

# Population mortality in the central Russia municipalities

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## Abstract

The Central Federal District (CFD) is the most populous district in Russia, as of the beginning of 2021, 27% of the Russian population lived out there. However, the CFD mortality rate is characterized by a significant variation across different territories of the District. The purpose of this study is to assess the CFD territorial differentiation of mortality rate based on life expectancy with a breakdown on municipalities in 2010–2019. Life expectancy by CFD municipality and urban district was based on information about population size of the CDF municipalities and urban districts, obtained from the database on municipalities for the period 2010–2020 and individual non-personalized Rosstat (Federal State Statistics Service) data on cause-of-death mortality. A total of 326 municipalities and 63 urban districts were included in the analysis. A total of 11.5 thousand life tables were developed. The analysis shows a significant differentiation of mortality rate at the municipal level. Even though the CFD life expectancy is above the Russian average mainly due to high levels of life expectancy in Moscow, the vast majority of the CFD municipalities report a life expectancy below the Russian average.

The worst situation with mortality in the CFD is developed in municipalities with a population of less than 10 thousand people. The main factor for a high gap in life expectancy across territories and gender is a high male mortality in working ages. There are significant reserves of for life expectancy growth within the CFD. These reserves are concentrated in the regional capitals with adjacent municipalities, as well as other large municipalities with a population over 100 thousand people.

## Keywords

mortality, Central Federal District, municipalities, life expectancy, spatial inequality in mortality, center and periphery, population of small territories

**JEL codes:** J11

## Introduction

The Central Federal District is the largest district in Russia by population with 39.25 million people or 26.9% of the country's population residing there as of the beginning of 2021. The District mainly consists of small but densely populated areas. However, the CFD is characterized by a high share of the Russians (89.1%) and a high share of urban population (82.7%).

Historically, economically and strategically the CFD regions act as the most important system-forming regions of Russia, concentrating economic, social, cultural and human capital. However, in most regions of the Central Federal District, demographic trends have become steadily negative in recent decades.

Available studies show that the post-Soviet period in the CFD regions is characterized by territorial polarization of space (Nefedova, Treyvish 2020). There is a fairly rapid outflow of population from rural settlements, small and medium-sized cities (Barinov 2013; Nefedova 2010) to regional centers. Such trends have a significant impact on the gap between the rural population and the population of small and medium-sized cities and large centers by a number of key socio-economic parameters: employment opportunities, income, living conditions, health, education, satisfaction of social and cultural needs.

Studies show that the Central Federal District is characterized by a central-peripheral model of development of municipalities with large intraregional differences in population dynamics and centripetal trends, when a distance from the center plays a greater role in the dynamics in population growth rather than a size of a settlement (Karachurina, Mkrtchyan 2010; Kalabikhina, Mokrensky 2017; Mizerovskaya, Rak 2019). It is noted that population of the most CFD municipalities continues to decline, due to both migration and natural population decline. There are significant intraregional differences in population dynamics (Kalabikhina, Mokrensky 2017).

Among indicators characterizing the level of socio-economic inequality in society, one of the leading places is occupied by mortality rates (Sen 1998). The most correct indicators of mortality include standardized mortality rate and life expectancy. For the analysis of territorial differences, the indicator of life expectancy is preferential since it does not depend on the selected population standard and is more visual in terms of interpreting trends (Denisenko 2007).

In the context of solving demographic problems and, in particular, increasing life expectancy in Russia, analysis of mortality in small territories is of particular relevance, which is of a great practical importance for the development of specific policy objectives to reduce mortality and increase life expectancy.

The analysis of differences in life expectancy at the municipal level could help complete the following tasks: to determine the extent of inequality in provision of quality medical services; to identify mortality factors and features of self-preservation behaviour among population of individual territories; to identify reserves for increasing life expectancy by reducing territorial differences in mortality and its structure. Thus, the results of such an analysis could contribute to a stronger justification of the policy on reducing mortality among both the entire population and its individual groups.

Due to limited territorial data on the population size and composition, a mortality analysis in Russia, as a rule, covers either the national or regional level. Thus, the available studies on Russia pay a lot of attention to the analysis of regional differences in demographic development (Zubarevich, Treyvish 2001; Zubarevich 2008) and demographic policy (Kalabikhina 2013; Elizarov et al. 2015), including in the context of regions with high rates

of population decline – north regions and central Russian regions (Popova, Sukneva 2012; Kalabikhina, Mokrensky 2017).

Mortality studies analyzing a lower administrative-territorial level are rather scarce in Russia. It is only in recent years that publications on mortality at the municipal level have begun to appear nationwide: mortality in the municipal districts of Russia (Timonin et al. 2020), in «million plus» cities (Shchur 2018), regional capitals (Shchur, Timonin 2020), and large and small cities (Shchur et al. 2021). The level and structure of mortality in Moscow and other megacities of the world were compared (Andreev et al. 2016). There are papers assessing mortality and its age characteristics at the municipal level within individual regions: Kostroma Region (Denisenko, Nikolaeva 2015; Denisenko 2012) the Khanty-Mansi Autonomous District (Ivanova et al. 2009), Arkhangelsk Region (Fattakhov, Mironova 2021). In a number of domestic works, infant mortality is estimated at the municipal level to calculate the human development index: Arkhangelsk Region (Ushakova et al. 2018), the Trans-Baikal Territory and the Republic of Buryatia (Valeeva 2016). Analyses of crude death rates at the municipal level are also available (Patsiorkovsky et al. 2019).

However, the issue of territorial differentiation of the CFD mortality in the context of municipalities are yet to be explored.

The purpose of this study is to assess territorial differentiation of the CFD mortality on the basis of life expectancy in the context of municipalities in 2010–2019, as well as to analyze major trends in changes in life expectancy with due regard to territorial differences, as well as to identify growing points of life expectancy in this Federal District.

## Data and methods

The assessment of life expectancy by municipality and urban district of the Central Federal District was based on information on population of municipalities and urban districts of the Central Federal District obtained from the database of indicators of municipalities for the period 2010–2020 and individual depersonalized Rosstat data on deaths by cause of death. The methodology for calculating life expectancy for small territories is described in scientific literature (Denisenko, Kalmykova 2007; Tebuev, Ediev 2007).

Age-specific mortality rates were calculated individually for males and females and total population by five-year age groups. The last age group included people aged 70 and older, since the information on population in the database of municipalities is limited by this age. The estimates were carried out for each municipality and urban district without any breakdown on urban and rural population.

A total of 326 municipalities and 63 urban districts were included in the analysis. 11.5 thousand life tables were developed. All urban districts (except for Voronezh, Kaluga and Novovoronezh, that did not have a single municipal district outside their limits) were merged with the municipalities within which they were located. The reason was that, as a rule, the place of death of residents of the municipality within the limits of which there are urban districts, is the corresponding urban district. In three cases, when there were several independent urban districts within the limits of one municipality (Bryansk district + the city of Bryansk, city of Seltso; Ivanovo district + the city of Ivanovo, city of Kokhma; Tambov district + the city of Tambov + city of Kotovsk), life expectancy was calculated for the entire population in total. Closed administrative-territorial entities (CATE) were excluded from the analysis, because data on their population age structure are not available.

It was not possible to calculate life expectancy by municipality and urban district of the Moscow Region, because data on population of the Moscow Region are fragmentarily presented in the Rosstat municipal statistics database. Therefore, the assessment of life expectancy in the Moscow Region is represented by the average regional indicator.

The results are presented both at the level of individual municipality and at the aggregated level. In case of aggregation, all areas under study were grouped into the following nine groups depending on the population size:

- Moscow and the Moscow Region (two areas)
- Over 1 million people (one area)
- 500 to 999 thousand people (six areas)
- 250 to 499 thousand people (10 areas)
- 100 to 249 thousand people (13 areas)
- 50 to 99 thousand people (47 areas)
- 25 to 49 thousand people (82 areas)
- 10 to 24 thousand people (153 areas)
- Less than 10 thousand people (75 areas).

When calculating estimates of life expectancy for each individual area, in order to increase sustainability of the calculation results, the method of moving average over a three-year period was used. Data smoothing was performed for the entire study period, i.e. 2010-2019. No smoothing was undertaken for life expectancy assessment by grouped areas and the estimates are presented for each year separately.

Life tables should follow the analysis of specifics of death registration in certain administrative-territorial entities. As known, some deaths are registered at the place of death rather than the place of residence. Displacement of this kind is most characteristic of infants and older children, whose deaths are registered at medical institutions. Furthermore, a small number of population groups in some municipalities, observation errors and special events could have an impact on sustainability and reliability of the calculated indicators.

## Results

In 2019, 51% of the FCD population resided in Moscow and the Moscow Region. In total, there were three areas with a population of over 1 million people: Moscow, the Moscow Region and Voronezh; six areas with a population of 500 thousand to 1 million people; 10 areas with a population of 250 thousand to 500 thousand; 13 areas with a population of 100 thousand to 250 thousand. In total, 77.8% of the population lived in the 32 mentioned above areas. Most areas of the District have a population of 10 to 25 thousand people, in total – 153 areas accumulating 6.2% of the population. There are 75 areas in the Central Federal District with a population of less than 10 thousand people, where 1.3% of the population or 533 thousand people live.

In 2010-2019, only 36 out of 389 areas reported a population growth. The highest population growth over the period under study was registered in million-plus cities and the Moscow region adding up to 8%, on average, while areas with a population of 500 thousand to 1 million increased by 5%, on average. A negative population growth was registered in areas with a population of less than 250 thousand people, and the smaller the population of the area, the greater the human loss. Thus, areas with a population of less than 10 thousand people lost about 17% of the population during the period under study. Areas with a smaller population size are characterized by a higher share of the elderly and a higher average age of the population (Table 1).

**Table 1.** Some characteristics of the CFD population, 2020

	<b>Distribution</b>	<b>Population growth over the period</b>	<b>Share of the retired*</b>	<b>Average age, years</b>
Moscow + Moscow Region	51.5%	8.2%	19%	41.0
>1000 thousand	2.7%	8.5%	20%	39.3
>500 thousand	8.7%	5.0%	21%	40.4
>250 thousand	9.9%	2.0%	21%	40.5
>100 thousand	4.9%	-4.0%	23%	41.8
>50 thousand	7.8%	-7.0%	23%	41.8
> 25 thousand	7.1%	-9.0%	23%	42.3
>10 thousand	6.2%	-12.0%	24%	43.1
less than 10 thousand	1.3%	-17.0%	25%	43.8

\*for men 65+, for women 60+.

Source: authors' calculations based on the Rosstat data.

Assessment of life expectancy indicates a noticeable intra-regional differentiation of the CFD mortality. During the period from 2010-2012 to 2017-2019, there was an increase in life expectancy among both sexes in 380 areas out of the 389 under study. The growth rate of life expectancy during the period under study was slightly higher in areas with a smaller population size. The largest increase in life expectancy is registered in areas located within the Moscow Region limits –districts of the Vladimir, Ryazan, Tula and Smolensk regions.

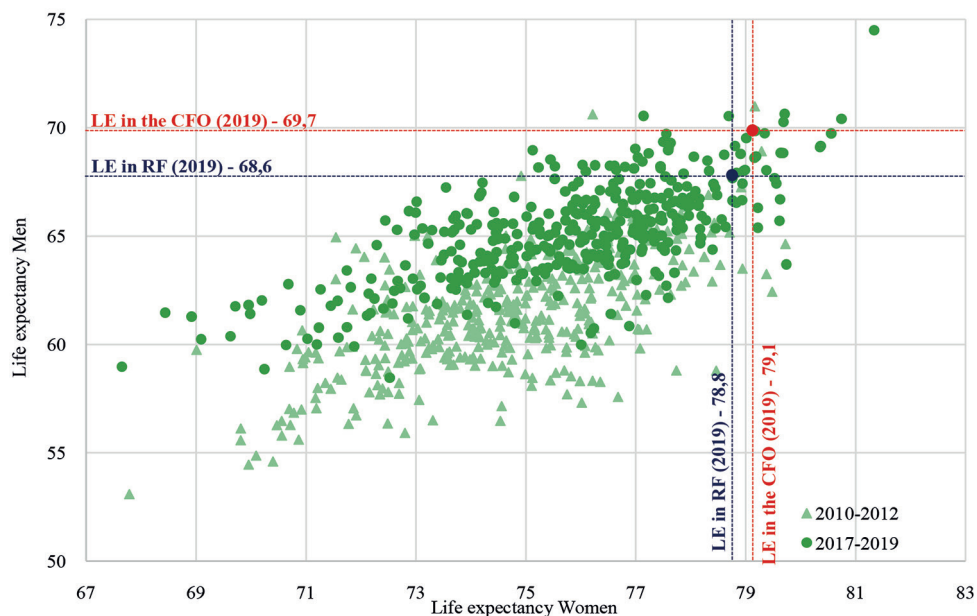
There are hardly any changes in life expectancy in most areas of the south regions of the District –the Belgorod and Voronezh regions, where life expectancy was initially high, as well as districts of the Ivanovo Region.

Spread in life expectancy in the Central Federal District in 2017-2019 across municipalities was significant. Male life expectancy ranged from 53.1 to 74.5 years, while the female one - from 67.7 to 81.3 years. Overall, during the period under study life expectancy in the Central Federal District increased from 64.2 to 69.7 years in males, and from 75.7 to 79.1 years in females.

Due to uneven distribution of the FCD population, the average FCD life expectancy significantly exceeds rates of the most municipalities. Moscow and the Moscow Region are the engine of life expectancy growth in the Central Federal District. Should Moscow and the Moscow Region be excluded from the Central Federal District, life expectancy in the remaining areas will be below the Russian average by 1.5 years (Figure 1).

The highest life expectancy for both sexes (78.4 years) was registered in 2019 in Moscow and the Moscow Region. In municipalities with a population of 500-999 thousand people life expectancy was already four-year lower.

Voronezh is the second largest city of the Central Federal District (after Moscow) with a population of over 1 million people. Life expectancy in Voronezh is comparable with rates in municipalities with a population of 500-999 thousand people, demonstrating the Russian average.



**Figure 1.** Changes in life expectancy in 2010-2012 / 2017-2019 in the CFD municipalities. *Source:* authors' calculations based on the Rosstat data.

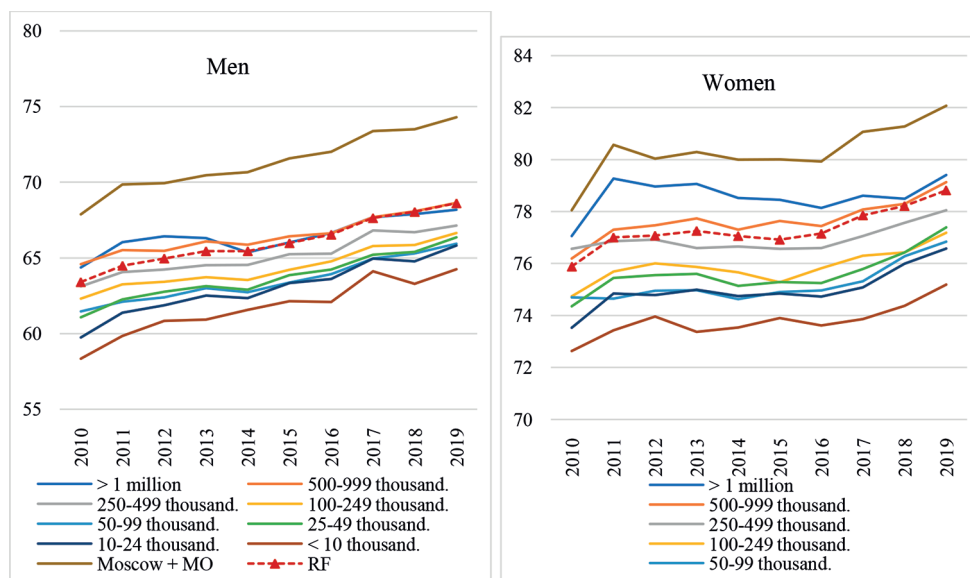
Municipalities with a population of less than 500 thousand people have a similar level and dynamics in life expectancy with rates below the Russian average. The smallest municipalities with a population of less than 10 thousand people are far behind with a gap in 2019 equaling to 4.4. years in males and 3.6 years in females compared to the Russian average. The gap added up to 10.0 years in males and 6.9 in females compared to the average rates in Moscow and the Moscow Region.

Increase in life expectancy from 2010 to 2019 in males was faster than in females. On average, an annual increase in males in the Central Federal Districts added up to 7.3 months per year, while in females - 4.5 months per year. The most rapid increase was registered in Moscow and the Moscow Region with the male average annual increase under the study period equaling to 8.5 months per year, and 5.4 months per year in females.

From 2011 to 2016, the increase in life expectancy in the Central Federal District was mainly due to the decrease in male mortality, while female mortality during this period remained stable in most municipalities (Figure 2).

The level of infant and child mortality in the CFD municipalities is below the Russian average. Differences in mortality across municipalities are mainly due to mortality in working ages. Thus, mortality in ages 15-19 in municipalities with a population of under 500 thousand people already starts to exceed the national average. Significant differences in mortality remain until the age of 50. In Moscow and the Moscow Region, a lower mortality rate is characteristic of both working ages and older age groups.

Low life expectancy in the Central Federal District, as in Russia as a whole, against the background of economically developed countries, is primarily accounted for by a very high male mortality. The male survival probability up to 65 years in 2019 was under 60% in most of the CFD municipalities. In Moscow and the Moscow Region, the survival probability



**Figure 2.** Life expectancy by municipality depending on the population size (years). *Source:* authors' calculations based on the Rosstat data.

adds up to 71%, in municipalities with a population of less than 10 thousand people it equals to 55%. The female survival probability up to 60 years in 2019 ranged from 86% to 91% depending on the area (Table 2).

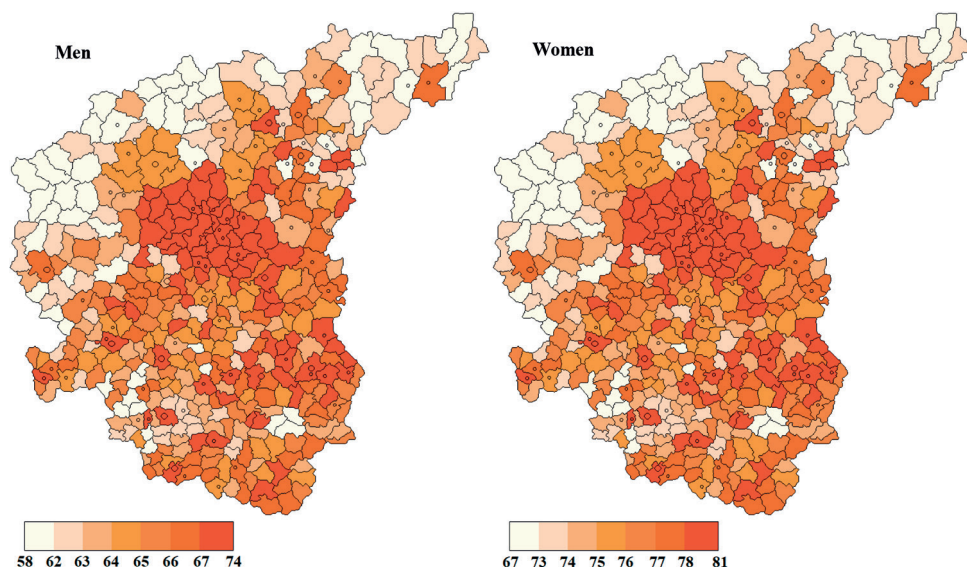
As a rule, the highest life expectancy is registered in regional capitals and other large cities with adjacent areas. The most difficult situation is observed in areas of the regions located on the North and West of the Federal Central District: Kostroma, Yaroslavl, Tver, Smolensk, Bryansk, Kursk regions. The situation is also difficult in the Orel and Kaluga regions, which

**Table 2.** Share of males and females survived until the age of 65 and 60, respectively, 2019

	Males	Females
Russian Federation	63.0	88.9
Moscow + Moscow Region	70.8	91.2
> 1 million	63.1	89.1
500-999 thousand	63.7	90.4
250-499 thousand	59.5	89.0
100-249 thousand	59.4	88.1
50-99 thousand	57.2	87.7
25-49 thousand	57.9	88.0
10-24 thousand	57.6	87.0
< 10 thousand	54.8	85.5

*Source:* authors' calculations based on the Rosstat data.





**Figure 3.** Life expectancy in the CFD municipalities in 2017-2019 (years). *Source:* authors' calculations based on the Rosstat data.

are located between the Moscow Region and the listed border regions in the Southwest of the District (Figure 3).

When considering the gap between men and women, one may note that there are no significant differences across groups of municipalities we have identified. The gap is very high everywhere, on average, females live 9-11 years longer than males. However, a more detailed analysis shows that the gap in life expectancy between men and women in 2017-2019 was less than 7 years in only seven municipalities of the Central Federal District. In the vast majority of areas (292 out of 389), the gap was 9-13 years, and over 13 years in 29 areas (Table 3).

All municipalities can be divided into the following three groups by this indicator:

- The first one includes areas with minimum difference in life expectancy between men and women, characterized by low life expectancy in both sexes (Kostroma, Yaroslavl, Tver, Smolensk regions).
- The second group includes areas with minimum difference in life expectancy between men and women, characterized by high life expectancy in both sexes (Moscow, Moscow region, Belgorod and Voronezh regions).
- The third one includes areas with maximum difference in life expectancy between men and women, characterized by low male life expectancy and high female life expectancy (Kaluga, Bryansk, Oryol, Lipetsk, Kursk, Tambov, Ryazan, Vladimir and Ivanovo regions).

Due to data limitations, we failed to directly assess life expectancy in rural population in the municipal context. However, we did manage to identify a certain relationship between the size of the area and the share of rural population: the smaller the population size, the higher the share of rural population. For example, in areas with a population of 25 to 50 thousand people, almost half (46%) of the population lives in rural areas, from 10 to 25 thousand – 62%, less than 10 thousand – 70% (Table 4).



**Table 3.** Number of municipalities of the Central Federal District by gap between men and women, 2017-2019

	Number
Less than 7 years	11
7-8 years	21
8-9 years	36
9-10 years	66
10-11 years	87
11-12 years	90
12-13 years	49
13-14 years	14
14-15 years	8
15 and more	7

Source: authors' calculations based on the Rosstat data.

**Table 4.** Life expectancy in the CFD municipalities depending on the population size (years)

	Male life expectancy 2019	Female life expectancy 2019	Life expectancy, both sexes 2019	Average annual increase in life expectancy, 2010-2019 (months)	Difference in life expectancy between males and females	Share of rural population
Moscow + the Moscow Region	74.3	82.1	78.4	7.0	8.1	9.5%
>1000 thousand	68.2	79.4	74.1	4.3	10.9	0%
>500 thousand	68.6	79.1	74.2	5.0	10.3	0%
>250 thousand	67.1	78.1	73.0	4.1	10.6	2%
>100 thousand	66.6	77.2	72.0	4.8	10.5	5%
>50 thousand	65.9	76.8	71.3	4.6	10.9	22%
> 25 thousand	66.4	77.4	71.8	5.9	10.7	46%
>10 thousand	65.8	76.6	71.0	6.5	10.7	62%
< 10 thousand	64.3	75.2	69.5	6.1	10.4	70%

Source: authors' calculations based on the Rosstat data.

## Research results and their discussion

Our study shows that all regions of the Central Federal District reported an increase in life expectancy during the study period. The CFD high life expectancy against the background of the all-Russia rates is mainly accounted for by mortality in Moscow and the Moscow Region, ensuring the CFD a place in the group of Federal Districts with life expectancy above the national average. At the same time, the average CFD life expectancy disguises a significant differentiation in mortality rates at the municipal level

It was revealed that under the study period the fastest growth rate was registered in Moscow and the Moscow Region. The most favourable situation is representative of regional capitals and municipalities with a population of over 500 thousand people, where life expectancy is comparable with the Russian average. According to some estimates (Zubarevich 2003), it is the population size of 500 thousand, that is considered a certain «borderline of social security» of settlements, starting from this size there is a significant drop in unemployment and higher employment opportunities. However, the overwhelming majority of the CFD municipalities report life expectancy below the Russian average. As a rule, most of these areas are located in the periphery of the Central Federal Districts and characterized by a small population size with a high share of rural population.

The analysis showed that the most difficult situation in the Central Federal District in terms of mortality was registered in municipalities with a population of less than 10 thousand people. As studies show, this is probably due to the fact that, the smaller the size of the settlement, the higher the probability of socio-economic problems out there (Nefedova 2008). The gap in life expectancy between municipalities with a population of less than 10 thousand people and Moscow and the Moscow Region added up to 8.9 years in both sexes in 2019, moreover, the gap remained unchanged throughout the period under study.

According to the study results, low life expectancy is mainly representative of municipalities with a significant share of rural population. Municipalities with a population of less than 10 thousand people are primarily inhabited by rural dwellers (70%, on average).

The study shows that high mortality among working age males is the main factor for a big gap in life expectancy across areas, also resulting in a big gap in life expectancy between men and women and low rates of survival to the retirement age among males.

To date, Russia has one of the lowest levels of life expectancy among the developed countries. According to WHO, in 2019, Russia ranked 96th out of 183 countries and 109th out of 189 according to the UN. The Russia's gap is mainly due to low male life expectancy. Russia reports the largest gap in the world in life expectancy between men and women.

Using the Central Federal District as an example, it is apparent that Russia has a significant territorial inequality in mortality rates. The difference between the maximum life expectancy rates (Moscow) and the minimum ones (Kologrivsky district of the Kostroma Region) adds up to 15 years. In many ways, such a large difference is due to a special position of Moscow on the «mortality map» of the Russian Federation, which, according to available research (Shchur, 2018), demonstrates such dynamics in life expectancy that no other Russian million-plus city has ever shown since the beginning of the XXI century.

To date, life expectancy in Moscow and the Moscow Region is comparable with life expectancy rates in Eastern European countries (Czech Republic, Estonia, Slovakia,

Poland). However, in the majority of the FCD municipalities life expectancy is significantly lower both in comparison with Moscow and the Russian average. Thus, about 20% of the CFD population reside in regional capitals, where life expectancy is comparable with the Russian average, while another 30% of the CFD population live in areas with life expectancy comparable with rates of the North African countries.

There are significant reserves within the Central Federal District for increasing life expectancy. Geographically, these reserves are concentrated in regional capitals with adjacent municipalities, as well as other large municipalities with a population of more than 100 thousand people, where over 75% of the CFD population reside. In total, there are 30 such municipalities in the Central Federal District.

Taking into account specifics of the gap in mortality in most areas, namely high male mortality in working ages, it should be noted that the potential of the healthcare system in solving this issue is rather limited, since mortality in working ages is largely determined by behavioural patterns and external factors (Ivanova 2014). Therefore, socio-economic transformations could contribute to reducing mortality to a greater extent: the fight against poverty, unemployment, creation of new jobs, growth of incomes of the population, implementation of measures to reduce alcohol consumption, development of a safe road transport infrastructure, etc.

With regard to potential of the healthcare system in reducing mortality in working ages, medical examination programmes and preventive medical examinations are of crucial importance. Increased coverage of the working age population with medical examinations and preventive examinations would contribute to early diagnosis and treatment of diseases of the circulatory system and neoplasms, potentially encouraging increase in life expectancy (Chandriga, Sagitova 2019).

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