the deceased (20.93% of men and 25% of women). Chronic heart failure is diagnosed only in 4.60% of deceased (3.49% of men and 5.68% of women). In general, cardiovascular diseases caused death in 66.67% of the deceased (60.47% of men and 72.73% of women).

Diagram 2.Cause of death in RT in 2002-2007, %.



It was revealed in all study groups that the regular independent predictors of cardiovascular death were age (RR=1.09) and female gender as a negative predictor (RR=0.43). Other predictors of cardiovascular death were a low level of education (no higher or secondary special education), the presence of symptoms of heart failure, such as shortness of breath at physical exertion and tachycardia, as well as diabetes.

Table 3. Cardiovascular mortality predictors.

No.	Predictor	P, χ-square	RR	95% CI
1	Age	0.0001	1.09	1.067-1.107
2	Female gender	0.0001	0.43	0.287-0.648
3	Residing in rural area	0.0027	2.66	1.402-5.038
4	Residing in small towns	0.1059	1.65	0.89-3.033
5	Education (low/middle level)	0.02	9.90	1.37-71.63
6	Dyspnea FC II (NYHA)	0.0004	2.3	1.45-3.66
7	Dyspnea FC IV (NYHA)	0.0002	5.29	2.22-12.59
8	HR over 90 bpm	0.01	1.69	1.11-2.56
9	Diabetes mellitus	0.002	2.59	1.43-4.69

The conducted incremental analysis adjusted for age and gender has revealed the most significant predictors of cardiovascular mortality in the Republic of Tatarstan. The significance is shown in descending order in Table 3.

Table 3. The most significant cardiovascular mortality predictors.

No.	**Predictor**	**P, χ-square**
1	Dyspnea FC IV (NYHA)	0.0005
2	Diabetes mellitus	0.0002
3	Dyspnea FC II (NYHA)	0.0008
4	HR over 90 bpm	0.133

4. Results and discussion

The analysis of cardiovascular mortality in the Republic of Tatarstan was conducted during 2002-2007. During the observation period, cardiovascular disease caused death in 4.93% of the subjects. In general, the cardiovascular mortality rate was 821.64 people per 100,000 population. The lowest rates of cardiovascular mortality were observed in the city of Naberezhnye Chelny - 479.61 people per 100,000 population. However, we should consider that the population of Naberezhnye Chelny is younger in general than in Kazan and rural areas of the republic. It is known

that the age and gender are the risk factors for total and cardiovascular mortality. In this study, the female gender is a negative predictor of mortality: the relative risk in terms of female gender was 0.43 (95% CI 0.29-0,65). On the other hand, age adversely affects mortality: RR was 1.09 (95% CI 1.07-1.11). The adjustment for these two parameters showed that the relative risk of cardiovascular mortality is minimal in Kazan, and is insignificantly higher in other cities of the republic. Rural areas had a significantly higher relative risk of cardiovascular mortality, which was 2.66 (95% CI 1.4-5.03, p=0.003), and even reached higher values in some rural areas (RR=3.29, 95% CI 1.63-6.63, p=0.0009).

Structure of mortality in the Republic of Tatarstan also has its own characteristics. Cardiovascular diseases are the main cause of death (66.67%). Moreover, the first place belongs to acute cerebrovascular accident as the cause of death. Acute cerebrovascular accident as a cause of death in women occurs almost 2 times more often than in men (35.2% and 19.8%, respectively).

The second cause of death is acute heart failure (23%). One of the main causes of cardiovascular death in the world is a sudden death. It should be noted that in the Russian Federation the diagnosis of "sudden death" in outpatients is almost never used. It can be assumed that the term “acute heart failure" referred to in the medical records as a cause of death, has been used also for patients who died of sudden death.

As previously noted, the age and gender are the most universal predictors of mortality. The conducted regression analysis revealed the predictors of cardiovascular mortality independent of age and gender. Clinical symptoms of chronic heart failure, namely dyspnea and tachycardia, are the major predictors of cardiovascular mortality. At the same time, the dyspnea of higher functional class has a higher predictive value. Another important predictor of cardiovascular mortality is diabetes mellitus. Currently, this risk factor has been given greater importance in the world. However, in the Russian Federation, the cardiologists in most cases neglect such patients and refer them to endocrinologists.

5. Summary:

1. Cardiovascular mortality in the Republic of Tatarstan is 821.64 people per 100,000 population.

2. Cardiovascular disease cause death in 66.7% of cases.

3. The minimum cardiovascular mortality was registered in the cities of the Republic of Tatarstan, and the maximum - in the rural areas.

4. The major predictors of cardiovascular mortality are chronic heart failure and diabetes mellitus.

Acknowledgements

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