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TYPOLOGY OF CONSTITUENT ENTITIES OF RUSSIA ON MORTALITY OF WORKING AGE POPULATION

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Abstract

The article presents results of the statistical classification of constituent entities of Russia concerning causes of death of working age population using descriptive statistics and cluster analysis. In Russia, positive results have been achieved in the reduction of mortality rate among children and elderly population. The maintenance of a high mortality rate among working-age population is reasoned by the influence of factors covering the overall quality of life of population. The most significant factors of mortality are crime rate, the average age of population, population density, unemployment rate, the incidence of active tuberculosis, the incidence of HIV infection, the number of detected offenses related to illegal production and trafficking of alcohol products.

The territorial differentiation in the level and structure of mortality of working age population in Russia reasoned by the heterogeneity of mortality factors is shown. The analysis of factors of mortality, the structure of mortality due to causes of death made it possible to substantiate the need to apply methods of multidimensional classification. As a result of the implementation of a two-step cluster analysis with weight coefficients added to classification variables, presented by mortality rates of working age population in constituent entities of Russia, the following has been identified: low and high mortality rates of working age population by all causes of death, low, medium and high mortality due to infectious and parasitic diseases. The results of the research can be used in development of measures of socio-demographic policy of regions.

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Keywords: Population, mortality, entities, Russia, territorial differentiation.

1. Introduction

The Russian Federation is characterized by a high mortality rate in comparison with the developed countries of the world. As a result of the stabilization of socio-economic situation, the development of health care system and the increase in the availability of medical services, mortality rate among children and elderly population has been reduced. Mortality rate of working-age population does not demonstrate positive changes, and is also accompanied by the increase in territorial differences (Grigoriev et al., 2010; Vishnevsky, 2015; Sievert, Zakharov, & Klingholz, 2011).

2. Problem Statement

The differentiation of the constituent entities of the Russian Federation according to the level and structure of mortality of the population in working age is associated with disparate living conditions and the dominant way of life of the population in certain territories. Territorial differentiation is one of the barriers to the development of effective measures aimed at the reduction of the mortality rate of working age population in the constituent entities of the Russian Federation (Kvasha, Kharkova, & Yumaguzin, 2014; Mikhalska-Zhila, & Stolbov, 2018). In this regard, it is important to study the differentiation and identify its factors, as well as to develop the typology of the constituent entities of the Russian Federation on the mortality rate of working age population.

3. Research Questions

In the Russian Federation, the mortality rate of working-age population in 2016 was 525.3 deaths per 100 thousand people of the corresponding age, the minimum value among the entities of the Russian Federation was in the Republic of Ingushetia (155.3 deaths per 100 thousand people), the maximum value was in the Republic of Tyva (830.8 deaths per 100 thousand people). The interregional differences in the mortality rate of working age population due to individual causes of death are more pronounced, as demonstrated by the values of descriptive statistics (Table 1).

Table 01. The values of variation indicators of mortality of working age population in the entities of the Russian Federation in 2016

Causes of death	Maximum value per 100 thousand people	Minimum value per 100 thousand people	Oscillation indicators, %	Variation indicators, %
Total deaths by all causes (y_1)	830,8	155,5	119,73	22,53
Circulatory diseases (y_2)	279,87	33,38	144,19	26,04
External causes (y_3)	371,1	31,75	218,42	33,25
Malignant tumours (y_4)	113,35	31,82	99,11	17,18
The diseases of the digestive system (y_5)	99,46	2,15	188,74	34,95
Infectious and parasitic diseases (y6)	116,77	3,92	361,71	77,20
Diseases of the respiratory system (y_7)	54,4	2,86	204,48	37,15

The constituent entities of the Russian Federation are heterogeneous in the level of mortality of working-age population by external causes (coefficient of variation 33.25%), the diseases of the digestive system (34.95%) and the diseases of the respiratory organs (37.15%). The differences in the mortality rate of working-age population by constituent entities of the Russian Federation are the result of disparate living conditions, which over the long term leads to the imbalance in the demographic development of the territories: accelerated aging and retirement of working-age population in regions with adverse living conditions (Velichkovsky, Kozlova, & Derstuganova, 2014; Sameem, & Sylwester, 2017).

4. Purpose of the Study

The purpose of the study is the assessment of territorial differences in the level and structure of mortality of working-age population; the identification of differentiation factors and the development of a scientifically based typology of constituent entities of the Russian Federation on the mortality rate of working-age population.

5. Research Methods

In order to conduct the study, the data base was formed which reflected the information on the entities of the Russian Federation for 2016 on the mortality rates of working age population for certain reasons and the most important socio-economic indicators. To identify the factors of mortality of working-age population by causes of death, the paired coefficients of correlation between mortality rates and socio-economic indicators were calculated. The analysis of the content and nature of the impact of socio-economic factors on the mortality rate of population by causes of death makes it possible to substantiate that mortality rates are independent classification criteria and can be used to develop a typology of the entities of the Russian Federation. The classification method was applied by means of hierarchical cluster analysis procedure - the Ward method. The initial values of the classification features (y2-y7) are pre-standardized; weights are also entered the values of which are calculated with the help of corresponding values of the coefficients of variation of the variables. At the first stage of the implementation of the cluster procedure, anomalous objects were revealed, which were characterized by a significant increase in the distance of objects merging into clusters compared to the previous merge stage. At the next stage, anomalous objects were excluded from the classification objects. The values of the weighting coefficients were recalculated taking into account the values of the coefficients of variation without anomalous objects. Cluster procedure was implemented on the basis of remaining objects. As a result, the classification was constructed without anomalous objects that form an independent cluster.

6. Findings

The authors found out the mortality factors for working-age population in the constituent entities of the Russian Federation, the most significant of which were presented by crime rate, the average age of population, population density, unemployment rate, incidence of active tuberculosis, HIV incidence, and the number of detected offenses related to illegal production and trafficking of ethyl alcohol and alcohol products. The values of mortality factors were heterogeneous in the regions of the Russian Federation (tab. 2).

Table 02. The values of variation indicators of mortality of working age population in the constituent entities of the Russian Federation in 2016

Mortality factors	Maximum value	Minimal value	Oscillation indicators, %	Variation indicators, %
The crime rate per 100 thousand of population	3662.8	279.4	230.4	34.9
Average age of population, years	43.0	28.2	37.8	7.6
Population density, people per km2	167.5	0.1	588.5	105.9
Unemployment rate, %	27.0	1.4	399.2	55.4
The incidence of active tuberculosis, per 100 thousand population	177.7	20.5	273.7	51.8
HIV incidence, per 100 thousand population	201.8	2.9	383.5	75.5
The number of detected offenses related to the illegal production and trafficking of ethyl alcohol and alcoholic beverages, units per 100 thousand population	709.4	5.2	686.2	88.6

The decisive influence on the mortality rate of working age population in the constituent entities of the Russian Federation is presented by the population density, which characterizes the possibility of providing timely, highly qualified medical care in a region. The high mortality rate of the population by external causes is a consequence of the corresponding level of crime in a region. The prevalence rate of mortality due to circulatory system diseases and malignant tumours is associated with the increase in the average age of population. High mortality rate due to infectious and parasitic diseases is associated with an unfavorable epidemiological situation regarding HIV infection and tuberculosis (Table 3).

Table 03. The results of the assessment of the impact of socio-economic factors on the mortality rate of working-age population due to individual causes of death for the constituent entities of the Russian Federation in 2016

Causes of death	Mortality factors (Correlation coefficient value)
Circulatory diseases (y2)	Crime rate (0.43) Average age of population (0.38) Level of urbanization (0.36) Population density (-0.48)
External causes (y3)	Crime rate (0.78) Incidence of active tuberculosis (0.57) The number of detected offenses associated with the illegal production and trafficking of ethyl alcohol and alcohol products. unit per 100,000 population (0.55) Population density (-0.56)
Malignant tumours (y4)	Average age of population (0.57) Crime rate (0.35) Unemployment rate (-0.41) Population density (-0.39)
The diseases of the digestive system (y5)	Average age of population (0.41) Crime rate (0.38) Unemployment rate (-0.31)
Infectious and parasitic diseases (y6)	HIV incidence (0.79) Incidence of active tuberculosis (0.67)

	Crime rate (0.38)
	The number of detected offenses associated with the illegal production and trafficking of ethyl alcohol and alcohol products. unit per 100,000 population (0.31)
Diseases of the respiratory system (y7)	Crime rate (0.47)
	Average age of population (0.38)
	Population density (-0.37)

Thus, the indicators of the mortality rate of working age population due to individual causes by the constituent entities of the Russian Federation present independent classification characteristics due to various socio-economic factors. According to the authors the mortality rate of working-age population is an integral characteristic of the quality of life of the population in the regions of the Russian Federation.

Then, the clustering of 85 subjects of the Russian Federation in terms of mortality of the working-age population due to the causes of death was carried out, the values of which were standardized and corrected for the values of weight coefficients. At the first stage of cluster analysis, the anomalous objects distilled from a set of classified objects were revealed (Aivazian, Afanasiev, & Kudrov, 2016). The following regions were included in the number of anomalous objects: Pskov Region, Krasnodar Territory, the Republic of Ingushetia, the Chechen Republic, the Chuvash Republic, Samara Region, Khanty-Mansi Autonomous Area, the Republic of Tyva, Irkutsk, Kemerovo, Sakhalin Regions, Jewish Autonomous Region, and Chukotka Autonomous Region. The remaining 72 objects were reclassified with a preliminary recalculation of weighting factors. According to the results of cluster analysis, as well as the qualitative analysis of anomalous objects, five classification groups of regions were identified in terms of mortality rates of working age population. Average values of attributes by groups of regions are presented in table 4.

Table 04. Average values of mortality rates for the population of working age due to the reasons by clusters

Cluster	Average values of classification variables per cluster					
	y_2	y_3	y_4	y_5	y_6	y_7
Cluster 1	129.6	110.5	70.0	37.2	23.2	15.7
Cluster 2	188.2	163.6	89.2	56.3	12.7	27.9
Cluster 3	186.2	173.8	84.2	61.7	34.5	30.5
Cluster 4	176.5	159.9	88.3	49.4	68.8	24.2
Cluster 5	210.9	231.7	91.4	67.1	56.2	38.5

The cluster 1 with a low mortality rate of working age population due to all causes contains 26 entities, including 5 of the number of abnormal ones. The cluster 2 contains 23 entities with low mortality due to infectious and parasitic diseases; the cluster of 3 includes 18 entities with an average mortality rate due to infectious and parasitic diseases, the cluster 4 includes 10 entities with a high mortality rate due to infectious and parasitic diseases. The cluster 5 contains 8 entities out of the number of abnormal and is characterized by a high mortality rate of working age population due to all causes. The composition of the clusters is given in table 5.

Table 05. The results of the assessment of the impact of socio-economic factors on the mortality rate of working-age population due to individual causes of death for the entities of the Russian Federation in 2016

Cluster	Cluster composition
Cluster 1 (26 entities)	Astrakhan Region, Volgograd Region, St. Petersburg, the Kabardino-Balkarian Republic, Kaliningrad Region, the Karachay-Cherkess Republic, Moscow, Moscow Region, Murmansk Region, the Republic of Adygea, the Republic of Dagestan, the Republic of Kalmykia, the Republic of Mordovia, the Republic of Sakha, the Republic of North Ossetia-Alania, the Republic of Tatarstan, Rostov Region, Saratov Region, Stavropol Territory, Tomsk Region, Yamalo-Nenets Autonomous Region, Krasnodar Territory, the Republic of Ingushetia, the Chechen Republic, Samara region, the Khanty-Mansi Autonomous District – Yugra
Cluster 2 (23 entities)	Arkhangelsk Region (without autonomous districts), Belgorod Region, Bryansk Region, Vladimir Region, Vologda Region, Voronezh Region, Kaluga Region, Kamchatka Territory, Kirov Region, Kostroma Region, Kursk Region, Lipetsk Region, Magadan Region, Nenets Autonomous District, Oryol Region, Penza Region, the Altai Republic, the Republic of Karelia, the Komi Republic, the Mari El Republic, Ryazan Region, Tambov Region, Yaroslavl Region
Cluster 3 (18 entities)	Amur Region, Sevastopol, Trans-Baikal Territory, Ivanovo Region, Krasnoyarsk Territory, Leningrad Region, Nizhny Novgorod Region, Novgorod Region, Omsk Region, Primorsky Region, the Republic of Bashkortostan, the Republic of Buryatia, the Republic of Khakassia, Smolensk Region, Tver Region, Tula Region, the Udmurt Republic, Khabarovsk Territory
Cluster 4 (10 entities)	Altai Territory, Kurgan Region, Novosibirsk Region, Orenburg Region, Perm Territory, the Republic of Crimea, Sverdlovsk Region, Tyumen Region (without autonomous districts), Ulyanovsk Region, Chelyabinsk Region
Cluster 5 (8 entities)	Jewish Autonomous Region, Irkutsk Region, Kemerovo Region, Pskov Region, the Republic of Tyva, Sakhalin Region, the Chuvash Republic - Chuvashia, Chukotka Autonomous Region

Thus, the use of two-stage cluster analysis in combination with the methods of descriptive statistics and qualitative analysis allowed us to identify homogeneous classification groups of the entities of the Russian Federation on the level and structure of mortality of working age population due to individual causes.

7. Conclusion

Thus, the constituent entities of the Russian Federation are characterized by disparate living conditions of the population, which leads to significant differences in the level and structure of mortality of working age population (Andreev, Lukiyanova, & Kadyshev, 2017; Bufetova, 2016; Motrich, 2017). The most unfavorable situation has developed in entities with a high mortality rate due to all causes, and infectious and parasitic diseases. These regions are characterized by a high incidence of HIV infection, active tuberculosis, an unfavorable crime situation, and illegal trafficking of alcohol. The reduction of the mortality rate of working-age population in the constituent entities of the Russian Federation is possible with the comprehensive implementation of measures of economic, social, spatial, demographic and security policies.

Acknowledgments

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