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Changes in mortality rates from acute types of coronary artery disease in Russia for the period from 2015 to 2019

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Aim. To identify regional specifics of changes in mortality rates from acute types of coronary artery disease (CAD) in 82 Russian regions for the period from 2015 to 2019.

Material and methods. The study used data from the Federal State Statistics Service of Russia on mortality from acute CAD types in 82 Russian regions. Standardized death rates (SDRs) for 2015 and 2019 were estimated based on the European standard. We analyzed the SDRs of the population from acute (primary) and recurrent myocardial infarction (MI), other acute CAD types (I21-I22, I24.8 in the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10)).

Results. Over the period from 2015 to 2019, mortality from all acute CAD types decreased by 21%, from acute MI — by 9%, from recurrent MI — by 22%, from any MI (acute/recurrent) recurrent — by 14%, and from other CAD types — by 21%. A decrease in mortality from all acute CAD types was recorded in 69 regions, from acute MI — in 58 regions, and recurrent MI — in 62 regions. However, a simultaneous decrease in SDRs from each of the acute CAD types (acute MI, recurrent MI and other acute CAD types) for the period 2015-2019 occurred only in 29 Russian regions. An increase in mortality from all acute CAD types was noted in 14 regions and from any MI — in 21 regions. The coefficient of variation (Cv) for recurrent MI and other acute CAD types of 69% and 103%, respectively, in 2015 and its growth (up to 75% and 134%, respectively) by 2019 indicate growing problems with the coding of death causes.

Conclusion. In 2019, compared to 2015, a decrease in mortality from acute CAD types was recorded in most Russian regions. The identified regional specifics require clarification of approaches to death cause coding and the introduction of additions to mortality reduction programs, taking into account the specifics of each Russian region.

Keywords: coronary artery disease, myocardial infarction, mortality, ICD-10.

Relationships and Activities: none.

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According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are the first of the 10 leading causes of death in the world [1]. According to the Global Burden of Disease, in 2015, more than 400 million people worldwide suffered from CVD [2]. In the 2015, 17,7 million people died from CVD, which accounted for 31% of all deaths in the world [3]. The cause of death of 7,4 million people was coronary artery disease (CAD).

Over the past two decades, a decrease in the age-standardized mortality rate from CVD has been noted worldwide: from 393 to 286 deaths per 100 thousand population [2]. The highest mortality rate from CAD in the Russian Federation (RF) referred to the period 1995-1998 and was 330 and 154 per 100 thousand men and women, respectively [4]. Moreover, these values were similar to those for 1985-1989. According to the Federal State Statistics Service, there was 633 cardiovascular deaths per 100 thousand population in 2019, while a year earlier it was 622,1 deaths per 100 thousand population [5].

In the last decade, significant efforts have been made to reduce mortality from CVD in Russia. In this regard, it is necessary to assess the effectiveness of the measures taken and to study the CVD mortality rates not only at the national, but also at the regional levels. These analyzes are the basis for further creation of effective regional programs aimed at improving the quality and availability of health care, and reducing the mortality rate of the population.

The aim was to identify regional specifics of changes in mortality rates from acute types of CAD in 82 Russian regions for the period from 2015 to 2019.

Material and methods

The study used Federal State Statistics Service data on the average annual population and the death number in one-year age groups in 2015 and 2019 by 82 Russian regions using Brief nomenclature of causes of death of Rosstat (C41 and C51). The term "acute" myocardial infarction (MI) in this nomenclature corresponds to codes I21.0-9 in the International Statistical Classification of Diseases and Related Health Problems, tenth revision (ICD-10), "subsequent" MI — codes I22.0-9, "other acute CAD types" — code I24.8. The study analyzed mortality rates from acute and subsequent MI, all cases of MI (sum of codes — I21-I22), other acute types and all acute types of CAD (sum of codes — I21-I22, I24.8). Standardized mortality ratio (SMR) was estimated using special software. Comparison of mortality was carried out based on SMR calculated according to the European Standard Population by direct standardization per 100 thousand population. Comparison of the regional mean SMR values in 2015 and 2019 for each of the death causes and their differences in SMR was performed using the nonparametric Wilcoxon test. The absolute and relative increase/ldecrease values, coefficient of variation (CV), maximum and minimum SMR and their ratio were estimated. Calculations and graphical data analysis were carried out using Statistica 6.0 and Microsoft Excel software packages.

Results

Dynamics in mortality from all acute CAD types

Table 1 shows mortality rates (per 100 thousand population), depending on the ICD-10 code, their dynamics and CV. During the period 2015-2019, average SMR from all acute CAD types decreased by 21% in Russia. At the same time, the absolute decline (per 100 thousand population) amounted to -17,3. The maximum SMR from all three acute CAD types per 100 thousand population in 2015 and 2019 were registered in the Krasnoyarsk Krai: 216,27 and 222,08, respectively (with a 3% increase), and the minimum — in the Republic of Dagestan: 13,77 and 12,49, respectively (with a 9% decrease) (Table 2). Over the period from 2015 to 2019, the CV increased by 6%, and the max/min ratio increased from 10,2 to 17,8.

The decrease in SMR from all three acute CAD types varied from -85% in the Chechen Republic (from 100,66 to 14,83 per 100 thousand population) to -1,0% in Arkhangelsk (from 66,94 to 65,96 per 100 thousand population) and Rostov (from 40,05 to 39,48 per 100 thousand population) regions. In 28 Russia subjects, the decrease in mortality from all acute CAD types was associated with a decrease in all SMR components — acute MI, subsequent MI and other acute CAD types.

An increase in mortality from all three acute CAD types from 2015 to 2019 was observed in 13 Russian regions. The most noticeable increase (+83%; from 61,73 to 113,09 per 100 thousand population) in mortality from all acute CAD types over 5 years occurred in the Chukotka Autonomous Okrug. In the only constituent entity of the Russian Federation — in the Kemerovo region, the increase in mortality from all forms of acute coronary artery disease (by 27%) was due to an increase in each of the SCS: from acute MI by 51%, subsequent MI by 14% and other acute CAD types by 13%.

Dynamics in mortality from all MI cases

In the Russian Federation, mortality from all cases of MI (acute and subsequent) for 5 years decreased by 14%. At the same time, the absolute decline was -4,13 per 100 thousand population. The analysis by regions showed a decrease in mortality from all MI cases over 5 years in 61 Russian regions.

Table 1

Mortality (SMR) per 100 thousand population from acute CAD types in 2015 and 2019 in Russia and their dynamics

Death cause	Code in ICD-10	SMR		Absolute increase/ decrease	% increase/ decrease	Coefficient of variation (CV)	
		2015г	2019г			2015г	2019г
All acute CAD types	I21-I22, I24.8	67,6	50,3	-17,3	-21	60%	66%
All MI cases (acute and subsequent)	I21-I22	36,5	30,8	-5,76	-14	46%	47%
Acute MI	I21.0-I21.9	26,8	23,6	-3,25	-9	44%	47%
Subsequent MI	I22.0-I22.9	9,7	7,2	-2,51	-22	69%	75%
Other acute CAD types	I24.8	31,0	19,5	-11,54	-21	103%	134%

Abbreviations: CAD — coronary artery disease, MI — myocardial infarction, ICD-10 — International Statistical Classification of Diseases and Related Health Problems, the tenth revision, SMR — standardized mortality ratio, CV — coefficient of variation.

Table 2

Maximum and minimum mortality (SMR) per 100 thousand population from acute CAD types in 2015 and 2019 in Russia

Death cause	Code in ICD-10	Highest SMR		Lowest SMR		Max//min ratio	
		2015г	2019г	2015г	2019г	2015г	2019г
All acute CAD types	I21-I22, I24.8	216,27	222,08	13,77	12,49	15,7	17,8
All MI cases (acute and subsequent)	I21-I22	107,90	100,71	5,10	6,41	21,16	15,7
Acute MI	I21.0-I21.9	79,08	76,84	3,69	6,41	21,43	11,99
Subsequent MI	I22.0-I22.9	34,54	23,88	1,05	0,00	32,9	-
Other acute CAD types	I24.8	144,43	169,16	2,37	0,74	60,94	228,59

Abbreviations: CAD — coronary artery disease, MI — myocardial infarction, ICD-10 — International Statistical Classification of Diseases and Related Health Problems, the tenth revision, SMR — standardized mortality ratio.

The largest decrease in all MI mortality from 2015 to 2019 was recorded in the Chechen (-78%) and Karachay-Cherkess (-52%) Republics, the Republic of Kalmykia (-54%), and the Volgograd region (-52%). More than a third of all MI decreased in St. Petersburg (-33%) and the Leningrad region (-36%), the Republic of Tatarstan (-47%), Buryatia (-33%) and Sakha (36%), Astrakhan (-47%), Tver (-37%), Ulyanovsk (-40%) and Murmansk (-34%) regions, and Primorsky Krai (-34%).

Only in 41 Russian regions, the five-year reduction in mortality from all MI cases was due to a simultaneous decrease in the SMR from acute and subsequent MI. At the same time, in 20 Russian regions, the decrease in mortality from all MI cases for 2015-2019 was due to the positive dynamics of only one of SMR components:

– from acute MI — in 9 Russian regions (with a SMR increase from subsequent MI): Kursk and Novgorod Oblasts, the Republics of Altai, Dagestan, Komi, Mari El, North Ossetia-Alania, Tyva, Udmurt;

– from subsequent MI — in 11 Russian regions (with a SMR increase from acute MI): in Belgorod, Kaliningrad, Kaluga, Kamchatka, Kurgan, Orenburg, Samara and Smolensk Oblasts, Kabardino-Balkar Republic, Perm Krai, Chukotka Autonomous Okrug.

The maximum SMR from all MI cases per 100 thousand population in 2015 and 2019 was registered in the Magadan region: 107,9 and 100,71, respectively (with a 7% decrease in mortality), and the minimum SMR — In the Republic of Ingushetia: 5,10 and 6,41, respectively (with a 26% increase in mortality).

By 2019, mortality from all MI cases increased in 20 Russian regions. The smallest increase (up to 1%) was in the Bryansk, Vladimir, Ivanovo, Kostroma, Lipetsk, Pskov and Yaroslavl Oblasts, as well as in the Republic of Karelia. The maximum growth in SCR was in Kemerovo (+12,13 per 100 thousand population, or +39%) and Jewish Autonomous (+11,63 per 100 thousand population, or +22%) Oblasts. An increase in mortality from all MI cases with a simultaneous increase in the SMR from acute

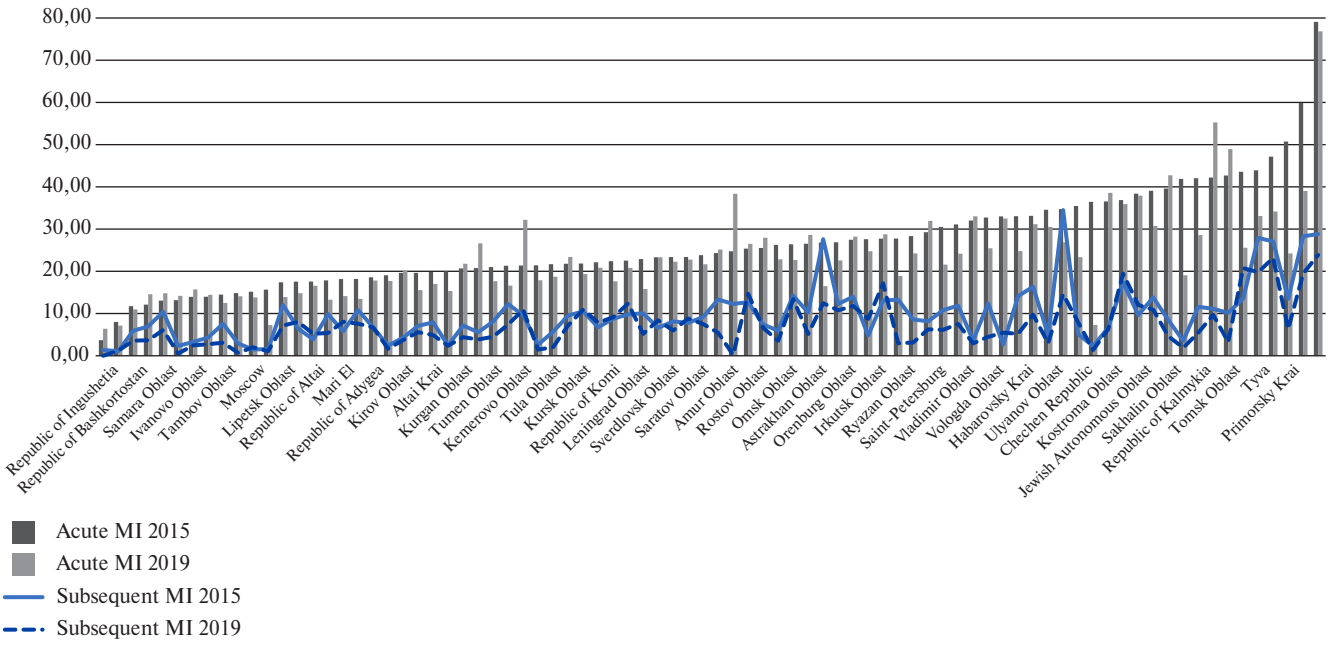

Figure 1 Standardized mortality ratio (per 100 thousand population) from all forms of acute coronary heart disease (I 21–I 22, I 24.8) and their fluctuations between the regions of the Russian Federation in 2015 and 2019.
Abbreviation: MI — myocardial infarction.

and subsequent MI was observed in Kemerovo (by 51% with acute MI and by 14% with subsequent MI), Irkutsk (by 4% and 31%, respectively) and Oryol (by 4% and 16%, respectively) Oblasts.

Mortality from all MI cases by 2019 increased due to acute MI in 11 Russian regions (Amur, Vladimir, Jewish Autonomous, Ivanovo, Novosibirsk, Pskov, Rostov and Yaroslavl Oblasts, Zabaykalsky Krai and the Republic of Ingushetia), and due to subsequent MI in 7 regions (Bryansk, Vologda, Kostroma and Lipetsk Oblasts, Republics of Karelia and Khakassia, Stavropol Krai).

Dynamics in mortality from acute and subsequent MI

Mortality from acute MI in Russia for the period 2015-2019 decreased by -3,25 per 100 thousand population (-9%) (Table 1). In 56 Russian regions in 2019, a decrease in the SMR from acute MI was recorded in the range from -1% to -80% compared to 2015. With a twofold decrease in the max/min ratio (from 21,43 to 11,99), the CV increased by 3% over a five-year period.

The largest decrease in the SMR from acute MI per 100 thousand population from 2015 to 2019 was recorded in the Chechen Republic (-29,15). The highest mortality rates from acute MI both in 2015 and in 2019 were recorded in the Magadan Oblast (79,08 and 76,84, respectively, per 100 thousand population), and the lowest in the Republic of Ingushetia (3,69 and 6,41, respectively, per 100 thousand population). The subjects with the lowest mortality rate from acute MI in 2019 were as follows: Republics of Dagestan (7,14) and Altai (14,13), Karachay-Cherkess (7,28) and Chechen (7,30) Republics, Moscow (12, 52) and the Tambov Oblast (13,91).

The decrease in mortality from subsequent MI by 2019 relative to 2015 was -2,51 per 100 thousand population (-22%) (Table 1). The largest decrease in SMR from subsequent MI (-19,93 per 100 thousand population) by 2019 was recorded in the Ulyanovsk Oblast. At the same time, the highest mortality rate from subsequent MI (23,88 per 100 thousand population) in 2019 was recorded in the Magadan Oblast (and in 2015 in the Ulyanovsk Oblast — 34,51 per 100 thousand population).

There were no deaths from subsequent MI in 2019 in the Republic of Ingushetia (in 2015, the SMR was 1,42). The lowest mortality rate from subsequent MI in 2019 was recorded in the Amur Oblast (0,22 per 100 thousand population). In 2019, the SMR from subsequent MI were low in 10 Russian regions: Kabardino-Balkarian (0,55), Karachay-Cherkess (1,08) and Chechen (1,37) Republics, Republics of Mordovia (0,70), Crimea (1,46), Kalmykia (1,90) and Mari El (2,00), Sevastopol (1,64), Tula (2,04) and Belgorod (2,73) Oblasts.

Dynamics in mortality from other acute CAD types

The decrease in mortality from other acute CAD types for the period from 2015 to 2019 amounted to -11,54 (21%). Attention is drawn to the higher CV (103% in 2015 and 134% in 2019; a 31% increase)

and a sharp increase in the max/min ratio (from 60,94 to 228,53, respectively).

The maximum SMR from other acute CAD types both in 2015 and in 2019 was recorded in the Krasnoyarsk Krai (144,43 and 169,16, respectively, per 100 thousand population), and the minimum SMR — in 2015 in the Tula Oblast (2,37 per 100 thousand population) and in 2019 — In the Astrakhan Oblast (0,74 per 100 thousand population).

Mortality from other acute CAD types in Russian regions varied over a five-year period: from a decrease in the Oryol Oblast (-92%; from 116,52 to 9,6 per 100 thousand population) to an almost sevenfold increase in the Chukotka Autonomous Okrug (+51,95%; from 8,9 in 2015 to 60,85 in 2019 per 100 thousand population).

Discussion

The results obtained reveal significant differences in SMR between the regions, which require additional discussion (Figure 1). The left diagram wing reflects the low and moderate mortality from all acute CAD types, mainly in the Central and Southwestern Russia, and the right wing is, for the most part, Siberian, Northern and Far Eastern regions with higher SMR values. Similar geographic imbalances exist in almost all countries. Statistics show that rural residents use ambulance services almost 2 times less often than urban residents (6,4% vs 10,3%), and higher mortality are recorded in regions with vast territories and remote rural settlements [6]. And, from our point of view, this problem requires further study.

In general, the decrease in mortality from acute CAD types by 2019 was formed due to the decrease in SMR from all three types in 69 Russian regions, from all MI cases (acute and subsequent) — in 61 subjects, from acute MI — in 58 subjects, from subsequent MI — in 62 subjects, and from other acute CAD types — in 61 subjects. At the same time, the decrease in the SMR from all acute CAD types due to a simultaneous decrease in each acute CAD type (acute and subsequent MI, other acute CAD types), indicating a real decrease in mortality, developed only in 28 regions.

Among the subjects with a unidirectional positive trend, the Sakhalin Oblast showed the maximum degression. The highest (more than 2-fold) rate of SMR decrease for three CAD types was noted in the Karachay-Cherkess Republic (by 55%), the Tver Oblast (by 59%), and the Chechen Republic (by 85%). In other subjects, there is a multidirectional dynamics in mortality rates for acute MI, subsequent MI and other acute CAD types, probably due to both objective and subjective factors.

One of these factors is a methodologically different approach to determining the initial death cause and incorrect accounting of death causes. In Russia, there are certain problems with the interpretation of the terms of acute CAD types, diagnosis and coding them in statistical documents, which can affect mortality rates [7].

The last 2 years, work has been carried out to adapt the Russian clinical classification of CAD to the requirements and terminology of ICD-10. Methodological and practical difficulties consisted in the fact that according to ICD-10, MI is considered to be “subsequent” if it develops within 4 weeks from onset of a previous infarction. All other cases of acute MI are included in I21.0-0, regardless of whether it is the first, second, or third, and are classified as “acute MI”. Thus, ICD-10 do not divide cases of acute MI into “first”, “second”, etc. WHO has now removed subsequent MI (I22) from mortality statistics, instead using I21. However, according to the Brief nomenclature of causes of death of Rosstat, the I22 code continues to be accounted for as a separate line.

This is probably due to the fact that in Russia, “subsequent MI” is considered as MI that developed 28 days after the primary MI, which is coded as I22, which led to the division of MI into “primary” and “ subsequent “ (ie, second, third, etc.). The rationale for this approach is that patients with subsequent MI have a worse prognosis and, accordingly, require other rehabilitation measures, secondary prevention and medical examination. In the 2020 Russian Guidelines on clinical, morphological and statistical classification of coronary artery disease, it is recommended:

1) to consider the term “acute” to be statistical and include it in diagnosis for subsequent unambiguous interpretation of the diagnosis as I21;

2) to save the term “subsequent MI” with coding I22;

3) in case of MI within 4 weeks from onset of a previous infarction, to register it as “Recurrent MI [8].

Thus, at present, differences in approaches to terminology and coding remain between the ICD-10 and Russian Society of Cardiology. These differences affect the variability of regional indicators and their dynamics.

The all-Russian trend of a decrease in mortality from MI, which has a multidirectional nature, testifies only to a partial success and once again exposes the coding defects, as well as, probably, the problems of providing health care in a number of regions. It is believed that the mortality rate from primary MI to a greater extent reflects the situation with the inpatient care for this disease, and the mortality rate from subsequent MI — with

the provision of outpatient care [7]. However, this hypothesis requires further confirmation.

Significant fluctuations of regional SMR are characterized by CV and the max/min ratio. The CV <33% indicates the relative homogeneity of the studied population, and the CV >66% revealed in our analysis most likely confirm the problems with coding the death causes and, probably, indicate an asymmetric care in the regions (Table 1).

From our point of view, the unidirectional changes in all three acute CAD types most clearly reflects the situation in regions, and the multidirectional changes is due to difficulties in coding, diagnosis, treatment and secondary prevention in each specific region. But the growth in mortality rates, as well as the multidirectional dynamics, requires identifying the reasons for such changes in each specific area.

Conclusion

In 2019, compared to 2015, a decrease in mortality from acute CAD types was recorded in most Russian regions. The identified regional specifics require clarification of approaches to death cause coding and the introduction of additions to mortality reduction programs, taking into account the specifics of each Russian region.

Relationships and Activities: none.

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