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Mortality differentiation by regions, cities of different population sizes and rural areas in Russia

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Problem statement

The problem of Russia's significant lagging behind the leading countries in terms of life expectancy, noticed at the highest state level[1], does not lose its relevance (especially in light of the huge loss of person-years of life in 2020 caused by the Covid-19 pandemic[2]), closely intertwined with challenges posed by high levels of inequality. 'Inequality in the face of death' is rightly perceived as one of the most acute types of social inequality[3]. The right to health and equal access to health care are enshrined in the basic law and regulations of a large number of countries[4]. Any manifestations of inequality in mortality by both ascribed (sex, race, ethnicity) and achieved (education, income) status, attract the attention of researchers[5] and the general public[6]; their elimination or minimization are declared priority goals by public health policy[7]. At the same time, the study of the range of inequality allows us to identify areas/population groups with very high mortality, the reduction of which to the level shown in the vanguard population can significantly reduce overall mortality in the entire population.

The problem of the high mortality rate of the Russian population is closely related to the inequality of mortality based on sex, level of education, financial situation (level of income or volume of assets), ethnic origin or place of residence. The latter is especially relevant for a country with the largest territory in the world, which sets the task of sustainable and balanced spatial development aimed at reducing interregional differences in the level and quality of life of the population[8].

[1] The Presidential Order of May 7, 2018 'On National Goals and Strategic Objectives of the Russian Federation through to 2024'.
[2] Webinar "The first year of the COVID-19 pandemic in Russia (April 2020 - March 2021)" URL: https://demogr.hse.ru/en/news/478713772.html
[3] Sen A. Mortality as an Indicator of Economic Success and Failure // The Economic Journal, 1998, 108(446), 1–25.
[4] Rosevear E., Hirschl R., Jung C. Justiciable and Aspirational Economic and Social Rights in National Constitutions. In K. Young (Ed.), The Future of Economic and Social Rights (Globalization and Human Rights, pp. 37–65), Cambridge: Cambridge University Press, 2019.
[5] Elo I. T., Preston S. H. Educational differentials in mortality: United States, 1979–1985, Social Science & Medicine, 1996, 42(1), 47-57.
[6] The guardian. Ethnic minorities dying of Covid-19 at higher rate, analysis shows. URL: https://www.theguardian.com/world/2020/apr/22/racial-inequality-in-britain-found-a-risk-factor-for-covid-19.
[7] Center of American Progress. Eliminating racial disparities in maternal and infant mortality URL: https://www.americanprogress.org/issues/women/reports/2019/05/02/469186/eliminating-racial-disparities-maternal-infant-mortality/.
[8] Spatial development strategy of the Russian Federation for the period up to 2025.

The centralization of the country and the growth of core-periphery disproportions in the development of territories after the dismantling of the socialist command system led to a significant increase in spatial differentiation in life expectancy between Moscow and the rest of the country[9], between regional centers, other major cities and the "periphery"[10], between European and Asian parts of the country, between Southern and Northern Russia[11].

The study of core-periphery differences in mortality, their magnitude, dynamics (convergence or divergence), the contribution of age groups and causes of death, as well as the identification of the main factors that determine spatial differentiation in mortality rates in Russia during 2004-2019 (that were characterized by a steady increase in life expectancy at birth[12]), will make it possible to understand to what extent progress in reducing mortality has covered all groups of Russian society, where the main "laggard areas" are located, what measures can and should be taken to tackle the inequality.

Previous studies on this topic

The study of geographical differences in mortality in Russia has always been the focus of attention of demographers, geographers and social hygienists[13]. In the 1970s–1980s, based on data collected during the census period, it was shown that the value of life expectancy decreases as you move across Russia from south to north and from west to east. The lowest mortality rates were noted in the North Caucasus, in the Chernozem zone and in certain areas of the Volga region, the highest - in the North of European Russia, in Eastern Siberia and the Far East. This pattern is called

URL: s://www.economy.gov.ru/material/directions/regionalnoe_razvitie/strategicheskoe_planirovanie_prostranstvennogo_razvitiya/strategiya_prostranstvennogo_razvitiya_rossiyskoy_federacii_na_period_do_2025_goda/

[9] Papanova E., Shkolnikov V., Timonin S. (2019). Distinctive features and components of mortality decrease in Moscow in 1989-2017. Demographic Review, 6(1), 50-103. https://doi.org/10.17323/demreview.v6i1.9113 (In Russ).

[10] Shchur A., Timonin S. Core-periphery differences in life expectancy in Russia: a regional analysis. Demographic review, 2020, 7(3), 108-133.

[11] Timonin S., Jasilionis D., Shkolnikov V., Andreev E. M. New perspective on geographical mortality divide in Russia: a district-level cross-sectional analysis, 2008–2012, Journal of Epidemiology and Community Health, 2020, 74(2), 144-150.

[12] From 2004 to 2019 we could observe the longest period of growth in life expectancy at birth in Russia, at least since 1964, which ended abruptly in 2020-2021.

[13] Novoselskij S.A. Differences in mortality between the rural and urban population of European Russia. Obshchestvennyj vrach, 1911. 4. (In Russ); Novoselskij S.A. Mortality and life expectancy in Russia. Saint Petersburg: Tipografiya MVD, 1916 (In Russ).

the "southwest-to-northeast mortality gradient"[14]. At the same time, this phenomenon turned out to be surprisingly stable, despite significant fluctuations in mortality in Russia from the mid-1980s to the early 2000s.[15]

The current stage of sustainable growth in life expectancy, the beginning of which is usually attributed to 2003-2005[16], includes all regions of the country[17], thus posing a logical question: is the period of growth in life expectancy accompanied by a reduction in interregional inequality in mortality. Responding to this question, Timonin et al. found that interregional variance, one of the quantities making it possible to quantify spatial differences in life expectancy, has remained virtually unchanged since 2005. However, the decomposition of changes in this measure of inequality by age shows that, in terms of mortality in childhood and working age, Russian regions are converging, while for older ages, on the contrary, there is a pattern of divergence, primarily due to a more rapid decline in mortality among the elderly in Moscow and St. Petersburg[17].

The privileged position of Moscow and St. Petersburg on the "mortality map" of Russia was first identified in the late 1990s and continued to grow throughout the 2000s[18]. Probably, an important role in this was played by the increasing political and economic role of Moscow and, to a lesser extent, of St. Petersburg. Both the driver and the consequences of this process include, among other things, a significant migration inflow to these cities and their surroundings, a concentration of human capital in them, and high standards of living, including greater share of health care

[14] Andreev E.M. Length of life in the USSR: A differential analysis. In E. Andreev, A. Vishnevski (Eds.), Length of life: Analysis and modelling. Moscow: Statistika. 1979 (In Russ); Shkolnikov V.M. Geographical factors of length of life. Izvestiya AN SSSR. Geographical Series, 1987, 3(12), 35–44. (In Russ).

[15] Vasin S., Costello C.A. Spatial, age, and cause-of-death patterns of mortality in Russia, 1988–1989. In J.L. Bobadilla, C.A. Costello, F. Mitcell (eds.), Premature Death in the New Independent States (66-119), Washington, DC: National Academies Press, 1997.

[16] Vishnevsky A.G., Shchur A.E. Mortality and life expectancy in Russia for half a century. Orgzdrav: novosti, mneniya, obucheniye, 2019, 5(2), 10-21. (In Russ).

[17] Timonin S., Danilova I., Andreev E., Shkolnikov V.M. Recent mortality trend reversal in Russia: are regions following the same tempo? European Journal of Population, 2017, 33(1), 733- 763; Zakharov S.V. Russia's population: 25 annual demographic report. Moscow: Izdatel'skiy dom NIU VSHE, 2019 (In Russ).

[18] Andreev E.M., Kvasha E.A., Kharkova T.L. Special points on the mortality map. In A.G. Vishnevsky (Ed.), Russia's Population in 2003-2004. 11-12 Annual Demographic Report. Moscow: Nauka, 2006 (In Russ); Timonin S., Danilova I., Andreev E., Shkolnikov V.M. Recent mortality trend reversal in Russia: are regions following the same tempo? European Journal of Population, 2017, 33(1), 733- 763.

spending – all these factors directly affect life expectancy[19].

Differences in mortality rates are affected by both conditions at the macro level ("contextual effects") and differences at the micro level, in the socio-demographic attributes of residents ("compositional effects") [20]. While the context affects the entire population of a territory, individual characteristics (such as, for instance, educational attainment) may not be directly related to the place of residence, but the unevenness in their distribution between inhabitants of different territories will certainly affect the differences in aggregated at the territory level mortality rates.

Some significant socio-demographic characteristics that affect the life expectancy of a person include the level of education, income level, professional status, marital status, ethnicity, religiosity, etc.[21]. All of them are more or less likely to determine the lifestyle and behavior of an individual, including attitude to one's health ("health lifestyle"), and exposure to different risk factors: smoking, alcohol and other substance abuse, unhealthy diet, low physical activity, hypertension, etc.

A separate question is what exactly is the mechanism of the influence of a person's socio-demographic characteristics on his health behavior, whether it [behavior] is the result of a conscious choice ("life choices" or "agency") or is determined by the environment as a set of learned socially approved behavioral practices a person adopted from his environment ("life chances" or "structure"). Analyzing the health behavior practices typical for the Russian population in the 1990s, W. Cockerham concludes, "**t**he health lifestyles of Russian males appear to be influenced less by choice or agency and more by chance or structure — given the limited choices available and the normative drinking/smoking/eating/exercising

[19] Marmot M. Social determinants of health inequalities, Lancet, 2005, 365(9464), 1099-1104.

[20] Cummins S., Curtis S., Diez-Roux A.V., Macintyre S. Understanding and representing 'place' in health research: A relational approach, Social Science & Medicine, 2007, 65(9), 1825- 1838.

[21] Marmot M.G., Shipley M.J., Rose G. Inequalities in death—specific explanations of a general pattern? Lancet, 1984, 1(8384), 1003–1006; Valkonen T. Trends in regional and socio-economic mortality differentials in Finland. International Journal of Health Sciences, 1992, 3(3-4), 157-166; Mackenbach J.P., Bos V., Andersen O., Cardano M., Costa G., Harding S., Reid A., Hemström Ö., Valkonen T., Kunst A.E. Widening socioeconomic inequalities in mortality in six Western European countries. International Journal of Epidemiology, 2003, 32(5), 830–837; Von Gaudecker H., Scholz R. Differential mortality by lifetime earnings in Germany. Demographic Research, 2007, 17, 83-108.

practices of these men". Consistent with Bourdieu's theoretical approach[22], these men's unhealthy lifestyle can be seen as a reflection of a habitus based on "their experience, socialization in a communist society and class reality"[23].

Contextual effects include differences in socio-economic, political and environmental conditions, in access to infrastructure, primarily to the healthcare system, including emergency medical care, modern amenities, and the quality of housing stock[24]. However, the contextual effect is usually reflected in many individual characteristics. As an example, the level of household income is higher where there are more high-paying jobs; the educational and vocational composition of the population and the direction of migration flows also depend on the level of development of the local economy. Thus, a higher level of socio-economic development or other factors that are attractive for migration and residence (climate, developed infrastructure, including leisure and education facilities) form a more “healthy population” with a higher life expectancy. Conversely, in regions with unfavorable social and economic conditions, a culture of anomie may emerge, contributing to the spread of unhealthy lifestyles and high mortality rates[25].

Due to the data limitations, the study of the geographical patterns of mortality in Russia, until very recently, considered only the highest level of administrative-territorial division - oblasts, republics, krais, etc. Consequently, much of the geographical disparity in mortality remained hidden from researchers. First, we are talking about differences in mortality within regions, between the "center" and the "periphery". How does the further concentration of the population, economic and financial resources in the centers affect the scale and dynamics of the core-periphery inequality in life expectancy both at the level of the whole country and within each region? The answer to this question largely depends on how centers are defined and what is referred to as the periphery.

[22] Bourdieu, P. Distinction. Cambridge: Harvard University Press, 1984; Bourdieu, P. The logic of practice. Stanford: Stanford University Press, 1990.
[23] Cockerham WC. Health lifestyles in Russia. Soc Sci Med., 200, 51(9): 1313-24.
[24] Diez-Roux A.V. A glossary for multilevel analysis. Journal of Epidemiology and Community Health, 2002, 56(8), 588–594.
[25] Shaw M., Dorling D., Mitchell R. Health, Place and Society. Singapore: Pearson, 2002.

Centers in Russia are usually conceptualized as the main cities – key elements of the country's settlement grid, "motors for the transmission of modernization impulses"[26]. Following the established "city hierarchy",[27] we pay special attention to the largest of them, with a population of at least 100,000 people. The ***population size*** in this case acts as a proxy indicator of the "centrality" of the place, which in the Russian context implies a more favorable socio-economic situation in relation to the surrounding territories, a more developed institutional environment and, as a result, a higher level of human capital[28]. In addition to size, the ***status*** of the city is also important, namely, whether it is the administrative center of its region. In the context of the "rigid over-centralization of the management system" characteristic of Russia[27], regional capitals, being the main "centers of power", concentrate a significant part of the human, institutional, financial and political capital of the regions and the country as a whole[29].

Centers, defined either as only regional capitals, or as all cities with a population of over 100,000 people, are contrasted in this study with the rest of the Russian territory (consisting from medium and small towns, as well as rural areas) or the periphery. Such a simple dichotomy certainly overlooks a significant degree of heterogeneity of the Russian periphery[30]. However, a closer focus on the centers might be justified in terms of their presumably avant-garde role in the demographic modernization of Russia, including in epidemiological transition and longevity expansion.

This dissertation presents the *first* attempt to characterize core-periphery differences in mortality in Russia (at the level of the whole country and within most of its regions). For the first time, the variation in life expectancy between Russian

[26] Zubarevich N V. Development of the Russian Space: Barriers and Opportunities for Regional Policy. Mir Novoj Ekonomiki, 2017, 11(2), 46-57. (In Russ).
[27] Zubarevich N.V., Safonov S. Development of big cities in Russia in the 2010s. Regionalnye Issledovaniya, 2019, 1, 39-51. (In Russ).
[28] Nefedova T.G. Polarization of Russian Space: Growth Areas and "Black Holes".Ekonomicheskaya Nauka Sovremennoy Rossii, 2009, 1 (44), 62-77. (In Russ).
[29] Leksin V.N. Cities of Power: Administrative Centres of Russia. Mir Rossii: Sotsiologiya, etnologiya, 2009, 18(1), 3-33. (In Russ).
[30] Nefedova T.G. Russian Periphery as a Socio-Economic Phenomenon. Regionalnye Issledovaniya, 2008, 5, 14-31. (In Russ).

settlements (cities with a population of more than 100,000 people, other urban and rural settlements in each region) is considered in a comprehensive manner, classified both geographically (belonging to a particular region) and by size (population). This approach adds a new dimension that allows us to identify previously overlooked differences in the spatial differentiation of mortality.

The objective of the study is to assess the magnitude and trends of core-periphery differences in mortality in Russia and identify what factors influence them.

To reach this goal the following tasks had to be completed*:*

1. Calculate mortality rates and life expectancies at birth in the largest cities of Russia, besides Moscow and St. Petersburg; analyze mortality trends in them in compared to the rest of the country;

2. Evaluate the impact of the population size, administrative status, educational composition and income level of the population on the life expectancy at birth in Russian cities with a population of over 100,000 people, in other urban settlements and in rural areas within Russian regions;

3. Identify Russian regions in which there is a significant advantage of the regional center in terms of life expectancy over the rest of the region; estimate the contribution of single age groups and causes of death to this advantage; track the changes in the gap in life expectancy between the center and the periphery over time.

Hypothesis: Despite the nationwide decrease in mortality rates in Russia in 2004-2019, there was an increase in the gap in life expectancy at birth between the "center" (vanguard territories at the forefront of the epidemiological transition) and the "periphery", due to both "contextual effects", and differences in the socio-economic characteristics of the inhabitants ("compositional effects").

Theoretical background of the study

- The concept of the epidemiologic transition of A.Omran;
- The concept of health transition of J.Frenk et al., who rethought and developed the concept of epidemiologic transition;
- Core-periphery model of development by John Friedmann;
- Studies on spatial concentration of the economy within the framework of the

"new economic geography" (P. Krugman).

Data and methods

1. Microdata of the 2010 All-Russian Population Census. With the help of the census constructor, data on the educational composition of the population at the level of municipalities were tabulated;

2. Mid-year population estimates as well as the deaths counts by sex, place of residence and causes of death by five-year age groups for 2010-2018 were obtained from the Federal State Statistics Service of Russia (Rosstat);

3. Death counts by sex, place of residence and causes of death by five-year age groups for 2003-2009 were tabulated from the depersonalized database of all the death certificates issued in Russia;

4. Data from the Russian Fertility and Mortality Database of the Center for Demographic Research of the New Economic School. Mid-year population estimates by sex, region and five-year age groups for the period 1989-2018 were used.

The following methods were used in the study:

- The methods of demographic analysis of mortality (including the methods of standardization of mortality rates, constructing life tables);
- The method of step-wise replacement decomposition of life expectancy by age and causes of death[31];
- Statistical methods for analyzing distributions;
- Linear regressions;
- Mapping.

The novelty of this study

1. For the first time, values of life expectancy at birth were calculated for Russian cities with a population of over 100,000 people, urban and rural population living in smaller settlements, in each region for 2003-2005 and 2015-2017.

[31] Andreev E. M., Shkolnikov V. M. Begun A. Z. Algorithm for decomposition of differences between aggregate demographic measures and its application to life expectancies, healthy life expectancies, parity-progression ratios and total fertility rates. Demographic Research, 2002, 7(14), 499-522.

2. It is shown that cities with a population of over a million residents in the 1990s–2000s began to outperform the rest of Russia in terms of life expectancy at birth.

3. It is shown that between 2003-2005 and 2015-2017 Moscow and St. Petersburg have maintained their advantage in life expectancy at birth over other large cities (with a population of over 100,000 people), which, in turn, have strengthened their advantage in this indicator over small urban and rural settlements (with a population of less than 100,000 people).

4. It is shown that the share of the population with higher education explains 66% (for men) and 62% (for women) of the variation in life expectancy at birth in 2015-2017 between Russian cities with a population of more than 100,000 people, smaller urban and rural settlements.

5. An evaluation of the differences in life expectancy at birth between the regional center and the rest of the population of the region in 2003-2018 is presented for 67 Russian regions (which are home to three-quarters of the country's population). Depending on the size of the gap and its trends, six types of regions have been identified.

6. For 36 regions of Russia with a high level of core-periphery inequality in life expectancy at birth, we assessed the contribution of single age groups and causes of death.

Results of the study

The main results of the study are presented in the form of three original articles published in the following peer-reviewed journals - *Demographic Review*, *Population and Development Review*.

1. ***Shchur A. Cities of over a million people on the mortality map of Russia // Демографическое обозрение. 2018. Vol. 5. No. 4. P. 66-91.***

The article presents the results of a comparative analysis of mortality rates for 15 Russian cities with a population of over 1,000,000 people (as of the beginning of 2016) with the rest of the country (without the cities mentioned above), as well as for

each city with its region (excluding the city itself) for the period from 1989 to 2016[32]. Cities with a population of over one million people ('million-plus cities') are also very often considered as reference points of the country's modernization, its educational and economic centers, places of attraction of people.[33] Thanks to this, we expected that they would also be at the forefront of the epidemiological transition in Russia, paving the way for the rest of the country and, above all, for the territories surrounding them.

Core-periphery differences in life expectancy at birth, weakly expressed in 1989 at the end of perestroika and the anti-alcohol campaign began to increase rapidly from the second half of the 1990s. The turning point was 1994, after which mortality in the largest cities of the country (and, especially, in the two capitals) began to decline at a faster pace. The increase in mortality in the early 2000s was also more intense in the rest of Russia, which only increased the gap in life expectancy between the "periphery" and the "center", represented in our study by the largest cities with a population of over one million people. The gap between the maximum and minimum values of life expectancy during this period (1994-2005) increased from 1.36 years for men and 1.05 years for women to 9.18 (8.98 according to adjusted data[34]) and 4.67 (4.63) years, respectively. Particularly significant is the difference between Moscow and both the rest of the country and the other million-plus cities, including St. Petersburg, where mortality remains lower than in all other cities under consideration.

Differentiation of million-plus cities in terms of life expectancy is not correlated with their level of economic development (expressed in terms of gross urban product per capita), size (population) or geographic position. However, one can see some link between the educational level of a city's population (the share of people over 30 years with higher education) and life expectancy in it.

In 1989-2016, the differences in life expectancy between the "centers" and the

[32] The period of the study is dictated by the availability of the necessary data.

[33] Zubarevich N.V. Cities as centers of economic modernization and human capital. Obshchestvennye nauki, 2010, 5, 5–19.

[34] Following the work of Papanova et al (Papanova et al. 2017), in order to obtain more realistic estimates of life expectancy at birth we adjusted the mortality tables calculated for Moscow using the methodology used in the Human Life Table Database.

"periphery" increased significantly in all the regions studied. If in 1989, the life expectancy in the *aggregate city*[35] was 0.8 years higher than in the *aggregate region*[35], in 2016 the gap increased to almost 2.5 years. In all the regions studied, including the two "capital regions", life expectancy in the administrative centers in 1989-2016 grew at a much faster pace than in other areas. In a number of regions, such as the Sverdlovsk and Chelyabinsk regions, life expectancy outside the regional centers in 2016 still had not reached the 1989 level.

The life expectancy gap between million-plus cities and their surroundings not only increased significantly in 1989-2016 (on average, by almost 2 years), but, as a rule, increased relative to the rest of the country, too, i.e. Russia's central-peripheral inequality in mortality is more pronounced at the sub-regional level. Interestingly, the south-west/north-east mortality gradient, relatively unimportant at the level of million-plus cities, is a good predictor of differences in life expectancy in their areas outside the "centers". Thus, the maximum level of central-peripheral inequality in mortality is observed in the regions of the Urals and Siberia, where there is a very low level of life expectancy outside the regional capitals, while in the regions of the European part of Russia the difference between "centers" and "periphery" is significantly smaller (with the exception of the Moscow region).

Possible reasons for the gap in life expectancy between million-plus cities and their surrounding territories include different levels of socio-economic development and different professional and educational compositions of the population, inequality in access to modern medical technologies, and the selection effects because of migration. The large gap in life expectancy might also be influenced by other factors determined by the settlement grid of a particular region: the degree of urbanization, the share of the population living in the agglomeration belt of the administrative center, and the presence of other large urban centers.

2. *Shchur A., Shkolnikov V.M., Timonin S., Andreev E., Leon D.A. Where do people live longer in Russia in the twenty-first century? Life expectancy across urban and rural Areas // Population and Development Review. 2021. Vol. 47. No. 4. P. 1049-1074.*

[35] Aggregate city - the set of non-capital million-plus cities (i.e. all Russian million-plus cities except Moscow and St. Petersburg), for which all indicators are aggregated; analogously, but for areas within regions, bar for million-plus cities, aggregate region.

In this study, we calculated life expectancy values (LE) for 291 cities in 2003-2005 and 292 cities in 2015-2017 with a population of 100,000 or more having grouped into four categories according to their population sizes[36], and for the urban populations in areas with fewer than 100,000 inhabitants, and of the populations in rural areas by oblast. For 2015-2017, we examined the link between LE and the characteristics of the populations of the residential areas (such as educational attainment, population size, income per capita, and administrative status). Finally, we estimated the temporal change in LE across the areas under study between 2003-05 and 2015-17 and its contribution to inter-regional mortality inequality.

The maximum LE value for each sex is observed for both time periods in Moscow, followed by in Saint Petersburg. For population size categories I-IV representing cities with populations from 100,000 to 1,000,000+ residents, the curve's shape resembles downward set of stairs in both 2003-2005 and 2015-2017; although the steepness of the stairs declined slightly between the two time periods, especially for males. In 2015-2017, unlike in 2003-2005, no statistically significant difference in LE was observed across the categories from I to IV, except for the female populations of medium-sized cities (100,000-250,000), who were lagging behind their counterparts living in the bigger cities. At the same time, the differences between the cities in categories I to IV and the smaller urban areas in category V had widened. For males in 2015-2017, category V (urban settlements with fewer than 100,000 inhabitants) had the lowest LE values. For females in 2015-17, the differences in LE between the small urban areas and the small rural areas had almost disappeared (**Table 1**).

Table 1. Life Expectancy by Population Size Category in 2003-05 and 2015-17

[36] Moscow and The populations of Moscow and Saint Petersburg were set aside as two separate categories due to their enormous sizes and special characteristics as Russia's two major metropolitan centers.
I - cities with a population of over 1,000,000 people
II - cities with a population of 500,000 to 1,000,000 people
III - cities with a population of 250,000 to 500,000 people
IV - cities with a population of 100,000 to 250,000 people
V - urban settlements with a population of less than 100,000 people
VI - rural settlements

	2003-2005		2015-2017		difference	
Category | Population size threshold (thousand)	Males	Females	Males	Females	Males	Females
Moscow	65.8	75.6	74.2	81.0	8.4	5.4
Saint Petersburg	61.2	73.7	70.5	79.0	9.3	5.3
I. The biggest cities | 1,000-1,999	60.2	73.5	67.1	78.0	6.9	4.5
II. Very big cities | 500-999	59.5	73.1	66.9	77.7	7.4	4.6
III. Big cities | 250-499	58.6	72.4	66.8	77.6	8.2	5.2
IV. Medium-sized cities | 100-249	58.4	71.7	66.2	76.9	7.8	5.2
V. Other urban areas | < 100	56.9	71.0	64.4	75.8	7.5	4.8
VI. Rural settlements	56.7	70.6	64.8	75.8	8.1	5.2
Total	58.5	72.0	66.4	77.1	7.9	5.1

Between 2003-2005 and 2015-2017, the country's LE increased by 7.9 years among males and by 5.1 years among females. Although LE increases were substantial for all categories, the largest gains were achieved in Saint Petersburg (by 9.3 and 5.3 years for males and females, respectively) and Moscow (accordingly, by 8.4 and 5.4 years), followed by in cities with between 100,000 and 500,000 inhabitants. The smallest increases of 6.9 years for men and 4.5 years for women occurred in cities with 1,000,000+ inhabitants other than Moscow and Saint Petersburg. Urban areas with fewer than 100,000 inhabitants experienced relatively small LE increases (7.4 years for males and 4.8 years for females), despite having particularly low starting LE levels. As a result of these uneven increases, by 2015-2017, the relative position of the smaller urban areas had worsened the most compared to the national average.

There was a decrease in the LE dispersion across all units under study among females, and a minor decrease among males. This moderate convergence was the result of substantial decreases in the LE dispersion within each of the population size categories except category I (cities with populations of 1,000,000+ other than Moscow and Saint Petersburg). These decreases were partly (females) and largely (males) counterbalanced by the widening between-category dispersion. This implies

that despite the increasing homogeneity within the same population size categories, the disparities between them persisted. In Russia, three major segments of the LE distribution are becoming more evident: Moscow and Saint Petersburg at the top, large-, and medium-sized cities in the middle, and smaller urban and rural areas lagging behind.

The share of the population with high education and the population size of the settlement have strong effects on the LE of residents of both sexes. The strength of the association with a settlement's administrative status is significant for males, but not for females. The average annual income has no effects for either sex in the mutually adjusted models. Overall, the four explanatory variables together explain 67% for males and 62% for females of the observed LE variance across studied units.

The "southwest-to-northeast" mortality gradient was found to be more pronounced for the areas with fewer than 100,000 residents. Meanwhile, the bigger cities, particularly those with populations of 250,000 or more inhabitants, appeared to be more resilient to the "geographic curse" of belonging to the northern and eastern parts of Russia, even though they were still slightly behind their more southern and western counterparts in terms of LE. A dispersion decomposition on the population-weighted LE performed on 290 observation units (all but Moscow and Saint Petersburg) shows that in 2003-2005, the intra-oblast dispersion constituted 37.6% and 39.4% of the total dispersion for males and females, respectively. By 2015-2017, these percentages had risen to 49.7% and 54.3%, respectively – i.e., they had increased by 12-15 percentage points, or by about one-third.

Although the LE variation across geographic space was found to be rather consistent along the southwest-to-northeast axis, mortality was shown to be lower in the biggest cities than in the smaller urban areas and the rural areas across all Russian territory. The latter pattern was more encompassing, and predicted mortality levels with a higher degree of certainty than the geographic position; i.e., Russia's spatial mortality gradient was largely vertical (by population size), and was only then horizontal (geographic).

3. *Shchur A., Timonin, S. Core-peripheral differences in life expectancy in Russia: a regional analysis // Демографическое обозрение. 2020. Vol. 7. No. 3. P. 108-133.*

This paper presents an assessment of the scope and dynamics of changes in mortality differences in 2003-2018 between the "center" (cities – regional centers) and the "periphery" (areas outside regional centers) in 67 regions of Russia, which are home to three-quarters of the country's population. Depending on the magnitude of the differences in LE and the dynamics, we identified six types of regions (*a-f*) [37]. For those regions with a LE gap between center and periphery larger than the average (*a-c*), the decomposition method was applied to determine single age groups and causes of death contribution to such high differences.

Our study reveals that amid longevity increase in Russia as a whole, in 2003-2011 there was a trend towards an increase in the advantage of centers replaced in 2012 by a trend towards convergence in the mortality rates. However, in order to confirm that life expectancy indicators in the centers and on the periphery of Russian regions are converging one should wait for the next population census' results being published. Although in 2011 the principle of registering migration in Russia was changed, leading to a significant increase in the number of registered migrants, we cannot completely exclude the possibility that the 2021 census, like the 2010 census, will show an overestimation of the current population in the periphery and an underestimation in the centers.

The gap in life expectancy (LE) between the center and the rest of the region mostly depends on the mortality rate in the periphery, while the direction of change in the gap equally depends on the dynamics of LE both in the center and in the periphery. In regions where the gap in LE is decreasing, this is primarily due to the catching up rate of the decrease in mortality outside the center. In contrast, the

[37] a – higher gap, divergence
b – higher gap, no trend
c – higher gap, convergence
d – lower gap, divergence
e – lower gap, no trend
f – lower gap, convergence

regions, which are characterized by divergence in the mortality rates between the center and the periphery, are distinguished by higher values and growth rates of LE in the centers. In addition, in regions *d-f*, where the gap is lower than the national average, the LE values are higher and, conversely, in regions *a-c* they are lower than the national average and the gap is higher. At the same time, the fastest growth in life expectancy in 2003-2018 at the level of the entire region (without the distinction into the center and the periphery) was in type *c* and *f*, where there was a convergence in mortality rates between the center and the periphery.

The gap in LE for men, as well as the change in this indicator over time, is mainly determined by the difference in mortality rates at young and middle (25-54 years) ages. Differentiation in mortality rates of women in this age group between the centers and the periphery is also important, but somewhat less than for men. External causes of death and diseases such as cardiomyopathy, tuberculosis, cirrhosis and some others indicating a rather marginalized lifestyle of the deceased and social exclusion are among the main causes of death that determine the lag of the periphery from the centers in this age group. It seems that, due to the more favorable educational composition, as well as the selective effects of migration, the share of the marginalized population in the regional centers is lower than in the periphery. Thus, the differences in the mortality rate at young and middle age between the centers and other settlements can be explained by the differences in the socio-demographic characteristics of their inhabitants, their lifestyles. At the same time, the lower mortality rate of older people from chronic diseases in the centers is presumably a presumably the result of a more or less successful health care system.

Conclusions

1. After the collapse of the USSR and the ending of the anti-alcohol campaign, mortality rates between the largest cities (Moscow and St. Petersburg), other cities with a population of over 1,000,000 people, and the rest of the country began to diverge.

2. Steady increase in life expectancy in Russia in the 2000s-2010s was accompanied by a divergence in mortality between cities with a population of over

100,000, and smaller settlements, with the differences in mortality between urban and rural settlements erasing.

3. Differences in life expectancy at birth between Russian settlements in 2015-2017 were closely related, first of all, with the level of education of their residents, population size and administrative status (the latter is significant only for the male population).

4. Currently in Russia, inequality “in the face of death” depends more on the type of settlement where people live, rather than on the oblast where they live; i.e., Russia’s spatial mortality gradient is more vertical (by population size category within regions) than horizontal (inter-region).

5. Regional centers tend to show higher values of life expectancy at birth than other areas outside them, and for the male population, the "administrative center" factor remains significant even after taking into account other factors such as city size, residents' educational level and income.

6. Differences in mortality between cores and peripheries in young and middle-aged populations can be explained by differences in the socio-economic characteristics of residents and their lifestyle, while differences in old age are more complex and more dependent on the work of the health system, including its territorial accessibility.

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Publications:

The author has published three academic papers on the subject of the dissertation research, 4.73 author sheets in total (personal contribution of the author is 3.20 author sheets). Among them one paper was published in an academic journal indexed in Scopus (as well as in Web of Science), two papers were published in the journal included into the list of academic journals recommended by the National Research Institute Higher School of Economics.

Papers published by the author in peer-reviewed academic journals included into the international scientific databases Web of Science and Scopus:

1. **Shchur A.**, Shkolnikov V.M., Timonin S., Andreev E., Leon D.A. Where do people live longer in Russia in the twenty-first century? Life expectancy across urban and rural Areas // Population and Development Review. 2021. Vol. 47. No. 4. P. 1049-1074.

Publications in the journals recommended by the National Research Institute Higher School of Economics:

2. **Shchur A.** Cities of over a million people on the mortality map of Russia // Демографическое обозрение. 2018. Vol. 5. No. 4. P. 66-91.
3. **Shchur A**., Timonin, S. Core-periphery differences in life expectancy in Russia: a regional analysis // Демографическое обозрение. 2020. Vol. 7. No. 3. P. 108-133.