The Population Health of a Mining Region as a Factor Affecting the Social and Economic Development of the Area (A Case Study of Kemerovo Region)

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Abstract: The most vital component of human, labour capital, the foundation of public welfare of a country and its regions is population health. Development of Russian regions without taking into account the health factor will be limited in its nature. The study examines the impact of the health indicators of Kemerovo Region’s population on the social and economic development of the region. We used data on morbidity and mortality by main categories of causes, indicators of gross regional product per capita, money income per capita and absolute poverty incidence in Kemerovo Region for 2003–2017. The impact of health indicators on key regional development indicators was studied on the basis of correlation and regression analysis. A statistically significant relationship has been established between the incidence of active tuberculosis, mortality from circulatory system diseases, deaths from external causes and indicators of the social and economic development of Kuzbass. The incidence of active tuberculosis, mortality from suicides and accidental alcohol poisoning has a significant negative impact on the gross regional product. Mortality from circulatory system diseases and accidental alcohol poisoning results in reduction in the level of nominal money incomes of the population. The increase in absolute poverty incidence is significantly affected by mortality from suicides, from accidental alcohol poisoning and all causes of external mortality in the aggregate. The research results can be recommended for use in the strategic planning of the development of the region.

1. Introduction
Successful development of any region implies optimal interaction of social, economic and environmental components. With all the significance of the economic, environmental component, the social component and, above all, its demographic aspects are of particular importance. Population health is a key factor in the formation of demographic processes and in many respects it determines the stability of regional development [1]. The most important asset for the successful functioning and development of the country and its regions are human (intangible) resources [2]. Dynamic
development is impossible without considering health as an essential component of human, labour capital and the quality of living of the population [3].

Population health has a significant impact on the quality of human resources, labour productivity and, as a result, on the social and economic development of regions. Reduction in morbidity and mortality as well as rise in life expectancy leads to an increase in the level of social and economic development. On the contrary, the deterioration of health, the growth of general and primary morbidity, disability incur significant economic losses [4]. According to researchers exploring this issue, in modern conditions, health is becoming a leading factor in social and economic development, given increased demands for the quality of labour and human capital [5].

Under these conditions, studying the peculiarities of the population health influence on the development of regions is relevant. Therefore, further research is necessary to identify the relationship between indicators of morbidity and mortality of the population by various categories of causes and indicators of the social and economic development of regions.

2. The current status of research in the study area

Health is formed and maintained by a complex combination of various factors. Among the determinants that have a direct or indirect impact on the condition of health, researchers commonly distinguish social, structural, economic, cultural, environmental and climatic, hereditary, sanitary and hygienic, psychological, medical and infrastructural, behavioral, and other factors [6, 7, 8]. Many scientists note that the effect of the above determinants on individual and population health, morbidity, mortality, and life expectancy at birth is significantly differentiated depending on gender, age, education, occupation, social and economic status of a person, and the region of residence [9, 10, 11].

According to the calculations of Yu. P. Lisitsyn, the key determinants of health are the lifestyle and living conditions. The expert estimates the contribution of this factor to the condition of health as approximately 50% [12, p. 79]. The results of the studies by V.M. Gilmudtinov, L.K. Kazantsева, and T.O. Tagayeva show that the contribution of environmental factors to the incidence depends on the medical and demographic characteristics of the population and the region of residence and ranges from 11% to 55% [4, p. 40]. O.V. Tretyakova studied the influence of medical infrastructure factors on mortality rates depending on the sex-age composition of the population. On the basis of the results obtained, she concludes that the health of children, adolescents, the elderly, senile age population and the state of the healthcare system are most closely interrelated [13, p. 71]. Studies of N.M. Rimashevskaya, L.A. Migranova, and E.V. Molchanova indicate the presence of a significant correlation between the indicators of the standard of living and those of the population health of various Russian regions [14].

Wilkinson and Pickett [15], Lynch, Smith, and Kaplan [16], and V.S. Tapilina [17] assessed the impact of social and economic inequality on morbidity and mortality rates. O.A. Kisliatsyna studied the interrelation between material deprivation and health. Based on the results, she concludes that poverty (deprivation) does not allow families and households to fully meet basic needs, people also experience negative subjective feelings about their low material status [18]. J.B. Shoven, V.M. Shkolnikov, E.M. Andreev, M. McKee, and D.A. Leon conclude that a decrease in morbidity and mortality as well as a rise in the life expectancy at birth is closely associated with an increase in the social and economic development of a country and its regions [19, 20].

This paper studies the assessment of the impact of morbidity and mortality by individual categories of causes on the indicators characterizing the social and economic development of Kemerovo Region. The relevance of the study is justified by the fact that the population health is a powerful resource capable of ensuring the successful development of Russian regions.

3. Materials and Methods

The study is based on the information borrowed from the official data sources of the Federal State Statistics Service for Kemerovo Region and Russia, available at the compendiums “Statistical Yearbook. Kuzbass” (http://service.kemerovostat.gks.ru/bgd/EJEGOD/Main.htm), “Regions of
Professors of Kemerovo State University and officers of the Federal State Statistics Service for Kemerovo Region acted as experts in selecting statistical indicators used in this study. They used the following criteria for the selection of indicators: the ability of an indicator to comprehensively describe the social and economic development of the territory, the availability of indicators or the possibility to calculate it independently based on public statistics. The statistical indicators selected on the basis of an expert survey were grouped into the following thematic blocks:

- **The health of the regions’ population**: the general incidence of active tuberculosis, the general incidence of alcohol addiction and alcoholic psychosis, mortality from circulatory system diseases, mortality from external causes, mortality from accidental alcohol poisoning and suicide;

- **Social and economic development of the region**: gross regional product (GRP) per capita, money income per capita (MIPC), the number of population with incomes below the regional subsistence minimum (absolute poverty incidence).

The study uses general scientific methods (comparative analysis, synthesis), statistical (generalization and grouping of statistical data) and econometric methods. When modeling the influence of morbidity and mortality indicators in the region on the social and economic development of Kemerovo Region, correlation and regression analysis was applied.

The calculation of Pearson correlation coefficients and building of regression equations were performed with the SPSS Statistics Base application package by IBM.

### 4. Population health and social and economic development of the region

Depopulation processes, an increase in morbidity, a high mortality rate, an unstable dynamics of fertility, a rather low life expectancy at birth are the factors hindering the stable development of many Russian regions. This is completely true for Kuzbass – a mining region of Russia.

Kemerovo region is the largest industrial region of Russia. Currently, Kuzbass accounts for 56% of Russian coal mining, about 80% of coking coal, more than 13% of the pig-iron and steel, 23% of rolled steel, over 11% of aluminum and 19% of coke production (according to the Investment Portal of Kemerovo Region). Nearly century-long dominance of industrial sectors – coal mining and metallurgy – has led to a very high level of environmental pollution. Adverse environmental conditions are complemented by a high proportion of the working-age population engaged in heavy physical labour. This contributes to the growth of the general and primary morbidity of the inhabitants, including occupational diseases, increases the risk of premature mortality, especially, among men of working age. All this determines the relevance of the problem under study.

The decade of 2000s, before the crisis of 2008–2009, was successful enough for Kemerovo Region, with a stable positive dynamics. During this period, gross regional product was growing rather actively, the nominal and real incomes of the population were rising, and the absolute poverty incidence was decreasing. This period was also marked by the positive dynamics of many indicators of population health.

For 2013–2017, many indicators of morbidity and mortality of the population by the main categories of causes have decreased rather notably. The incidence of active tuberculosis decreased by 1.8 times, that of alcohol addiction and alcoholic psychosis – almost 2.2 times, the mortality from circulatory system diseases – by 1.7 times, the mortality among the working-age population fell by 1.6 times, deaths from all external causes – 2.4 times. Differentiating the external causes of lethal outcomes into separate groups, one can observe that the death rate from accidental alcohol poisoning (2.9 times), and from suicides (almost twofold) decreased most intensively. Mortality from external causes in Kuzbass over the past fifteen years has declined substantially, but so far, in fact, this is only a return to the level of the corresponding figure of 1990. Statistical indicators characterizing the population health and social and economic development of the region are summarized in Table 1.
Table 1. Indicators of population health and social and economic development of Kemerovo Region.

| Indicators of population health and social and economic development of Kemerovo Region | The minimum value for 2003 – 2017 | The maximum value for 2003 – 2017 |
|--------------------------------------------------------------------------------------|---------------------------------|---------------------------------|
| The total incidence rate of active tuberculosis, *number of cases per 100,000 of population* | 198                             | 365                             |
| The total incidence rate of alcohol addiction, alcoholic psychosis, *number of cases per 100,000 of population* | 676                             | 1486                            |
| Mortality from circulatory system diseases, *number of cases per 100,000 of population* | 564                             | 970                             |
| Mortality from external causes, *number of cases per 100,000 of population* | 135                             | 329                             |
| including from: |                                                                                      |
| Suicide deaths, *number of cases per 100,000 of population* | 25.6                            | 50.6                            |
| Mortality from accidental alcohol poisoning, *number of cases per 100,000 of population* | 18.0                            | 53.0                            |
| Mortality of the working population, *number of cases per 100,000 of population* | 682                             | 1115                            |
| **GRP per capita, thousand rubles** | **59.36** | **316.26** |
| **Money income per capita, rubles per month** | **4907** | **21849** |
| **Absolute poverty incidence, %** | **9.7** | **15.9** |

Of the seven morbidity and mortality rates for the population of Kemerovo Region, five were selected on the basis of a correlation analysis. The strongest relationship was found between these indicators and gross regional product, average per capita money income, and absolute poverty incidence. The correlation of indicators of regions’ population health and those of social and economic development is presented in Table 2.

Table 2. The relationship between social and economic development and health indicators of the population of Kemerovo Region.

| Health indicators (independent variables) | GRP per capita, Y₁ | Money income per capita, Y₂ | Absolute poverty incidence, Y₃ |
|-------------------------------------------|--------------------|-----------------------------|-------------------------------|
| Coefficient of total incidence of active tuberculosis – X₁ | -.951              | -.713                       | Weak relationship             |
| Mortality from circulatory system diseases – X₂ | -.958              | -.976                       | Weak relationship             |
| Mortality from external causes – X₃ | -.959              | -.970                       | Weak relationship             |
| Suicide deaths – X₄ | -.962              | Weak relationship .577      |
| Mortality from accidental alcohol poisoning – X₅ | -.960              | -.968                       | .562                          |
In the table cells: Pearsons (sig.) is at the value of p<0.05; N= 15.

All independent variables presented in Table 2 have a negative impact on the social and economic development of the region under study. The relationships between the selected population health indicators (X₁–X₅) and gross regional product (Y₁), money income per capita (Y₂), and absolute poverty incidence (Y₃) was determined using a multiple linear regression model.

For each regression equation, a determination coefficient was calculated, which shows how well the model describes the relationship between explanatory and dependent variables. Of the seven models that were built, three were selected that had the highest determination coefficients: 0.954 (health indicators and absolute poverty incidence); 0.969 (health indicators and gross regional product); 0.982 (health indicators and money incomes per capita). The higher the determination coefficient is, the higher the quality of the regression model. Characteristics of the regression equations are presented in Table 3.

Table 3. Characteristics of the regression equations describing the impact of morbidity, mortality on GRP, money incomes per capita and the absolute poverty incidence in the region.

| Health as an impact factor | GRP per capita, Y₁ | Money incomes per capita, Y₂ | Absolute poverty incidence, Y₃ |
|---------------------------|-------------------|------------------------------|-------------------------------|
| Constant                  | 549.103           | 40324.609                    | 16.125                        |
| Coefficient of total incidence of active tuberculosis, degree of impact X₁ on dependent variables | -2.628            | Non-significant impact       | Non-significant impact        |
| Mortality from circulatory system diseases, degree of impact X₂ on dependent variables | Non-significant impact | - 18.866                    | Non-significant impact        |
| Mortality from external causes, degree of impact X₃ on dependent variables | Non-significant impact | Non-significant impact | 1.122                         |
| Suicide deaths, degree of impact X₄ on dependent variables | - 4.710            | Non-significant impact       | 2.350                         |
| Mortality from accidental alcohol poisoning, degree of impact X₅ on dependent variables | - 3.505            | -214.701                    | 1.601                         |

Gross regional product per capita is a generalizing indicator of the efficiency of economic activity in a region. Gross regional product is generated by the work of people employed in various sectors of the economy. In this regard, the most important non-economic indicators affecting the level of the GRP dynamics are the variables related to the population health. The following health indicators have a negative impact on gross regional product: mortality from accidental alcohol poisoning (Sig. 0.013) and the incidence of active tuberculosis (Sig. 0.151). These two indicators significantly affect the reduction in gross regional product, i.e. have a negative impact on the pace of development of the mining region.

The level of nominal and real incomes of the population, their dynamics is an important indicator of the social and economic development of any region. Under the influence of morbidity and mortality, the level of per capita money income decreases. Mortality from accidental alcohol poisoning (Sig. 0.005) and deaths from circulatory system diseases (Sig. 0.151) have a negative impact on the nominal amount of income.

Absolute poverty incidence is one of the main indicators of the social and economic development of a country and regions. The absolute poverty criterion is based on regulatory requirements that define the minimum permissible level of goods and services consumption. Minimum regulatory standards include food, hygiene products, clothing, shoes, durable goods, and services necessary to maintain human health and ensure its vital activity.
High poverty incidence impede the accumulation of human capital and reduce the pace of economic development [21, p.27]. In our case, an indicator calculated by the government statistics service of the Russian Federation was used to estimate the absolute poverty incidence. This is the proportion of people with incomes below the regional subsistence minimum. During the period from 2003 to 2008, the share of absolutely poor people in Kuzbass decreased from 20.2% to 9.7%. For the later period, unstable dynamics was recorded, which was caused in some years by a decrease in the absolute poverty incidence, then growth was recorded again to 15.9%. This study found a significant effect of suicide deaths (Sig. 0.009), accidental alcohol poisoning (Sig. 0.000), and mortality from all external causes (Sig. 0.000) on the increase in absolute poverty incidence.

The analysis conducted made it possible to identify significant causes of morbidity and mortality, which have a negative impact on the social and economic development of Kuzbass. The most significant impact on gross regional product, per capita income of the population, the absolute poverty incidence is made by the mortality from accidental alcohol poisoning. Despite a rather considerable decline in mortality from this cause in recent years, the level of alcohol poisoning in the region exceeds the average national indicator 1.9 times (according to the data for 2017).

The second leading cause of mortality, which has a negative impact on gross regional product and the absolute poverty incidence in Kuzbass, is death from suicides. Suicide mortality is an indicator of the social disadvantage of any region. The problem of suicidal mortality is very relevant for Kemerovo Region, as it leads to a reduction in the number of population, especially the working-age group, and reduces the level of social and economic development. According to the standards of the World Health Organization, the critical level of suicide deaths is 20 cases per 100,000 of population. According to the data for 2017, this indicator in the region exceeded the critical level by 2.53 times [22]. In Kemerovo Region, suicide death rate ranks first within the structure of mortality from external causes. The level of this indicator in the region is 1.8 times as high as the national average (according to the data for 2016). Despite the decrease in this indicator in the region in 2003–2017, the corresponding value is 1.8 times as high as the national average for Russia (according to the data for 2016).

The incidence of active tuberculosis is also a factor acting to hinder the social and economic development of Kemerovo Region. According to the standards of the World Health Organization, the primary incidence rate of 50 cases per 100,000 of population corresponds to the epidemic level. In 2017, in Kuzbass, a similar indicator was 94.5 cases, that is, the established critical level was exceeded by almost 1.9 times. The high overall incidence rate of active tuberculosis significantly reduces the gross regional product per capita. The incidence of active tuberculosis in the mining region is 1.7 times as high as the national average for Russia (according to the data for 2016).

5. Conclusion
In the course of the study, statistically significant causal relationships between mortality and morbidity rates for individual categories of causes and indicators of the social and economic development of the mining region were found. The incidence of active tuberculosis, suicide deaths and accidental alcohol poisoning has a significant negative impact on gross regional product calculated per capita.

Mortality from diseases of the cardiovascular system and accidental alcohol poisoning acts to reduce the level of nominal money incomes of the population in Kuzbass. The increase in absolute poverty incidence is significantly affected by mortality from suicides, accidental alcohol poisoning and all causes of external mortality in the aggregate.

Thus, the results of the study confirmed a strong enough relationship between morbidity, mortality rates and the level of social and economic development of Kemerovo Region. Reduction on mortality from external causes, primarily from alcohol poisoning and suicide, should become one of the priorities in the field of socio-demographic policy. Prevention of the risks of mortality from external causes, from accidental alcohol poisoning, and circulatory system diseases will reduce the negative impact of these factors on the dynamics of the mining region.

Prospects for further research are related to the study of statistical and sociological indicators for several regions in which the mining industry is the main sector of their economy. In addition, it is
advisable to expand the list of health indicators as factors influencing the development dynamics of regions. Additional indicators can include the incidence and disability within different age groups of the population – children under 14 years old, young people from 15 to 29 years old, and the working age population. This will allow us to more fully estimate the impact of morbidity, disability, mortality on the development features of mining regions. The results of the study can be recommended for use in the strategic planning of regional development, in particular, socio-demographic policy.

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