Nat. Volatiles & Essent. Oils, 2021; 8(4): 3742-3750

Multivariate Region Classification In Russia By Average Life Expectancy In The Context Of Sustainable Development

Natalia Sadovnikova[1], Aleksandr Bezrukov[2], Leysan Davletshina[3], Igbal Guliev*[4]

[1] Head of the Department of Statistics, Plekhanov Russian University of Economics, Moscow, Russia

[2]Associate professor of the Department of statistics, Plekhanov Russian University of Economics, Moscow, Russia

[3]Associate professor of the Department of statistics, Plekhanov Russian University of Economics, Moscow, Russia

[4]Associate professor of the International Institute of Energy Policy and Diplomacy, MGIMO University, Moscow, Russia. ORCID: 0000-0002-8667-8132. Corresponding author: guliyevia@bk.ru

Abstract

The article presents the results of multivariate classification of average life expectancy of the population. Clustering was performed using the authors' approach to the selection of indicators, which defines the scientific relevance in the evaluation of regional differentiation by the provided indicator and the connected characteristics. The performed analysis was aimed at revealing the regions under the conditions of significant territorial differentiation of Russian regions by living standards and socioeconomic development that are characterized by significant lagging behind on a regular basis, or suffering a sharp decline in sociodemographic situation, with the purposes of accentuating the measures necessary to be taken to resolve the looming problems not only on the regional but also on the federal level. The significance of the study is defined by the importance of achieving both strategic and global goals of Russia, which appears impossible without the relevant and timely information allowing to accurately define the needs in additional subsidies for regions, bonuses and other assistance.

Keywords: clustering, socioeconomic development, living standards, average life expectancy, population.

[1] Head of the Department of Statistics, Plekhanov Russian University of Economics, Moscow, Russia
[2] Associate professor of the Department of statistics, Plekhanov Russian University of Economics, Moscow, Russia
[3] Associate professor of the Department of statistics, Plekhanov Russian University of Economics, Moscow, Russia
[4] Associate professor of the International Institute of Energy Policy and Diplomacy, MGIMO University, Moscow, Russia. ORCID: 0000-0002-8667-8132. Corresponding author: guliyevia@bk.ru

1. Introduction

The issues of life expectancy and aging in the developed countries are very important as they characterize the economic situation in these countries, allow to forecast the future development of their societies and find the structural problems of demographic policies, that should be solved immediately. In the developing economies life expectancy reflects the successes and failures of their social politics and the effectiveness of the mechanisms of transformation of economic wealth and development into social and public improvements. In this regard, Russia has to estimate both the influence of life expectancy and demographics as a developed and developing economy, as it's the economy in transition. Moreover, the Asian and the European demographic models are mixed in Russia and hence the thorough research on the topic of life expectancy is needed in order to get real information on the demographic situation in the country. In addition to that, the shortening of interregional differentiation and the securing of balanced socioeconomic development of a country's subjects are the priority goals for any country of the world, which is evidenced in one of the most important documents – the global agenda – "2030 Agenda for Sustainable Development" (UN General Assembly, 2015). Among the UN SDGs: Goal 3 – "Ensure healthy lifestyles and promote well-being for all at all ages"— are defined as the vital components of sustainable development; Goal 10 – "Reduce inequality within and between countries" – it is pointed out that the problem of inequality still lingers: there are observed significant differences in the level of accessibility of medical and educational services, as well as other production assets (United Nations, 2020a, 2020b). It proves the significance of the demographic policy, which would contribute to the shortening of the gaps in demographic indicators between different regions of a country, which is of high importance for the countries of federal type of state system, such as Russia, and countries which consist of numerous territories with significant territory sovereignty such as USA, Canada etc.

Let us mark that the questions of increasing the life expectancy and developing the human potential are presently paid significant attention in Russia. The life expectancy is the main characteristic that reflects the results of fulfilling these priorities, which is supported by presidential decrees "In order to implement a breakthrough scientific, technological and socioeconomic development of the Russian Federation, increase the population of the country, improve the standard of living of citizens, create comfortable conditions for their residence, as well as conditions and opportunities for self-realization and disclosure of the talent of each person, I decide: 1. The Government of the Russian Federation to ensure the achievement of the following national development goals of the Russian Federation for the period up to 2024: ...

increasing life expectancy to 78 years (by 2030 – up to 80 years)" (Official Internet Resources of the President of Russia, 2018).

It is also stated as one of the central goals in the concept of long-term socioeconomic development: "The goal of the state demographic policy is to reduce the rate of natural population decline, stabilize the population and create conditions for its growth, as well as improve the quality of life and increase life expectancy" (Rusinova, Panova, & Safronov, 2007, p. 140; the Government of the Russian Federation, 2008). It is accepted to consider that the life expectancy is a demonstrative and persuasive characteristic of health. The people having relatively good health throughout their life would live to deep old ages.

The purpose of the article is to identify the specific features of territorial division of Russian Federation subjects by such a criterion of societal living standards and by the overall socioeconomic development as population life expectancy, so that it's possible to develop a diversified approach to the demographic policy for the regions, characterized by the European and Asian demography types and to estimate the key features of socio-economic policy of the country that require changes. In order to reach this goal, the authors have solved several tasks, namely: classified the regions by life expectancy, clusterized them by the average values of indicators, used for classification, developed measures for the improvement of demographic policies in the clusters.

The significance of the article is characterized by the new approach to the life expectancy issues, based on the analysis of death causes, not the issues of policies and economic problems. Such approach is based on the supposition, that the citizens suffer from the diseases, generated by their surroundings and hence these diseases reflect the major issues in the abovementioned policies.

The novelty of the article includes the new approach to the mortality rates analysis, leading to the better understanding of gaps in the economic and social politics through the results of healthcare system functioning. The theoretical significance of the article encompasses the high importance of the clusterization procedures for the Russian scientific community as the regions' clusterization is rarely used in contemporary analysis of healthcare and economic performance of Russian regions. The practical significance of the article is high, as the achieved results can be included in the state system of demographic planning and in the government social development strategies. In addition to that, the results can be introduced in the state control and monitoring system, allowing to pinpoint the problem spheres in regional social and economic policies.

2. Literature Review

The problem of life expectancy is one of the most discussed in the scientific community; in the Scopus database in socioeconomic journals there are more than 2000 papers with the keyword "life expectancy". The authors have divided all the found and analyzed works into three major groups.

The first group includes the works like the following ones. Miladinov (2020) discussed the relationship between socioeconomic development and life expectancy in the EU candidate countries and compared the causes of specific life expectancy in European countries. Another article underlying this comparison is (Soboleva et al., 2020), but the main problem of this article is the narrow field of study, since it is focused on Siberia. In (Kossova, Kossova, & Sheluntcova, 2020), authors focused on the destructive role of alcohol, overlooking social and economic reasons that reduce life expectancy, their approach is unable to explain the dynamics of life expectancy in Russia. The described gap is highlighted in (Barinova & Zemtsov, 2020), however, the authors did not focus on life expectancy, covering a wide range of demographic issues. All the mentioned articles are of a narrow field of research – they do contribute to the development of the approach, narrowing the life expectancy gap, but miss out such important factors as medical and healthcare issues.

The second groups encompasses the works, devoted to similar themes as the following. The central aspect of discussions of inequality is the population living standards is a complex category that can be considered by many parameters, both by indicators of population income and expenditures (López Rodríguez & Barac, 2019) and by sociodemographic development characteristics (education, healthcare, population reproduction, etc.) (Murawska, Mickiewicz, Zajdel, & Michalcewicz-Kaniowska, 2020). Both sources present the highly valuable implications for this article, especially the findings in the field of medical and healthcare reasons for different mortality rates, presented in the second source, but at the same time, these sources analyze the countries with relatively low differentiation in life expectancy by regions and a single demographic policy, missing out the effects of federal state system on this parameter.

The major criterions, presented in this article have been found in several works, namely: societal living standards (Ericson, 2008), where the authors have made conclusion on the life expectancy as the derivative of living standards; overall socioeconomic development (Mau, 2018), which states that the higher is the development of economy, the longer the citizens of the country live (which is doubtful if analyzing the developing economies), and in (Solanko, 2020), which is devoted more to the estimation of Russian policies, than to the analysis of the reasons for differentiation in life expectancy. The mentioned works include healthcare as one of the parameters, characterizing life expectancy, but don’t figure out its significance and value for the analysis of life expectancy through death causes.

The third group includes normative acts and their analysis, such as in the works hereinafter. The solution of the healthcare tasks in the conditions of constant growth of expenditures on medical care: the thorough volume of financing is stated in the state program “Public Healthcare development” (Shishkin & Vlassov, 2009; the Government of the Russian Federation, 2017) would allow to attain a substantial improvement of population health and demographic indicators, reduce the mortality ratios as well as for the able-bodied population category, increase the life expectancy for the country in total and in its regions.

The sources, that have been found by the authors, are divided into three major groups, characterizes above: the ones, stating narrow field of research for specific regions or issues, the ones characterizing healthcare as an element of analysis for life expectancy and the ones, characterizing healthcare issues as the reasons for lower life expectancy. In this regard, the article fills the gap and proposes a new approach to healthcare analysis in the framework of life expectancy.

3. Methodology

High dynamics of modern development of socioeconomic events and processes, their multiaspect nature and broad possibilities of evaluation upon a wide array of indicators lead to the necessity of application of multivariate statistical methods. The notion of “multivariate statistical analysis” includes a wide spectrum of methods and procedures such as the multiple regression, the factor analysis, the cluster analysis and other. The transformation of the purpose of this article into a specific statistical task allows to formulate it as follows: break down the multitude of the studied objects into a relatively small number of homogeneous groups by the life expectancy of the population in such a way that every object would only belong to one group. The objects belonging to one group must be similar, and the objects belonging to different groups must therefore be dissimilar. The number of groups is not known in advance.

The most adequate method for the set goals in this case is the application of the cluster analysis instruments because it is clustering that allows to dissect the studied population of objects upon a number of indicators into homogeneous unknown target groups and analyze a significant volume of information, and present the data arrays in a more depictive way. Moreover, the content-analysis of clustering procedures use in the modern statistical surveys performed by Ilyshev M.M. and Shubat O.M. (2010, p. 35) allows to state that “... the practice of applying multidimensional methods to various socioeconomic aggregates has shown their effectiveness and the possibility of obtaining highly analytical scientific and practical results obtained in the course of economic and statistical research”.

Let us mark that the choice of the clustering method in a number of cases is determined by the specifics of the initial data and the statistical research goals.

It is known that traditionally the cluster analysis methods are divided into hierarchical and non-hierarchical. The first group of methods allows to form the clusters by means of dendric data structure, while by calculation method it is divided into agglomerative (uniting) and divisive (dissecting) clustering. This method, however, is considered laborious and requires a good amount of mathematical computations, therefore it is recommended to be applied for relatively small samples (Ashley, 2012; Everitt, Landau, Leese, & Stahl, 2011; Galbraith & Jiaqing, 2001; Ilyshev & Shubat, 2010; Maher, 1990; Pinter, Madeira, Vieira, Majzik, & Pataricza, 2008; Usman, Asghar, & Fong 2009).

The second group of methods assumes that initially the number of clusters that the data will be divided into is known. The centers of the given clusters are defined and followingly the objects within certain border value limits are united into one or another cluster. The unconditional advantage of non-hierarchical methods is the possibility of using them for large sample sizes. Both groups of methods, however, have their own drawbacks.

Among the main problems in the application of non-hierarchical methods the specialists commonly point out the following: the need to know the number of clusters and the independency of cluster centers selection. Consequently, the clustering results are dependent on the order of cluster centers selection. Additionally, the cluster results depend upon the order of observations in the data. Moreover, some of these methods are relatively sensitive to non-typical values of the studied population and significantly react on the “outliers” as the latter may substantially distort the means and shift the cluster centers (Ilyshev & Shubat, 2010). From the economy standpoint, however, it is nonsensical to carry out the procedure of “cleaning” or refining the data, as the presence of certain outliers is consistent with and is a distinguishing feature of a studied process.

All above-mentioned proves the practicality of joint use of hierarchical and non-hierarchical methods while carrying out the classification procedure:

at the preliminary stage of the analysis the research used the hierarchical methods to identify the number of clusters and cluster centers;

at the second stage the non-hierarchical methods were applied, for which the number of clusters or centroids is equal to the preliminary stage results.

This approach enabled to not only reduce the laboriousness but also increased the confidence degree of the study.

The scientific novelty of the research is contained in the presentation of the results of the authors-constructed model of the regions of Russia dependence on the population life expectancy

and the homogeneous parameters defining it, that would enable to form the homogeneous typological classes and identify the "problematic" regions.

In the context of targeting the public policy at the realization of the principle of reducing the socioeconomic differentiation of regions and the achievement of UN SDGs the performed analysis therefore possesses inarguable practical significance.

The authors used the following method of classification of the Russian regions. For the basis of the classification there were used the characteristics: the integral living standards characteristic – the life expectancy, and the indicators characterizing the mortality level by the causes.

The resulting set of variables for the classification is as follows:

x_1 – life expectancy at birth, years;

Mortality rates of the population of working age by main classes of causes of death per 100,000 persons of working age:

x_2 – from some infectious and parasitic diseases;

x_3 – from neoplasm;

x_4 – from diseases of the circulatory system;

x_5 – from respiratory diseases;

x_6 – from diseases of the digestive system;

x_7 – from external causes of death.

The infectious and parasitic diseases high volume indicates the low quality of food and water, along with low hygiene and low income, high volume of neoplasm indicates bad ecology and low density of medical service per capita, the diseases of circulatory system the overall mortality rate in the country tendencies, the high volume of respiratory diseases shows the poor state of medical treatment and the low income, along with high influence of traditions on the society, the diseases of digestive system – the low quality of food, bad hygiene, low income and high population density, bad situation on the labor market with low quality of medical service, and external causes of death indicate high poverty, bad situation on labor market and high crime environment. Such suppositions are made based on the reasoning of death cases through the most often met causes of death and social and economic problems, revealed in literature, mentioned above and (Starodubov et al., 2018; Timonin, Danilova, Andreev, & Shkolnikov, 2017).

After clustering, the authors analyzed the statistics on the presented hereabove indicators, using standard methods of statistics – mod and median classification. It allowed to give the recommendation on the practical implementation of the clustering method, so that in accordance with the deviation the regions could assess the efficiency of their politics in the demographics.

4. Results

Presently, by an array of indicators characterizing the demographic situation in our country we are observing certain improvements. Thus, on average for a period of years 2000 to 2018 the life expectancy at birth in Russia is annually increasing by 0.44 years: this indicator is increasing by 0.5 years for men and by 0.32 years for women. In 2018 the life expectancy at birth was 67.75 years for men and 77.82 years for women.

The life expectancy is one of the leading characteristics that are included in the calculation of the human potential development index, that in its own term is the main integral characteristic if international and interregional comparisons of living standards and life quality. The living standards of the population are characterized by the average life expectancy on the country level as well as on separate regions level. The life expectancy changes are commonly consequential to carrying out social, economic and political reforms and the changes of society ideologies.

The negative factors impacting the demographic situations include the structural changes caused by the reducing number of reproductive women aged 20–29 years with the concurrent increase of the women cohort aged 30–39, and the tendency to delay the firstborn birth for later years.

Still, the indicators, given in the demographic programs for the development of the Russian Federation are unachieved. In this regard it's necessary to classify the regions by life expectancy in order to give recommendations on the diversified demographic policy development in Russia.

The classification performed upon the regions of Russia by the characteristic of life expectancy of the population and the main parameters defining it enabled to identify the country subjects with anomalous characteristics of mortality in the years 2000 and 2018.

The number of clusters identified upon the study of the indicators that were used as the basis of the classifications and the visual analysis of the clustering results by various methods (the preliminary stage of cluster analysis). As the result, clustering the regions of Russia was performed by the K-means method into 5 clusters that enabled to receive more detailed characteristics of the existing territorial differences in mortality.

Clustering with the use of 2000 data identified a significant level of differentiation by life expectancy and mortality of the population by regions of Russia (Table 1).

Table 1. The classification of Russian regions by life expectancy in 2000

Cluster No.	Number of regions	Cluster composition

Cluster No.	Number of regions	Cluster composition
1	8	Republic of Kalmykia, Republic of Dagestan, Republic of Ingushetia, Tyumen Region, Khanty-Mansiysk Autonomous Okrug - Yugra, Yamalo-Nenets Autonomous Okrug, Republic of Sakha (Yakutia), Chukotka Autonomous Okrug
2	29	Moscow, Kaliningrad Region, Murmansk Region, Astrakhan Region, Kabardino-Balkar Republic, Karachay-Cherkess Republic, Republic of North Ossetia-Alania, Stavropol Territory, Republic of Bashkortostan, Republic of Mari El, Republic of Tatarstan, Udmurt Republic, Chuvash Republic, Orenburg Region , Kurgan Region, Chelyabinsk Region, Republic of Khakassia, Altai Territory, Trans-Baikal Territory, Krasnoyarsk Territory, Irkutsk Region, Novosibirsk Region, Omsk Region, Tomsk Region, Primorsky Territory, Khabarovsk Territory, Amur Region, Sakhalin Region, Jewish Autonomous Region
3	19	Belgorod Region, Voronezh Region, Moscow Region, Yaroslavl Region, Republic of Karelia, Arkhangelsk Region, Vologda Region, St. Petersburg, Republic of Adygea, Krasnodar Region, Volgograd Region, Rostov Region, Perm Region, Orenburg Region, Kirov Region, Samara Region, Saratov region, Ulyanovsk region, Sverdlovsk region, Kemerovo region
4	19	Bryansk Region, Vladimir Region, Ivanovo Region, Kaluga Region, Kostroma Region, Kursk Region, Lipetsk Region, Oryol Region, Ryazan Region, Smolensk Region, Tambov Region, Tver Region, Tula Region, Leningrad Region, Novgorod Region, Pskov Region, Republic of Mordovia, Nizhny Novgorod region, Penza region
5	7	Republic of Komi, Nenets Autonomous District, Republic of Altai, Republic of Buryatia, Republic of Tyva, Kamchatka Territory, Magadan Region

The first group of regions unites 8 subjects of the Russian Federation that are characterized by the highest values of the average life expectancy in the year 2000 (on average the life expectancy by cluster is 69.35 years), which indicates low mortality in contrast to other regions not included in

this cluster. The low mortality is indicated both in overall and by separate characteristics defining its level.

The first group is characterized by a high level of rural population and a traditional way of life. The second group includes low-urbanized regions (except for Moscow) with an average level of medicine, and the third and fourth groups are urbanized. The level of social services in the third group is higher than in the fourth (which follows from the assumption of the high importance of social, especially medical, services in life expectancy). The fifth group is similar to the first in terms of urbanization, but the main difference lies in the average wealth of these regions: the first group represents, on average, the richer regions, and the last group is less economically developed than the first (Rese, Balabanova, Danishevski, McKee, & Sheaff, 2005).

Table 2. Average cluster levels by indicator

Indicator	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Life expectancy at birth, years	69.3	66.6	66.3	62.8	56.1
Mortality rate of the population from some infectious and parasitic diseases (per 100,000 persons)	13.3	36.7	21.5	23.8	93.8
Mortality rate of the population from neoplasms (per 100,000 persons)	60.1	221.8	208.6	243.7	116.0
Mortality rate of the population from diseases of the circulatory system (per 100,000 persons)	198.1	697.6	1075.7	1356.8	440.3
Mortality rate of the population from respiratory diseases (per 100,000 persons)	20.3	92.6	68.0	99.4	80.1
Mortality rate of the population from diseases of the digestive system (per 100,000 persons)	20.9	32.8	35.9	49.9	67.0
Mortality rate of the population from external causes (per 100,000 persons)	184.8	191.2	233.6	314.4	435.0

The second and the third groups include 48 regions and are the largest groups among the clusters. The life expectancy in these clusters is slightly above the overall Russian Federation level in 2000 which was 65.27 years, while at the same time the clusters themselves differ only by 0.3 years.

The fourth group includes 14 regions and is characterized by life expectancy 62.81 years which is below the overall Russian level, and possess relatively high mortality levels.

The last group includes 7 subjects of Russian Federation. These regions are characterized by very adverse demographic situation that indicates shorter life expectancy. It is necessary to specifically point out the distinctive population mortality level from external causes in this group, that states that there are 435 deaths per 100000 population in each of these regions.

The overall lower development of Russia's healthcare system (Vertakova & Vlasova, 2014) does not explain the high deviation of the fifth cluster, the main reasons lie in the field of the unequal distribution of healthcare in Russia.

The differentiation of mortality in 2018 allows to obtain the following results (Table 3).

Table 3. The classification of Russian regions by life expectancy in 2019

Cluster No.	Number of regions	Cluster composition
1	5	Republic of Dagestan, Republic of Ingushetia, Chechen Republic, Khanty-Mansi Autonomous Okrug-Yugra, Yamalo-Nenets Autonomous Okrug
2	33	Voronezh Region, Ivanovo Region, Lipetsk Region, Moscow Region, Tambov Region, Yaroslavl Region, Moscow, Komi Republic, Kaliningrad Region, Leningrad Region, Murmansk Region, Krasnodar Region, Astrakhan Region, Rostov Region, Republic of North Ossetia-Alania, Republic Bashkortostan, Republic of Mari El, Republic of Mordovia, Republic of Tatarstan, Udmurt Republic, Nizhny Novgorod Region, Orenburg Region, Samara Region, Kurgan Region, Chelyabinsk Region, Republic of Khakassia, Altai Territory, Irkutsk Region, Kemerovo Region, Tomsk Region, Kamchatka Territory, Primorsky Territory , Khabarovsk Territory, Magadan Region
3	5	Oryol region, Tver region, Novgorod region, Pskov region, Republic of Crimea
4	25	Belgorod Region, Bryansk Region, Vladimir Region, Kaluga Region, Kostroma Region, Kursk Region, Ryazan Region, Smolensk Region, Tula Region, Republic of Karelia, Arkhangelsk Region, Vologda Region, St. Petersburg, Republic of Adygea, Volgograd Region, St. Sevastopol, Stavropol Territory, Perm Territory, Kirov Region, Penza Region, Saratov Region, Ulyanovsk Region, Sverdlovsk Region, Novosibirsk Region, Jewish Autonomous Region
5	17	Nenets Autonomous District, Republic of Kalmykia, Kabardino-Balkar Republic, Karachay-Cherkess Republic, Republic of Mordovia, Chuvash Republic, Tyumen Region, Altai Republic, Altai Republic, Buryatia Republic, Tyva Republic, Transbaikal Territory, Krasnoyarsk Territory, Omsk Region, Sakha Republic (Yakutia), Amur Region, Sakhalin Region, Chukotka Autonomous District

The first group includes five regions with the highest life expectancy levels and low mortality coefficients, while in comparison with the leading cluster in 2000 the life expectancy increased by more than 9 years, as well as the mortality ratios reduced, for example, from external causes to 33.85 people per 100000 population from 184.8 people per 100000 in the year 2000 for the first cluster.

Table 4. Average cluster values by indicator

Indicator	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Life expectancy at birth, years	78.9	72.0	70.5	70.3	68.8
Mortality rate of the population from some infectious and parasitic diseases (per 100,000 persons)	9.2	24.2	22.1	16.4	33.6
Mortality rate of the population from neoplasms (per 100,000 persons)	67.1	207.2	214.1	238.7	138.1
Mortality rate of the population from diseases of the circulatory system (per 100,000 persons)	178.4	534.3	744.7	1019.2	352.6
Mortality rate of the population from respiratory diseases (per 100,000 persons)	12.8	46.1	51.6	62.7	39.4
Mortality rate of the population from diseases of the digestive system (per 100,000 persons)	12.5	74.6	76.8	86.1	63.5
Mortality rate of the population from external causes (per 100,000 persons)	33.85	104.8	117.9	118.2	167.5

Just as in 2000, the first cluster in 2018 includes the regions Republic of Dagestan, Republic of Ingushetia, Khanty-Mansiysk Autonomous Okrug-Yugra, Yamalo-Nenets Autonomous Okrug, but, in 2018 the Chechen Republic is also included due to the reason that its indicators were not participating in clustering in 2000.

The second group is the most numerous, and includes 33 regions, with life expectancy 0.7 years below the overall Russian country level.

The third and the fourth groups include 30 regions combined. The life expectancy in these clusters is below the overall Russian Federation level, while these clusters are different only by 0.2 years in life expectancy, however, the 4th cluster is very distinctive by high population mortality from circulatory system diseases, where this characteristic amounts to 1019.2 people per 100000 population.

The fifth group contains 17 Russian Federation subjects, these regions are characterized with shorter life expectancy. It is worth mentioning that since 2000 the life expectancy in the cluster with the lowers values of it increased by 12.7 years, while the mortality from external causes reduced by 2.6 times or by 267.5 people per 100000 population.

In general, the situation remains the same, which allows to conclude that the healthcare and social services system in Russia did not change significantly, or at least the changes were insignificant, and the healthcare reform carried out in Russia is not efficient to the required extent.

5. Discussion

The realization of the necessity for a shift from “the dead center” on the level of strategic development objectively forcedly forecast into the future, project and construct its more favorable parameters that were determined in May 2018 and define the vectors of the strategic development of Russia to 2024, among which besides some economical goals there are specified the sociodemographical ones. According to the Executive Order "On National Goals and Strategic Objectives of the Russian Federation through to 2024", the Government of the Russian Federation is obliged to ensure the achievement of an increase in life expectancy to 78 years (by 2030 – to 80 years) (Official Internet Resources of the President of Russia, 2018). This goal formed the basis for the development of the national project "Demography" (Ministry of Labour and Social Protection, 2018).

For the beginning of July 2020 Rosstat disseminated the preliminary evaluation of life expectancy at birth.

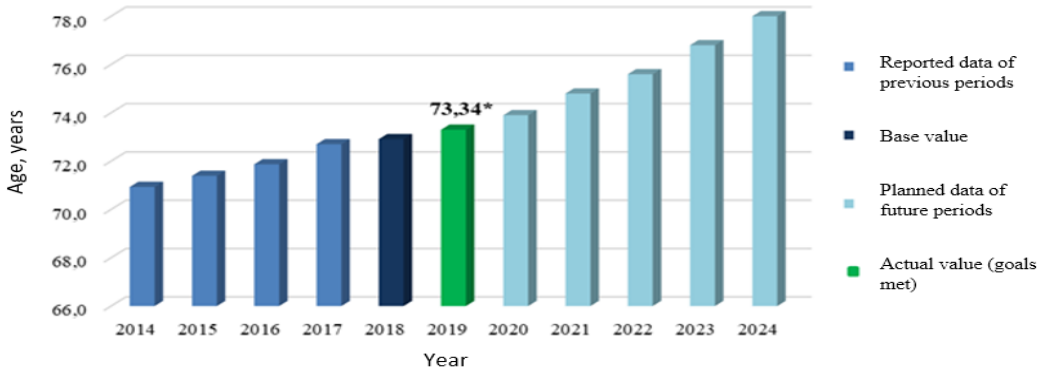

Figure 1: The dynamics of life expectancy of Russians, actual values for the years 2014 to 2019 and planned values according to the national project for the years 2020 to 2024

Source: Accounts Chamber (2020), Rosstat (2017).

In accordance to the data of the Accounts Chamber (2020) the planned life expectancy at birth in 2019 was 73.2 years. The plan fulfillment indicator for this characteristic is 100.19%.

As of September 2020, the data of life expectancy in 2019 in regional dissection have not yet been disseminated.

In context of the performed study and with the account of active public policy aimed at increasing the life expectancy of the population, we recommend to perform in the foreseeable future clustering displayed in this article, that would enable the comparison of results and define the efficiency of measures taken in this area. Such comparison is also highly useful when comparing the regional performance and assessing the efficiency of regional social and economic policies, especially in the regions with higher autonomy (such as “kray”, republic, autonomous oblast, federal city etc.)

In this regard, the regulation policy can be assessed by the parametric method of results achievement. As on the situation today, the final indicators, taken as the goals in the Executive Order "On National Goals and Strategic Objectives of the Russian Federation through to 2024", the indicator of the life expectancy is just one of the necessary system of indicators. The authors propose the introduction of the more complex system of healthcare financing estimation – the indicators of mortality and birth expectancy, used in the cluster analysis and the use of the proposed clusters in order to compare the functionality of the system of healthcare support. Furthermore, the proposed system allows to figure out, which sector of healthcare in the region functions in the worst way – through the system of mortality by causes indicators.

The introduction of the differentiated system of state measures, aimed at the support of the social or medical services in the region, according to the mortality rate and to the cluster analysis,

developed by the authors in this article, looks as the most effective measure of the state policy in the discussed field today.

In addition to the mentioned, the analysis of the mortality rates from the different factors, used in the analysis allows to interconnect the healthcare politic of the country with social and economic policies, forming a unified approach to solving the demographic issues in Russia.

6. Conclusion

Over the last few years, the socioeconomic processes were defined by the characteristic of "stagnation", while the lead scientists are concurrent in the opinion that stagnation is harder to escape than crisis.

The most relevant are the results of the cluster analysis performed for 2018, that indicated the overall favorable regions with higher life expectancy characteristics and low mortality, which are the regions of the first cluster, and the regions with higher mortality and consequentially shorter life expectancy, which are the regions of the fifth cluster. It is worth noting that there have occurred significant changes in comparison to the base year (2000): the life expectancy significantly improved for all clusters, the "outsider" cluster lagging behind it shortened from 9.13 years to 3.9 years. The situation significantly declined in the Republics of Kalmykia, Sakha (Yakutia) and Chukotka Autonomous Okrug, these regions moved from the first cluster (2000) into the fifth cluster (2018) with the shortest life expectancy. In the regions Nenets Autonomous Okrug, Altai Republic, Buryatia, Tyva the average life expectancy increased, while the mortality coefficients reduced, however, they still lag behind the overall country level for the base and the reporting year, as these regions were placed into the fifth cluster. This lagging being systematic or sharp decline in demographic situation states that there is need for measures taken for solving these problems not only on the regional but also on the federal level, as well as additionally subsidizing these regions and taking the measures of bonuses and assistance.

It is also important to note that the nearest perspective appears to state the increase of life expectancy, but it is necessary to further develop the legislation and advance the medical system. Significant reduction in mortality and increase of life expectancy can be achieved by deep changes not only in individual behavior of man but also in terms of society and government treatment of health and life of people, which currently is reflected in gradual increase in healthcare expenditures.

The most significant measure to be taken is the coordination of economic and social politics on federal and regional level with regard to the better living conditions and standards, the estimation of the effectiveness of which is to be conducted by the death causes analysis. This will

lead to closing the gap between the richest and the poorest regions in Russia and will contribute to the fulfillment of the UN Sustainable Development Goals.

Funding

This research was conducted in the framework of the state task in the field of scientific activity of the Ministry of Science and Higher Education of the Russian Federation, project "Development of the methodology and a software platform for the construction of digital twins, intellectual analysis and forecast of complex economic systems", grant no. FSSW-2020-0008.

Conflicts of Interest

The authors declare no conflict of interest.

References

Accounts Chamber. (2020). Increase in life expectancy to 78 Years (up to 80 Years by 2030) as of September 7, 2020. Retrieved from https://ng.ach.gov.ru/en/nt-002-report

Ashley, R. A. (2012). Fundamentals of applied econometrics. 1st ed. Hoboken, NJ: Wiley.

Barinova, V. A., & Zemtsov, S. P. (2020). Inclusive growth and regional sustainability of Russia. Regional Research of Russia, 10(1), 10–19. https://doi.org/10.1134/S2079970520010025

Ericson, R. E. (2008). The Russian economy: from Lenin to Putin. Comparative Economic Studies, 50(4), 713–16. https://doi.org/10.1057/ces.2007.37

Everitt, B., Landau, S., Leese, M., & Stahl, D. (2011). Cluster Analysis. 5th ed. Wiley Series in Probability and Statistics. Chichester, West Sussex, UK: Wiley.

Galbraith, J. K., & Jiaqing, L. (2001). Cluster and discriminant analysis of time series as a research tool. In: J. K. Galbraith & M. Berner (Eds.), Inequality and industrial change: a global view (pp. 280–286). Cambridge, UK: Cambridge University Press.

The Government of the Russian Federation. (2008). Concept of long-term socio-economic development of the Russian Federation until 2020, approved by the Governmental Decree of November 17, 2008 No. 1662-r. Retrieved from http://government.ru/info/6217/

The Government of the Russian Federation. (2017). State program “Public healthcare development”. Retrieved from https://programs.gov.ru/Portal/programs/passport/01

Ilyshev, A. M., & Shubat, O. M. (2010). Multidimential classification of data: methods, analysis of practice and perspectives of implementation. Voprosy Statistiki, 10, 34–39.

Kossova, T., Kossova, E., & Sheluntcova, M. (2020). Gender gap in life expectancy in Russia: the role of alcohol consumption. Social Policy and Society, 19(1), 37–53. https://doi.org/10.1017/S1474746419000058

López Rodríguez, M. I., & Barac, M. (2019). Inequality of Spanish household expenditure for the 2006–2016 period — are we converging?" Economy of Region, 15(3), 780–790. https://doi.org/10.17059/2019-3-12

Maher, C. A. (1990). Statistical analysis tools for learning in engineering laboratories. European Journal of Engineering Education, 15(3), 223–231. https://doi.org/10.1080/03043799008939479

Mau, V. (2018). Russian economic policy: challenges of growth. Russian Journal of Economics, 4(2), 87–107. https://doi.org/10.3897/j.ruje.4.27743

Miladinov, G. (2020). Socioeconomic development and life expectancy relationship: evidence from the EU accession candidate countries. Genus, 76(1), 2. https://doi.org/10.1186/s41118-019-0071-0

Ministry of Labour and Social Protection. (2018). National Project "Demography". Retrieved from https://mintrud.gov.ru/ministry/programms/demography

Murawska, A., Mickiewicz, B., Zajdel, M., & Michalcewicz-Kaniowska, M. (2020). Multidimensional analysis of the relationship between sustainable living conditions and long and good health in the European Union countries. European Research Studies Journal, 23(3), 716–735. https://doi.org/10.35808/ersj/1664

Official Internet Resources of the President of Russia. (2018). The President signed Executive Order on national goals and strategic objectives of the Russian Federation through to 2024. Retrieved from http://en.kremlin.ru/events/president/news/57425

Pinter, G., Madeira, H., Vieira, M., Majzik, I., & Pataricza, A. (2008). Integration of OLAP and data mining for analysis of results from dependability evaluation experiments. International Journal of Knowledge Management Studies, 2(4), 480–498. http://dx.doi.org/10.1504/IJKMS.2008.019753

Rese, A., Balabanova, D., Danishevski, K., McKee, M., & Sheaff, R. (2005). Implementing general practice in Russia: getting beyond the first steps. BMJ, 331(7510), 204–207. https://doi.org/10.1136/bmj.331.7510.204

Rosstat. (2017). Russia in figures. 2017: Statistical handbook. Moscow, Russia: Federal State Statistics Service.

Rusinova, N. L., Panova, L. V., & Safronov, V. V. (2007). Life expectancy in the regions of the Russian Federation: the importance of economic factors and the social environment. Journal of Sociology and Social Anthropology, 10(1), 140–161.

Shishkin, S. V., & Vlassov, V. V. (2009). Russia's healthcare system: in need of modernization. BMJ, 338, b2132. https://doi.org/10.1136/bmj.b2132

Soboleva, S. V., Smirnova, N. E., Chudaeva, O. V. (2020). Changes in the number and age–sex structure of the population of the Siberian Federal District and its regions in 1989–2017: assessment of consequences and risks. Regional Research of Russia, 10(2), 220–234. https://doi.org/10.1134/S2079970520020136

Solanko, L. (2020). From reforms to stagnation – 20 years of economic policies in Putin's Russia. BOFIT Policy Brief 2020 No. 1. Bank of Finland; Institute for Economies in Transition. Retrieved from https://helda.helsinki.fi/bof/bitstream/handle/123456789/16548/bpb0120.pdf?sequence=1

Starodubov, V., Marczak, L. B., Varavikova, E., Bikbov, B., Ermakov, S. P., Gall, J., Glenn, S. D., Griswold, M., Idrisov, B., Kravchenko, M., Lioznov, D., Loyola, E., Rakovac, I., Vladimirov, S. K., Vlassov, V., Murray, C. J. L., & Naghavi, M. (2018). The burden of disease in Russia from 1980 to 2016: a systematic analysis for the global burden of disease study 2016. Lancet, 392(10153), 1138–1146. https://doi.org/10.1016/S0140-6736(18)31485-5

Timonin, S., Danilova, I., Andreev, E., & Shkolnikov, V. M. (2017). Recent mortality trend reversal in Russia: are regions following the same tempo? European Journal of Population, 33, 733–763. https://doi.org/10.1007/s10680-017-9451-3

UN General Assembly. (2015). Resolution A/RES/70/1 adopted by the General Assembly on 25 September 2015: Transforming our world: the 2030 Agenda for sustainable development. Retrieved from https://undocs.org/A/RES/70/1

United Nations. (2020a). The sustainable development goals. Goal 3: ensure healthy lives and promote well-being for all at all ages. Retrieved from https://www.un.org/sustainabledevelopment/health/.

United Nations. (2020b). The sustainable development goals. Goal 10: reduce inequality within and among countries. Retrieved from https://www.un.org/sustainabledevelopment/inequality/.

Usman, M., Asghar, S., & Fong, S. (2009). A conceptual model for combining enhanced OLAP and Data Mining Systems. In: 2009 Fifth International Joint Conference on INC, IMS and IDC, Seoul, South Korea (pp. 1958–1963). IEEE. http://dx.doi.org/10.1109/NCM.2009.354

Vertakova, J., & Vlasova, O. (2014). Problems and trends of Russian health care development. Procedia Economics and Finance, 16, 34–39. https://doi.org/10.1016/S2212-5671(14)00771-0