

Blinova, Tatiana; Bylina, Svetlana

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Determinants of Mortality in Russian Regions: an Empirical Analysis

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Determinants of Mortality in Russian Regions: an Empirical Analysis

Tatiana Blinova – Doctor of Economics, Professor, Deputy Director on Science of the Institute of Agrarian Problems of the Russian Academy of Sciences (IAGP RAS)

Svetlana Bylina – Scientific Researcher. Institute of Agrarian Problems of the Russian Academy of Sciences (IAGP RAS)

Abstract. The objective of this paper is to make an empirical analysis and econometric evaluation of determinants of mortality for population of the able-bodied age in Russian regions. The model that was evaluated included five groups of factors (economic, social, ecological, demographic and behavioral). Results of the empirical analysis are presented to show that statistically relevant indicators are the characteristics of the region, way of life of the people and investments in the health care. Taxonomy of the regions of the Russian Federation is made according to basic classes of causes of death of the population of the able-bodied age that is developed by employing hierarchical cluster analysis and the SPSS statistical processing software. The results of the study show that the regional structure of mortality among the population of the able-bodied age is governed by specific characteristics of the region. The relationship between the ecological adversity and high mortality from neoplasm is revealed. The hypothesis that anti-social behavior affects the level of mortality from external causes is confirmed. It is argued that increased investments in the public health service and promotion of the healthy way of life can help reduce the mortality among the able-bodied population from cardiovascular diseases. The regression equations are evaluated by using the data openly presented by the Federal State Statistics Service on the website of Rosstat. The study of the nosological profile of mortality among the able-bodied population by Russian regions allowed identify the territorial features of the structure of causes of death, which can be used when developing regional strategies for reducing mortality among the population of the able-bodied age.

JEL Classification: R1, J1, I1

Keywords: Russian regions, population, able-bodied age, mortality structure, taxonomy, regression analysis, regional data

1.INTRODUCTION

The urgency of the research is due to the need to identify the dominant factors and territorial features of the mortality structure in Russia that determine the opportunities of life expectancy growth. Active demographic policy measures set out in The Concept of the Long-term Social-Economic Development of the Russian Federation for the Period Ending 2020 and the Concept of the Demographic Policy of the Russian Federation for the Period Ending 2025, the “Health” national priority project and regional programs for modernization of the public health service helped reduce the mortality. Making use of the instruments offered in state programs, priority national projects, and pursuing active demographic policies the government of the Russian Federation allocated considerable financial resources aiming to improve the standard and quality of life, health protection, ensure the factors of life expectancy growth, reduce the mortality, encourage the fertility and support young families. Prerequisites were created for improving the conditions of reproduction of the population and many of these measures produced positive effects. Between 2005 and 2010 the number of the deceased fell from 2.3 to 2.0 million people per year (Russia in Figures, 2011) and the life expectancy grew from 65.3 to 69.0 years.

At the same time the rate of mortality among the population of the able-bodied age remains high in Russia. The structure of causes of death among the able-bodied population is presented in Figure 1.

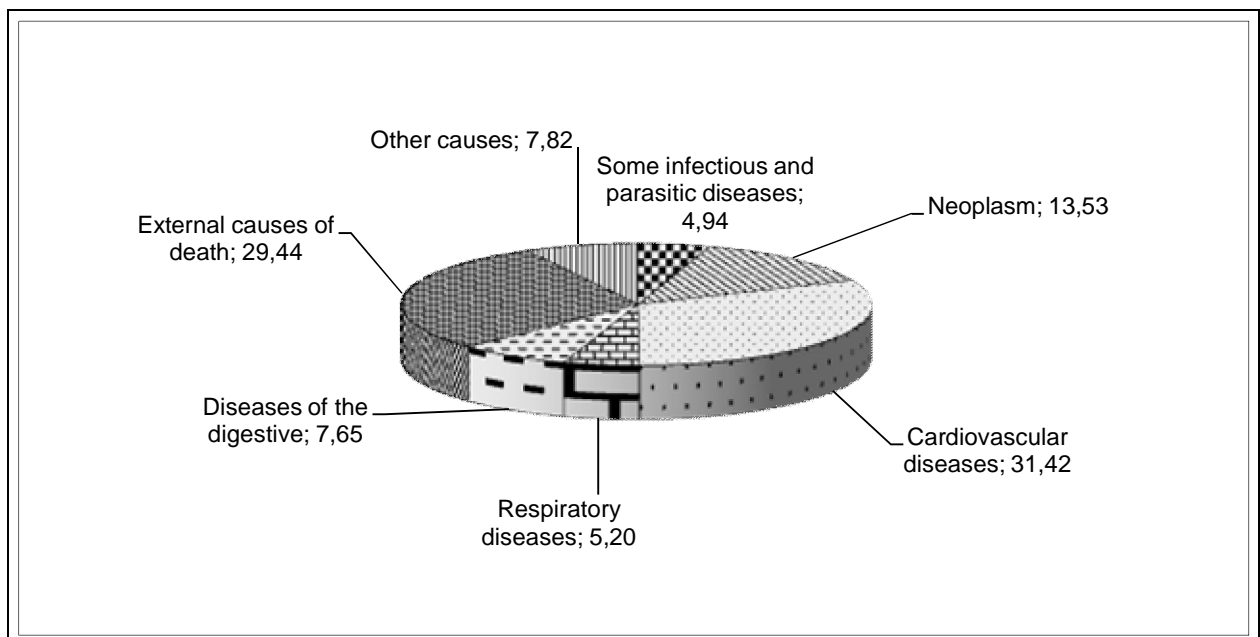


Figure 1. Structure of causes of death among the able-bodied population of RF, 2009, per cent

The data shows that cardiovascular diseases have the largest proportion in the structure of causes of death (31.4%), followed by external causes (29.4%), neoplasm ranking third (13.5%). However, the structure of causes of death and the set of factors determining it differ considerably by regions. Thus, the difference between the polar values of the rate of mortality among the population of the able-bodied age is 6.4 times. The differences between the polar values of mortality among the population of the able-bodied age from cardiovascular diseases and neoplasm respectively constitute 9.6 and 3.7 times. The highest value of the rate of mortality from external causes exceeds the lowest one 12.5 times. The difference between the highest and lowest values of the rate of mortality from respiratory diseases and that of the digestive makes 69.2 and 21.2 times, respectively. Hence, there exists a significant inter-regional differentiation of causes of death among the able-bodied population of RF (Table 1).

Table 1 – The highest and lowest values of the rate of mortality among the able-bodied population of Russian regions by basic classes of causes of death (number of the deceased per 100000 of the able-bodied, people)

Statistics	All causes	Some infectious and parasitic diseases	Neoplasm	Cardiovascular diseases	Respiratory diseases	Diseases of the digestive	External causes of death
Average for RF	641,7	31,7	86,8	201,6	33,4	49,1	188,9
Lowest	191,5	7,4	30,5	44,5	1,2	4,4	37,8
Highest	1227,2	117,7	114	429,1	83	93,2	471,2

To analyze the regional features of the structure of causes of mortality among the able-bodied population we classified the Russian regions and evaluated the regression equations. In our research we attempted to use quantitative methods to evaluate spatial differences in the structure of causes of mortality among the population of the able-bodied age and to pick out the set of relevant factors directly or indirectly affecting the mortality in different regions. In Section 1 we state the problem and describe the current situation. In Section 2 we present the model that is to be evaluated empirically and discuss the theoretical approaches to studying the causes, factors and determinants of mortality among the population. Evaluation of the econometric models by the regions of Russia is accomplished in Section 3. Section 4 contains the interpretation and discussion of the results. The concluding section presents some recommendations on how the social policy can be improved. We did not see making a comprehen-

sive analysis of causes of mortality in Russian regions our objective. Instead, we assumed a more particular research task that is to find answers to a number of questions that can be evaluated quantitatively by using econometric models. We used regression models as instruments to make our quantitative evaluation of the factors and determinants influencing the specific regional features of the structure of mortality among the able-bodied population and analyze the inter-regional differences. The explanatory variable was the mortality rate derived for relatively homogenous groups. The set of factors used as regressors captures the objective living conditions in different regions, features of the regional social policies and behavioral characteristics of the population.

2. THE MODEL

Modern approaches to regional development take account of the increasing role of intangible and non-economic factors. The theory of human capital evolved by T.Schultz, G.Becker and many other prominent authors explains the economic role of not only education and health care, but the entire system of factors affecting human health. Health is treated in this theory as an important resource of economic development. G.Becker considered investing in health a necessity. Improving health is a specific form of accumulation of human capital as is education. The concern for human health paid by the government that makes investments in the “health industry”, the way of life of different population strata and social groups wishing to improve (or destroy) their health are important factors affecting the rate and structure of mortality, as well as the social-economic development of the regions. Now as the society is getting to realize the true value of human life, the attitude of the government and regional authorities towards the public health system and its resource provision changes. Expenditures on education and health care are a form of investments in human capital. Improvement of human capital is a factor of economic growth and regional development. Improvement of human health is a form of accumulation of wealth and welfare. In this sense, taking care of health the whole life, especially labor life, should be considered an economically rational activity. Making use of different concepts enabled us to expand the range of factors for scientific analysis that are suitable for quantitative comparisons.

Attention should be paid, first, to the increasing importance of intangible factors, including the value of human life and health, and, second, to the increasing role of behavioral factors representing the way and style of life of different population strata and social groups. Health and longevity are expressed in terms of such social-demographic indicators as life ex-

pectancy and mortality rate. Human Development Index (HDI) that is published in United Nations Development Programme Annual Reports includes life expectancy.

Particular tasks of our research imply the choice of indicators. Factors that reduce mortality and improve health of the Russian population are actively discussed in the literature where the range of research problems is seen from demographic, economic and social perspectives. Demographers study the regularities of fertility and mortality affecting the reproduction of population, its age and sex structure and features of demographic behavior. Economists are interested in finding out the costs of losing health and the amount of profits from production of gross regional product (GRP) lost as a result of a fall in the number of the employed in the economy due to premature deaths of the able-bodied population. Conversely, low level of economic development is a cause of poor social infrastructure, insufficient number of doctors and other medical personnel, poor quality of the treating plants and drinking water and low level of incomes of the people.

Sociologists study how the system of values, orientations and motives affects the rate and causes of mortality among different social groups. In his concept P. Bourdieu points at the close relationship between the way of life, health and habits stressing that the knowledge of rational behavior influences the attitude towards health. Many authors also note the relationship between health and social-economic inequality. Income differentiation among the population is largely a cause of differences in the living standards and access to quality health-care services. Medical-social papers present some results of direct and indirect influence of anti-social behavior, namely addiction to alcohol, on mortality. Ecological research shows that the lifetime of the people depends on ecological safety.

Generalizing the approaches to analyzing the factors of health and determinants of mortality existing in the literature we select the range of indicators we need to include in the regression equation. Then we econometrically evaluate the model of the kind

$$Y = F(R + B + P), \quad (1)$$

where: Y is the dependent variable characterizing the regional risks of mortality among the able-bodied population measured in regional values of the rate of mortality among the able-bodied population (number of the deceased of the able-bodied age per 100000 of the able-bodied population).

R is the characteristics of the region in which the able-bodied population included in the sample live.

B is the behavioral characteristics of the able-bodied population of the region representing their way of life.

P is the regional policy of development of the public health system.

Among the multitude of indicators we chose those that showed high relevance in pair correlations. These indicators can be governed through public policy measures. The model described here defined the range of basic parameters that were included in the regression equations.

3. AN EMPIRICAL IMPLEMENTATION OF THE MODEL

3.1. Database of the research

The database of the research is comprised of the data on the structure of mortality among the able-bodied population by basic classes of causes and Russian regions openly and officially presented online by the Federal State Statistics Service (Rosstat). The parameters of the model were statistically evaluated with taking into account the cross-sectional data. The general rate of mortality, as well as that of mortality among the able-bodied population, is widely used in international comparisons. The indicators of mortality and life expectancy presented in the national statistics all over the world mirror the public health. Moreover, the Russian statistics calculates the regional values of these indicators, which allows strictly rank the subjects of RF according to their mortality indicators.

The sample includes 80 subjects of the Russian Federation representing all Federal Okrugs of Russia. There are considerable regional differences in both the structure of causes of mortality and the set of factors determining it in Russia. To study the regional features we classified the Russian regions by basic classes of causes of mortality: cardiovascular diseases, some infectious and parasitic diseases, neoplasm, respiratory diseases, that of the digestive and external causes. We used the official statistics on the rates of mortality (number of the deceased per 100000 people of the able-bodied age) among the population of RF and regions by basic classes of causes of mortality (Demographic Yearbook of Russia, 2010). The classification was made by employing hierarchical cluster analysis and the SPSS statistical processing software. The results of the classification were then made use of to draw a map (Figure 2). To reduce the dimension the indicators were aggregated by making a factor analysis using the principal-component method and the SPSS 13.0 statistical processing software. Two principal components with the proportion of integrated explained variance equaling 78.8% were derived. This was followed by the procedure of hierarchical cluster analysis.

3.2. Taxonomy of the regions of Russia

As a result of the taxonomy five groups of regions were formed, each having their specific features. The regions of the first classification group have the highest mortality among the able-bodied population by basic classes of causes of mortality. In all the subjects comprising the group the rates of mortality among the able-bodied population by basic classes of causes of mortality are higher than the Russian average, with the exception of infectious and parasitic diseases. The dominant cause of mortality among the able-bodied population in most of the regions of the first group is cardiovascular diseases. Mortality from this cause is the highest in Chukotka Autonomous Okrug (429.1 people per 100000 of the able-bodied), Pskov (357.9 people), Novgorod (347.3 people), Magadan (326.4 people) and Vladimir (323.5 people) Oblasts. External causes of mortality among the able-bodied population prevail Amursk (292.0 people), Irkutsk (254.2 people), Leningrad (246.6 people) Oblasts, Jewish Autonomous Oblast (307.3 people) and Perm Krai (279.4 people). Eight regions of fifteen by far top the Russian average rates of mortality from infectious and parasitic diseases. The highest rate of mortality from neoplasm among the able-bodied population of RF is observed in Oryol Oblast (114.0 people per 100000 of the able-bodied), the rates being also high in Tula (112.8 people), Vladimir (108.5 people), Novgorod (106.7 people) Oblasts and Chukotka Autonomous Okrug (105.0 people). All regions of the first group outpace the Russian average in terms of mortality from respiratory diseases and that of the digestive, the rates for the able-bodied population reaching their highest values in Magadan Oblast. Therefore, the situation with mortality among the able-bodied population in the regions of the first group can be called critical.

The second group embraces the regions where the rates of mortality from all causes, except for infectious and parasitic diseases, surpass the Russian average. Especially high there are the rates of mortality among the able-bodied population from cardiovascular diseases, neoplasm and external causes that exceed the Russian average in all regions of the group. The highest rates of mortality from neoplasm among the able-bodied population in the group can be seen in Sakhalin (109.9 people) and Ryazan (109.3 people) Oblasts, from cardiovascular diseases – in the Republic of Karelia (288.8 people), Sakhalin (276.1 people) and Kostroma (273.3 people) Oblasts, from external causes – in Kemerovo (316.1 people) Oblast. All regions of the second group, with the exception of Kaliningrad Oblast, have rates of mortality from respiratory diseases that are higher than the Russian average rate. The situation with mortality from this cause is the worst in the group in Kemerovo (49.9 people), Sakhalin (49.6

people) and Kaluga (49.2 people) Oblasts. Sakhalin Oblast is also notable for having the highest mortality from diseases of the digestive in the group. Mortality among the able-bodied population from this cause in all subjects of RF included in the second group, except Kirov Oblast, is higher than the Russian average.

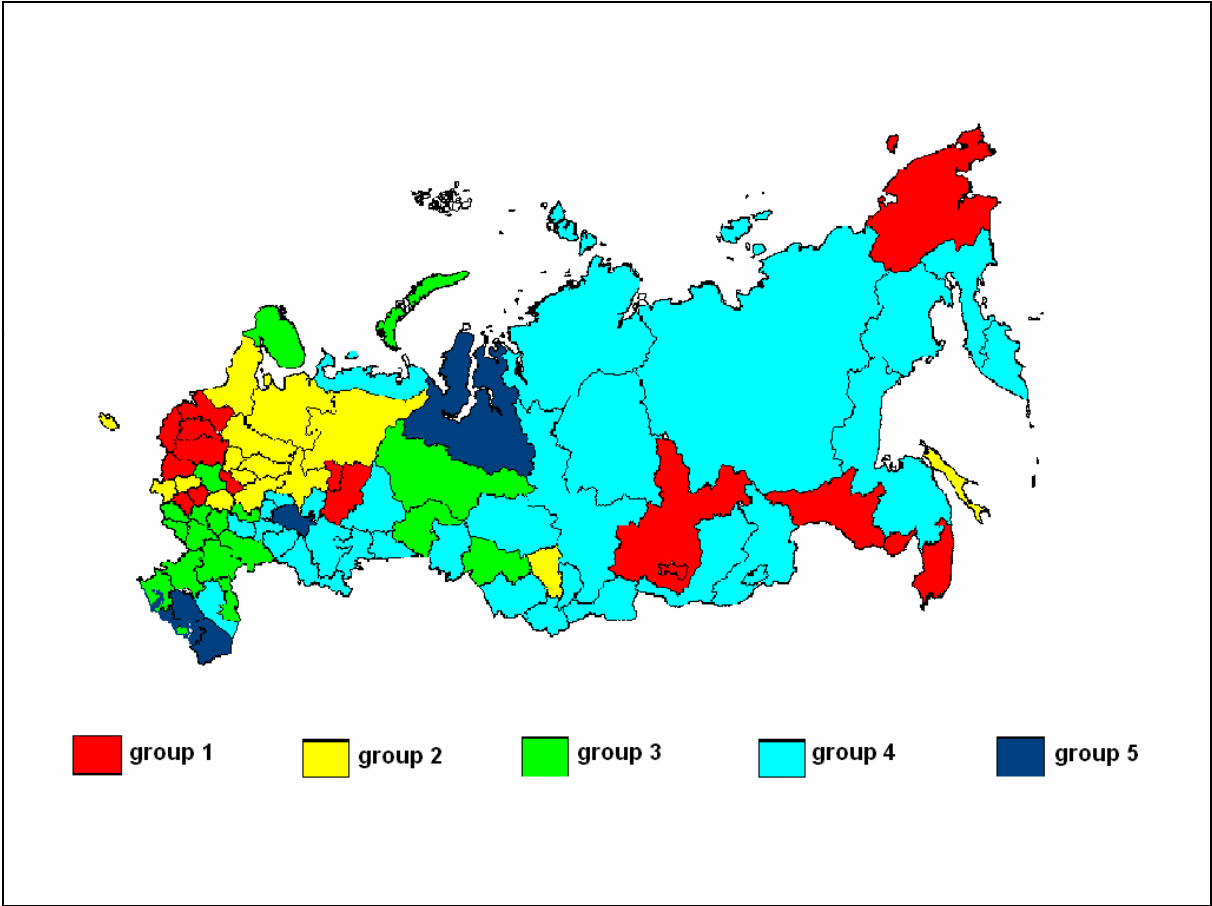


Figure 2. Taxonomy of Russian regions by basic classes of causes of mortality among the able-bodied population

The regions of the second classification group, however, show the rates of mortality from some infectious and parasitic diseases that are below the Russian average. The exceptions are Kemerovo (57.8 people) and Kaliningrad (42.4 people) Oblasts. In general, the regions of the second group have lower rates of mortality among the able-bodied population by basic classes of causes of mortality compared to the regions comprising the first group. But still the situation with mortality among the able-bodied population in the regions of this group can be called precarious.

The third group exceeds the Russian average in terms of mortality among the able-bodied population from cardiovascular diseases and neoplasm, but has lower mortality from

causes belonging to the other classes than in RF on average. In 14 regions of this group the rates of mortality from neoplasm top the Russian average, being particularly high in Tambov (113.1 people) and Kursk (108.1 people) Oblasts. The rates of mortality from cardiovascular diseases among the able-bodied population are high in half of the regions, the worst situation in Murmansk Oblast (305.2 people). In all regions of the third group the rates of mortality among the able-bodied population from external causes are lower than the national average. Hence, the third classification group can be characterized as problem from the point of view of mortality among the able-bodied population from neoplasm and cardiovascular diseases.

Table 2 – Rates of mortality among the able-bodied population of Russian regions by basic classes of causes of mortality (number of the deceased per 100000 of the able-bodied population)

Groups	Number of subjects	Basic classes of causes of mortality					
		Some infectious and parasitic diseases	Neo-plasm	Cardio-vascular diseases	Respiratory diseases	Diseases of the digestive	External causes
RF	80	31,7	86,8	201,6	33,4	49,1	188,9
1	15	38,26	101,03	288,82	53,53	69,38	260,81
2	15	26,47	96,13	248,89	42,00	65,29	233,25
3	18	27,42	90,26	209,63	31,18	47,71	162,24
4	24	36,42	83,78	194,10	36,86	48,78	252,52
5	9	19,74	61,98	127,78	15,93	29,39	112,20

High mortality among the able-bodied population from external causes is a distinction of the regions of the fourth group. In all regions of the group it exceeds the Russian average. The number of those who died from external causes is particularly high in the Republics of Tiva (471.2 people – the highest rate in RF), Altai (347.9 people), Buryatia (354.7 people) and Zabaikalski Krai (344.5 people). In most regions of the group mortality from diseases of the digestive is also higher than in Russia on average. In this respect the situation is the most complicated in the Republics of Udmurtia (72.8 people), Tiva (65.3 people) and Khabarovsk Krai (61.8 people). The Republic of Tiva also has the highest rate of mortality from infectious diseases (117.7 people). At the same time, in most regions of the fourth group mortality from neoplasm and cardiovascular diseases is lower than the Russian average. So, for the regions

comprising the fourth classification group the situation with mortality from exogenous causes is the most unfavorable.

The fifth group consists of nine regions in which the rates of mortality among the able-bodied population from basic causes of death are lower than the national average. Among all the groups the situation with mortality among the able-bodied population is the most favorable in this group.

Thus, studying the nosological profile of mortality among the able-bodied population of Russian regions enabled us to identify the territorial distinctions of the structure of causes of mortality, which can be made avail of when developing regional strategies for reducing mortality among the population of the able-bodied age.

3.3. Regression analysis

The quantitative evaluation of the influence of different factors on the rates of mortality in Russian regions and the analysis of inter-regional differences were made by using regression models. As the explanatory variable we used the mortality rate indicator calculated for relatively homogenous groups. The set of factors used as regressors mirrors the objective living conditions in different regions, specific features of the regional social policies and behavioral characteristics of the population. To evaluate the determinants of the regional rates of mortality among the able-bodied population we picked out three groups of indicators and derived regression equations. The following factors were considered:

- (1) Characteristics of the region – economic, social, ecological, demographic.
- (2) Investments in the public health service, consolidated budget allocations for health care, physical culture and sport reflecting the features of the social regional policy.
- (3) Behavioral characteristics of the population mirroring the way and style of life.

In our research we ignored the influence of natural-climatic conditions, industrial injuries and some other factors. To enter in the regression equations we chose only those factors that were available in the database.

We evaluated the equations of regression dependence of the rates of mortality among the able-bodied population (SM) on the explanatory variables (demographic, economic, social, ecological, behavioral ones) for Russia in general and individual groups of regions. The following variables were used:

X_1 – amount of the gross regional product (GRP) per capita, ln.

X_2 – consolidated budget allocations for health care, physical culture and sport.

X_3 – investments in public health service’s fixed assets.

X_4 – number of people having incomes below the subsistence minimum, per cent of the total population.

X_5 – number of alcoholics registered in health care settings, people per 100000 of population.

X_6 – number of drug addicts registered in health care settings, people per 100000 of population.

X_7 – number of registered crimes per 100000 of population.

X_8 – unemployment rate calculated according to the methodology of the International Labor Organization (ILO), per cent.

X_9 – migration inflow, people per 100000 of population.

X_{10} – number of doctors per 10000 of population.

X_{11} – number of nursing staff per 10000 of population.

X_{12} – polluted wastewater discharge in surface water bodies reflecting the ecological parameters of regional development.

We derived regression dependencies of the rate of mortality (people per 10000 of the able-bodied) on the chosen indicators. Of all the equations derived we chose the models having regression coefficients of 5% relevance and multiple determination coefficients over 0.6.

RF	$SM = 463,37 - 0,017 \cdot X_3 + 0,096 \cdot X_5 + 4,89 \cdot X_4 + 0,164 \cdot X_{12}$	$R^2 = 0,622$
Group 1:	$SM = 756,48 + 0,087 \cdot X_5 - 0,13 \cdot X_2$	$R^2 = 0,799$
Group 2:	$SM = 672,27 - 0,009 \cdot X_3 + 0,376 \cdot X_9 - 1,396 \cdot X_{10} + 5,43 \cdot X_8$	$R^2 = 0,739$
Group 3:	$SM = 470,34 - 0,011 \cdot X_3 + 0,112 \cdot X_5 + 0,121 \cdot X_{12}$	$R^2 = 0,794$
Group 4:	$SM = 433,93 + 0,055 \cdot X_5 + 16,72 \cdot X_8$	$R^2 = 0,707$

The analysis allowed take into account the influence of spatial differences in the regresses on the rate of mortality in each group. Having evaluated the dependencies derived, we can conclude the following.

For Russia in general the parameters affecting the rate of mortality among the able-bodied population the most are investments in public health service’s fixed assets, number of people having incomes below the subsistence minimum (per cent of the total population), number of alcoholics registered in health care settings (people per 100000 of population) mirroring the way of life and behavioral characteristics of the population and polluted wastewater

discharge in surface water bodies reflecting the ecological parameters of regional development.

For the regions of the first group that have high rates of mortality among the able-bodied population by basic classes of causes of mortality the most important factors are consolidated budget allocations for health care, physical culture and sport and the number of alcoholics registered in health care settings.

For the regions of the second group experiencing high mortality among the able-bodied population from basic causes of death, except for infectious diseases, the most influential parameters are investments in public health service's fixed assets, number of nursing staff per 10000 of population, situation on the regional labor market and migration inflow of population.

In the regions belonging to the third classification group and suffering from high mortality from neoplasm and cardiovascular diseases the factors affecting mortality among the able-bodied population the most are characteristics of development of the social sphere in the form of investments in public health service's fixed assets, behavioral characteristics of the population of the region and ecological parameters of regional development, namely polluted wastewater discharge in surface water bodies.

For the fourth group of regions that is notable for the highest mortality from external causes the important factors of influence in terms of mortality among the able-bodied population appeared to be the following: situation on the regional labor market and behavioral characteristics of the population. The rate of unemployment in the regions of the fourth group is one of the highest and the average number of registered crimes per 100000 of population for the group is the largest. The highest proportion of the people having incomes below the subsistence minimum among the groups, as well as the relatively high rate of migration outflow from the regions and number of alcoholics registered in health care settings are other symptoms indicating that the social situation in the regions is far from being satisfactory.

We did not make regressions for the regions of the fifth group. We also ignored the influence of natural-climatic conditions, although it is considerable. Some Russian authors (Vishnevski, Shkolnikov) show that it manifests itself by decreasing the life of the people in the direction from southwest to northeast (the northeast gradient).

This research proves that there is a need to apply a comprehensive approach to reducing the rate of mortality among the population that would allow for not only the government expenditures on the public health service, but also the distinctions of the way of life of the people, their motives, values and social orientations, as well as the regional policy features.

4. CONCLUSIONS AND POLICY IMPLICATIONS

Our analysis allows draw the following conclusions. First, there exist inter-regional differences in the structure of causes of mortality among the population of the able-bodied age. Second, the rate of mortality in different regions of Russia is governed by different classes of causes of death. Third, there is a relationship between the rate and structure of causes of mortality and economic, social, demographic and behavioral factors that produce both direct and indirect influence. The set of variables we used in our regression equations in order to make quantitative evaluation of the factors governing the structure of causes of mortality among the population of the able-bodied age included characteristics of the regions, regional policy features and behavioral distinctions of the population. The initial working hypotheses have undergone empirical testing and were confirmed.

Analyzing the dependencies derived we find out the following. The rate of mortality among the able-bodied Russian population can be to a large extent reduced through increasing the amount of investments in the public health service, reducing the proportion of the people having incomes below the subsistence minimum, preventing the number of alcoholics from growing and ensuring ecological safety of the region. In the regions of the first group having high rates of mortality among the able-bodied population by basic classes of causes of death the situation with mortality can be much improved by spending more budget resources on health care, physical culture and sport and pursuing anti-alcoholic policies. In the second group of regions the mortality rates can be reduced by increasing the amount of investments in the public health service and the number of medical personnel, by making the situation on the regional labor markets more stable and by taking control over the inflow of migrants. Increased investments in the public health service, new stereotypes of the healthy way of life and improved ecological situation and quality of drinking water could be much helpful in reducing the rates of mortality among the able-bodied population in the regions of the third group where they are high mostly due to cardiovascular diseases and neoplasm. The regions of the fourth group need to have a more stable labor market situation, lower unemployment rates, improved living conditions; their population should better understand the true value of life and stick to healthy ways of living. Having studied the nosological profile of mortality among the able-bodied population by Russian regions we revealed certain territorial distinctions in the structure of causes of death, which can be instrumental when developing policy measures with the view to reduce mortality among the population of the able-bodied age. As we already mentioned above, we did not make any regressions for the regions of the fifth

group. Thus, the models that we derived and that relate the rate of mortality among the able-bodied population to the social-economic, demographic and ecological characteristics of the regions allow select among the approaches to choosing and implementing the regional strategies aiming at improving the health of the population, reducing the mortality rates and increasing the life expectancy.

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