



Rural-urban Health Disparities for Cardiovascular Disease in the Republic of Kazakhstan

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Abstract

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BACKGROUND: An important global public health problem in many economically developed countries, in particular Kazakhstan, is the leading cause of incidence of and mortality from cardiovascular disease (CVD).

AIM: The purpose of our study was to compare incidence and mortality from CVD in urban and rural areas of the Republic of Kazakhstan in 2019 based on statistics.

METHODS: We conducted a descriptive study, which based on secondary data from the statistical reports on the Republic of Kazakhstan «Health of the Republic of Kazakhstan and the activities of health care organizations». Information from this database were generated by 14 provinces, three cities of republican significance and whole Kazakhstan. In addition, these indicators were divided for rural and urban settlements.

RESULTS: Data from our epidemiological study of the incidence of and mortality from cardiovascular disease (CVD) in all provinces indicate a relatively high incidence of and mortality from CVD among urban population of the Republic of Kazakhstan. Among urban residents (per 100,000 population), the highest incidence rates of CVD was in Akmola province (3771.7), the ischemic heart disease (IHD) was in Almaty city (850.8), arterial hypertension (AH) was in Akmola province (2623.8), acute myocardial infarction was in the North Kazakhstan province (212.9), the highest mortality from CVD was in Karaganda province (365), the IHD was in East Kazakhstan province (135.4). Among rural residents (per 100,000 population), there are high incidence rates of CVD in the East Kazakhstan province (3452.8), the IHD in Zhambyl province (713.1), AH in the East Kazakhstan province (1871.4), acute myocardial infarction in Atyrau province (148.3), the highest mortality from CVD was in East Kazakhstan province (201.9), and the IHD also in East Kazakhstan province (77.3).

CONCLUSIONS: There is rural-urban health inequality in many countries and CVD is not the exclusion. In the Republic of Kazakhstan, the rural population has got lower rates of incidence and mortality. This may be due to the bad access to medical facilities that are typical for rural areas of Kazakhstan and the shortage of modern diagnostic equipment which may interfere with timely diagnosis.

Introduction

Cardiovascular diseases (CVDs) are still the leading cause of mortality in many countries of the world, for no other reason, as many people do not die every year as from CVD [1]. According to the World Health Organization, 17.9 million people died from CVD in 2016, which is 31% of all deaths in the world [1], more than 8 million people of this number died from ischemic heart disease (IHD). Kazakhstan ranks first in terms of mortality from CVD among the countries of the European Union, Central and Eastern Europe, and Central Asian regions. According to the World Health Organization (WHO), the standardized mortality rate of the population of the Republic of Kazakhstan due to CVD is 2 times higher than in the countries of the European Region [2].

The most probable and able-bodied part of the population have cardiovascular pathologies. The

largest number of patients and deaths for this reason are among men aged 35–65. Experts of the Ministry of Health of the Republic of Kazakhstan note that the annual damage due to the CVD in Kazakhstan averages about 89 billion tenge [3].

The identification of a set of factors contributing to the development of atherosclerosis and CVD is one of the achievements of modern cardiology. The concept of risk factor appeared as a result of generalization of the data from large-scale prospective epidemiological researches. This conclusion is the base to prevent CVDs. Hypercholesterolemia, hypertension, and smoking belong to the main or «major» risk factors, the combination of these factors increases the risk of CVD by 3–10 times. There are a number of factors that make a little influence on the development of the CVD. These factors include gender, age of a person, hereditary predisposition to CVDs, physical activity, overweight, psychoemotional stress, and metabolic disorders [4].

Smoking, poor nutrition, overweight and obesity, low physical activity, dyslipidemia, hypertension, psychosocial, and diabetes belong to the leading modified risk factors for CVD. Risk factors for unmodified CVD include men over 45 and women over 55 years of age, male gender, coronary heart disease in relatives of the first degree of kinship, or family history of early occurrence of CVD (men – from 55 and women – from 65) [5].

One of the most significant and common risk factors for cardiovascular pathology is the arterial hypertension (AH). The prevalence of this disease differs significantly in different countries: The incidence of the disease in the European population varies from 23% to 36%, in the USA – 27–43% [6], and in India – 25.3% (more often in men [27.4%] than in 15 women [20.0%]) [7]. Many researchers suppose that these indicators are slightly underestimated and taking into consideration the new recommendations of the American Heart Association/American College of Cardiology.

The favorable dynamics of the mortality of the population from CVD in our country appears with the realization of the Program for the development of cardiological and cardiac surgical aid in the Republic of Kazakhstan for 2007 - 2009, the State Program for the Development of Healthcare of the Republic of Kazakhstan «Salamatty Kazakhstan/Healthy Kazakhstan» for 2011-2015, the State Program for the Development of healthcare of the Republic of Kazakhstan «Densaulyk/Health» for 2016-2019, the State Program for the Development of Healthcare of the Republic of Kazakhstan for 2020-2025. These state programs provide for the modernization of the domestic healthcare system, including the development of the organizational structure of cardiological, interventional cardiological and cardiac surgical aid; the introduction of effective methods of prevention, early diagnosis, treatment and medical rehabilitation of patients and invalid people with CVD; training and advanced training of specialists in cardiac surgery profile, etc. [8].

The country has unequal distribution of health-care professionals on locality: As a rule, there is a higher density of health workers in urban areas because of better standards of living and higher salaries in comparison with rural areas. About 40% of the country population resides in rural areas and such patients have higher prevalence of chronic somatic disorders that need health-care interventions but travel burdens to specialty services may be unbearable for this population. Access to specialized care is a key priority in the managing of health administration and understanding the geographic distribution and province designation of this population in regard to medical centers can help in medical aid coordination. Moreover, absence of equal and fair access of the population to all levels of medical aid is also explained by poor road infrastructure [9]. Thus, the purpose of our research

is to assess the general incidence of and mortality from CVD in urban and rural areas of the Republic of Kazakhstan in 2019.

Materials and Methods

Research design and procedures

This was a retrospective study on the basis of the data obtained from the statistical reports on the Republic of Kazakhstan «Health of the Republic of Kazakhstan and the activities of health-care organizations». This was a retrospective study on the basis of the data obtained from the statistical reports on the Republic of Kazakhstan «Health of the Republic of Kazakhstan and the activities of health-care organizations». From this database, we got the information about CVD incidence and mortality in 2019.

Statistical reports on the Republic of Kazakhstan «Health of the Republic of Kazakhstan and the activities of health-care organizations» are published every year. This statistical book covers statistical materials on the activities of health-care organizations and health indicators of the population of the Republic of Kazakhstan and includes data about newly diagnosed cases of CVD and IHD that are collected by medical doctors who are working in primary health-care facilities all over the country. Data gathering process is standardized and obligatory for all primary practice medical doctors.

To enable comparative analysis of incidence and mortality rates, we divided the territory of Kazakhstan into five geographic areas: East that includes East Kazakhstan and Pavlodar provinces; West which covers Aktobe, Atyrau, Mangystau, and West Kazakhstan provinces; North that consists of Kostanay and North Kazakhstan provinces; South which covers Almaty, Zhambyl, Kyzylorda, and Turkistan provinces; and Central (Akmola and Karagandy provinces). In accordance with national policy, three cities – Nur-Sultan, Almaty, and Shymkent are categorized as cities of republican subordination and are considered as provinces in statistical analysis.

Ethical issues

We did not use personal data for this reason as there was no need for information consent. Ethical committee of Semey Medical University (Semey, Kazakhstan) approved our research before it was started (Protocol 2 dated October 18, 2019).

Statistical analysis

Crude rates of incidence and mortality per 100,000 population were calculated.

The total incidence rate was calculated as the ratio of the total number of diseases from CVDs to the estimated population:

- Number of new cases of CVD or IHD during one specified year in all age groups/midyear general population $\times 100,000$.

The crude mortality rate was calculated as the ratio between the total number of deaths because of CVD and estimated population number:

- Number of deaths from CVD during one specified year in all age groups/midyear general population $\times 100,000$.

All calculations were done with Statistical Package for the Social Sciences software, version 20.0 for Windows.

Results

Table 1 shows incidence of the population of the Republic of Kazakhstan which was registered in a healthcare organization in 2019. As it can be seen, incidence of CVD covers the main part of the general incidence (over 16%). In 2019, general incidence comprised 19,278,994 but CVD incidence was 3,144,167.

Table 1: Incidence of the population of the Republic of Kazakhstan registered in a healthcare organization

Year	General incidence		In particular CVD incidence	
	Altogether absolute numbers	Per 100,000 people population	Altogether absolute numbers	Per 100,000 population
2019	19,278,994	104,133.8	3,144,167	16,982.9

CVD: Cardiovascular disease.

Table 2 presents the information about an issue of CVD in each areas of Kazakhstan in 2019. The chart shows each area of Kazakhstan with the information about how more people were ill and in general in rural areas of Kazakhstan, CVD was less than in urban areas.

Table 2: Incidence of CVD across provinces of urban and rural areas of Kazakhstan in 2019 (per 100,000 population)

Geographic zone	Province (City)	CVD	
		Urban	Rural
Republic of Kazakhstan		3068.4	2403.5
East	East Kazakhstan	3396.0	3452.8
	Pavlodar	3113.4	2737.9
Central	Akmola	3771.7	2505.0
	Karaganda	3111.3	1622.9
North	Kostanay	2249.1	2545.9
	North Kazakhstan	2328.9	2986.5
West	Aktobe	1932.1	2521.7
	Atyrau	2255.3	2207.9
	Mangystau	3616.5	1232.5
	West Kazakhstan	1861.8	2823.5
South	Almaty	3674.2	2319.7
	Zhambyl	3391.0	2746.5
	Kyzylorda	2932.9	2722.2
	Turkistan	2372.9	2082.7
Cities	Nur-Sultan	2843.5	–
	Almaty	3758.3	–
	Shymkent	3418.6	–

CVD: Cardiovascular disease.

In East Kazakhstan, the number of disease in urban areas essentially equals with the number in

rural areas. Differences between them are only 56, but in central areas of Kazakhstan cities have more issues than rural areas. For instance, disease in Akmola is greater than in rural places in Akmola for 1266. It shows that countryside of central area is very healthy.

In addition, west sides of our Republic of Kazakhstan have very low result than in other sides. There are vice versa in chart, if in other areas of Kazakhstan, urban state is more than rural, but in West Kazakhstan, the parameter of disease in rural more than urban area, furthermore, it presents us that cities of west area are more healthy. The table shows the opposite, if in other regions of Kazakhstan, the urban state is larger than the rural one, but in West Kazakhstan, the incidence rate in rural areas is higher than in urban areas, in addition, it shows that the cities of the western region are healthier.

The next table (Table 3) presents the incidence of AH in cities and villages of Kazakhstan. In general, the incidence of AH of Kazakhstan in urban areas is slightly more than in rural areas, accordingly 1443.4 and 1227/100,000 population. Looking at the details, the AH incidence in all urban regions is more than in rural regions, except East Kazakhstan, Kostanay, North Kazakhstan, and West Kazakhstan. The most incidence of AH was in urban population of Mangystau that was estimated 2227.4/100,000 population. However, the least incidence was in rural areas of Mangystau too (625.6/100,000 population).

Table 3: Incidence of AH across provinces of urban and rural areas of Kazakhstan in 2019 (per 100,000 population)

Geographic zone	Province	AH	
		Urban	Rural
Republic of Kazakhstan		1443.4	1227
East	East Kazakhstan	1510.2	1871.4
	Pavlodar	1263.1	1144.5
Central	Akmola	2623.8	1574.0
	Karaganda	951.8	835.8
North	Kostanay	1037.8	1197.5
	North Kazakhstan	630.5	1199.6
West	Aktobe	1009.2	734.9
	Atyrau	1396.5	1225.1
	Mangystau	2227.4	625.6
	West Kazakhstan	1205.9	1607.6
South	Almaty	1952.8	1259.5
	Zhambyl	1554.7	1414.7
	Kyzylorda	1406.5	1230.5
	Turkistan	1410.0	1075.0
Cities	Nur-Sultan	1212.2	–
	Almaty	1732.2	–
	Shymkent	1733.9	–

CVD: Cardiovascular disease, AH: Arterial hypertension.

Table 4 demonstrates the incidence rates of IHD and acute myocardial infarction across different provinces of Kazakhstan in 2019. In common, it can be clearly observed that the incidence rates in cities are significantly higher than in villages. In this case, Almaty city had the highest indicator of IHD in 2019 that was equal to 850.8. The second highest rate was seen in the cities of Zhambyl province (792.4). In rural areas, the most incidence of IHD was observed in Zhambyl province. In addition, the lowest indicator of IHD was in Mangystau villages which were estimated 200.9.

Table 4: Incidence of IHD and acute myocardial infarction across provinces of urban and rural areas of Kazakhstan in 2019 (per 100,000 population)

Geographic zone	Province	IHD		Acute myocardial infarction	
		Urban	Rural	Urban	Rural
Republic of Kazakhstan		612.5	463.6	145.2	81.1
East	East Kazakhstan	633.1	583.8	190.9	80.5
	Pavlodar	585.6	599.3	134.7	122.5
Central	Akmola	600.1	530.7	119.5	99.4
	Karaganda	725.3	449.8	166.9	102.5
North	Kostanay	408.8	416.2	112.5	78.0
	North Kazakhstan	515.9	654.2	212.9	104.4
West	Aktobe	431.9	393.4	178.4	15.3
	Atyrau	330.1	287.9	114.6	148.3
	Mangystau	542.6	200.9	175.7	36.9
	West Kazakhstan	311.5	476.7	151.1	88.9
South	Almaty	713.5	457.3	141.0	78.9
	Zhambyl	792.4	713.1	166.0	52.0
	Kyzylorda	691.5	430.6	79.2	60.5
	Turkistan	430.9	363.8	124.0	89.8
Cities	Nur-Sultan	475.9	–	109.0	–
	Almaty	850.8	–	133.4	–
	Shymkent	554.4	–	166.1	–

IHD: Ischemic heart disease.

Another interesting point is that the highest number of acute myocardial infarction incidence was in urban areas of East Kazakhstan in 2019 (190.9). On the other hand, the lowest incidence rate of acute myocardial infarction was presented in rural population of Aktobe province, it comprised only 15.3. In contrast, the lowest acute myocardial infarction incidence number in urban regions was seen in Kyzylorda province (79.2). Detailed data on the incidence of IHD and acute myocardial infarction are demonstrated in Table 4.

The bar chart (Figure 1) illustrates the indicators of CVD incidence throughout the country in 2019. As can be seen from the chart, in rural areas, the incidence of CVD is less than in urban areas, accordingly 2403.5 and 3068.4. In particular, the incidence of AH takes half of CVD that was estimated 1227 and 1443 in rural and urban population accordingly. The incidence rates of IHD comprised 463.6 in rural regions and 612.5 – in urban region. Furthermore, the incidence rate in urban areas of acute myocardial infarction was almost 2 times higher than rural areas, 145.2 and 81.1, respectively.

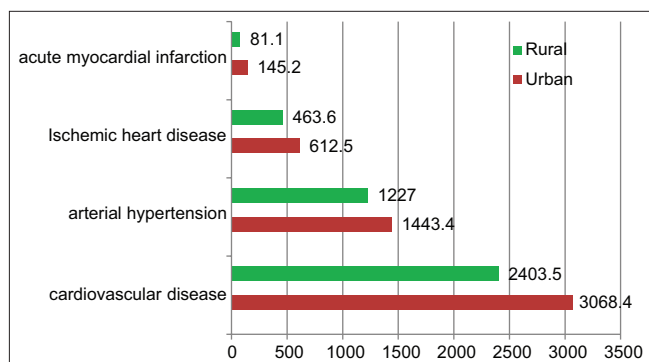


Figure 1: Incidence of cardiovascular disease in urban and rural areas of Kazakhstan in 2019 (per 100,000 population)

The map of Kazakhstan (Figure 2) presents mortality from CVD by provinces of Kazakhstan in 2019. Overall, the mortality rates from CVD in urban areas were higher in comparison with rural areas of Kazakhstan. The highest CVD mortality was observed in Karaganda province cities (365). East Kazakhstan

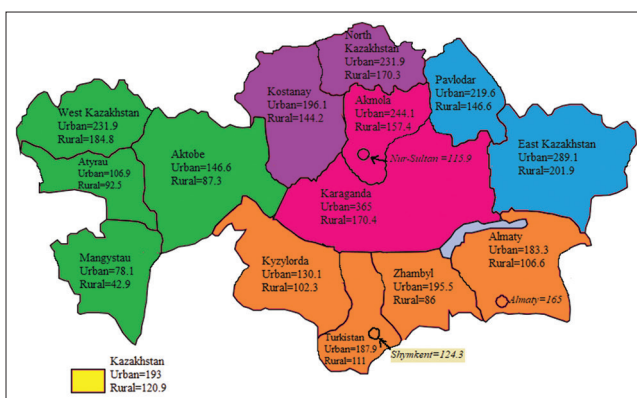


Figure 2: Mortality from cardiovascular disease in urban and rural areas of Kazakhstan in 2019 (per 100,000 population)

province cities had the second highest mortality rate of CVD in 2019 (289.1). In rural areas, East Kazakhstan (201.9) and West Kazakhstan (184.8) provinces had the highest rates that occupied first and second places among other provinces in 2019. The least mortality from CVD was in Mangystau province villages (42.9), also this province had the lowest rate among urban people (78.1). In general, in Kazakhstan, CVD mortality rate was 193 in urban and 120.9 in rural population.

Table 5 shows mortality rates from IHD in provinces of our country by urban and rural areas. In general, the mortality rates of cities are higher than villages across all provinces of Kazakhstan. East Kazakhstan had a peak of mortality in urban regions (135.4). Akmola, Karaganda, and North Kazakhstan provinces had the second, third, and fourth highest mortality rates following East Kazakhstan province. It can be clearly observed that the lowest mortality rate was shown in rural province, in particular in Mangystau province (8.5). Among urban population, the lowest mortality rate was seen in Atyrau province (24.1). Overall mortality from IHD in Kazakhstan was 71.4 and 38.7 in urban and rural areas, respectively.

Discussion

Thus, the results of this research demonstrate the incidence of CVD in urban areas higher than rural areas; it means that rural population of Kazakhstan is healthier than cities. This high number of CDV incidence has been observed in Eastern, Central, and Southern provinces of Kazakhstan, as well as in two large cities – Almaty and Shymkent. Still, a number of provinces of North Kazakhstan and West Kazakhstan (besides Mangystau) experienced low number of CVD incidence in cities. Although the least indicator of CVD incidence was in rural areas of Mangystau province per 100,000 population. As for the incidence of IHD, it was the same situation with incidence almost in all provinces of Kazakhstan during the research period. Actually, the

Table 5: Mortality from IHD across provinces of urban and rural areas of Kazakhstan in 2019 (per 100,000 population)

Geographic zone	Province	IHD	
		Urban	Rural
Republic of Kazakhstan		71.4	38.7
East	East Kazakhstan	135.4	77.3
	Pavlodar	65.9	36.1
Central	Akmola	109.2	71.8
	Karaganda	111.8	44.1
North	Kostanay	86.2	58.6
	North Kazakhstan	96.9	58.1
West	Aktobe	59.7	36.3
	Atyrau	24.1	27.0
	Mangystau	29.6	8.5
South	West Kazakhstan	79.8	65.0
	Almaty	57.6	35.5
	Zhambyl	79.6	30.6
	Kyzylorda	27.9	27.2
Cities	Turkistan	32.3	24.5
	Nur-Sultan	44.6	–
	Almaty	80.8	–
	Shymkent	28.9	–

IHD: Ischemic heart disease.

incidence of AH of cities was observed with the highest rates in Akmola and Mangystau provinces. However, the lowest data were in North Kazakhstan and Aktobe provinces. The incidence rate of acute myocardial infarction in urban areas was higher than the incidence in rural areas, especially East Kazakhstan, North Kazakhstan, Aktobe, and Mangystau provinces had the highest incidence rate. Mortality from CVD and in particular IHD of urban population is significantly higher than rural one. Urban provinces such as East Kazakhstan, North Kazakhstan, Akmola, and Kostanay had higher mortality rate than other provinces.

In 2014, the total mortality rate from CVD in Kazakhstan comprised 232.4/100,000 people; in 2015, it was 219/100,000 people. In regional scale, the highest rate of CVD was registered in the Karaganda province with 368.1 deaths/100,000 in 2015 [10]. In rural areas, mortality rates were substantially lower than in urban areas. Among urban residents in 2014, the total mortality rate from CVD comprised 238.3/100,000, while in rural areas, it was 162.2/100,000. Kazakhstan ranks third in terms of mortality from IHD among the countries of the former Soviet Union [11].

Kazakhstan started realization of national health programs in 2011 and the first program launched was «Salamatty Kazakhstan/Healthy Kazakhstan», which was gradually transferred to the «Densaulyk/Health» program scheduled for 2016–2020. CVD was among the greatest public health problems concerned by both programs. This helped to reduce the CVD mortality rate by 4.3%. Within the implementation of the national health programs, clinical protocols were updated, legal regulatory documents were upgraded, medical facilities became better equipped, and more than 300 medical professionals got training abroad: In Israel, Russia, and Japan [12].

Kazakhstan is given to further reducing mortality from CVD and has developed a new regulatory document entitled «Human health and the healthcare system» and offered a new national public health program that is planned for 2020–2025. This program is based on cost-effective, evidence-based demographic

strategies which are able to reach very broad segments of the population and includes legislative measures in order to control the use of tobacco products through taxation and restrictions on advertising. Other cost-effective strategies are nicotine replacement therapy for refusal of smoking and therapy with a fixed combination of low doses to reduce blood pressure in patients with moderate or severe hypertension (25). The introduction of obligatory social health insurance system in Kazakhstan that will begin in 2020 will introduce solidary responsibility for the state of health. However, it is highly important that any such systems supply benefits for outpatient treatment and medicines and not only for hospitalization, which was the attention of earlier public health insurance schemes. Finally, improved health information systems such as a mortality surveillance system are necessary to inform about the policy in health sphere and set targets as well as to monitor the effects of intervention programs [13].

A national screening program for CVD and diabetes was introduced in Kazakhstan within the period from 2011 to 2015. Screening of CVD in Kazakhstan is performed every 2 years as a part of free medical care in all district polyclinics for men and women aged 18, 25, 30, 35, and 40–64 years who have not been diagnosed with heart disease or diabetes. In the course of the screening, they give patients a questionnaire that evaluates risk factors and they measure their height, weight, blood pressure, cholesterol, and blood sugar levels [14]. Individuals with high risk of cardiovascular mortality got referrals to have further treatment. From 2011 to 2015, more than 7.5 million adults in Kazakhstan were screened for the presence of CVD. As a result, more than 600,000 cases of heart disease were revealed (7.9% of the number screened) [15].

It is considered that residents of rural regions comprise 40% of the population of the Republic of Kazakhstan. A major proportion of the rural population lives under the conditions of undeveloped transport communications and the lack of modern means of communication that broadly explains the low level of their appeal to health-care centers. Rural residents' appeal to health-care centers is 2.5 times lower than that of urban residents. It is necessary to notice the prevalence of chronic non-contagious diseases among the rural population (chronic diseases of the circulatory systems, respiratory organs, blood diseases, and diabetes mellitus) that take a leading place in the structure of mortality, disability, and morbidity in all countries of the world [16].

AH is one of the most widespread diseases in Kazakhstan and constitutes a serious problem for public health. In the period from 2009 to 2013, the prevalence of AH increased essentially from 10,778 to 13,392/100,000 people, as a result of what 24.3% of Kazakhstan adult population suffered from hypertension in 2013 [17]. The rates of mortality connected with hypertension have also increased and currently take the first place among

the causes of death. About 40% of deaths were noted in the able-bodied age group (20–64 years), 64% of which were men. To restrain this epidemic, the State Health System has created a screening program for early revealing of CVD and factors of their risk [18]. Majority of the patients examined through screening had not earlier got any treatment for their health conditions [19]. In our research, as well as in researches carried out in Asian and European countries, it was shown that the prevalence of hypertension is higher among urban residents [20]. However, in spite of the lower prevalence of AH, rural residents with AH often remain without screening and the severity of the disease and its complications are substantially higher. At the younger ages of 18 and 39, AH is diagnosed less often in rural population than in urban ones ($p < 0.05$). Rural respondents, as a rule, go to polyclinics only when they have serious health problems. In this group, the disease is more often diagnosed at a later age and at later stages of development that brings to increased health risks and extra expenses for the patient and the health-care system [21].

The education level varied between communities and share of people with higher formal education was lower in rural areas than in cities and towns. There are strong links that have been documented in many researches between socioeconomic variables (education, profession, income, and marital status) and the development of CVD in the countries with different socioeconomic status, as well as among rural or working age populations. Only a few studies have explored this issue in countries with an economy in transition like former Soviet Union countries, such as Kazakhstan [22].

Advantage of our research is we used official statistics as our data, and thus, the quality of our results depends on the quality of the reporting documentation. The limitation of our research is our dependence on the reporting format adopted in the Republic of Kazakhstan that makes it impossible to compare the data with the results of most foreign and Russian researched. However, these limitations cannot reduce the consequences of the fact that this is the first study to assess the inequality of morbidity and mortality from CVD between urban and rural areas of Kazakhstan.

Conclusions

Rural-urban health disparities exist in many countries and CVD is not the exception. Although an ample body of international research reports on poorer outcomes for rural population, this was not a matter of fact for Kazakhstan, where rural population tends to have both lower incidence and mortality rates. It might be due to worse access to health-care facilities, typical

for rural areas of Kazakhstan, and lack of modern diagnostic equipment, which can prevent from timely diagnosis. Thus, there is a need for prospective cohort studies to ascertain and explain this phenomenon. Besides, urban population of Kazakhstan might benefit from tailoring of preventive strategies targeted on cardiovascular risks reduction.

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