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Natural population movement and COVID-19: data from Russia

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Abstract

The COVID-19 pandemic is highly infectious, so it paralyzed the health systems of many countries causing a high mortality rate. Official data on COVID-19 deaths at many sites are questioned, and the figures are considered several times higher than official data. In this sense, the objective of the study was to determine the impact of the COVID-19 pandemic on the natural movement of the population and, in addition, to evaluate the real mortality rate from COVID-19 in Russia from the construction of predictive mortality models. The study used data from the World Health Organization and the Statistical Service of the Federal State of Russia; se used linear and polynomial models to construct mortality models. The study revealed an underestimation of the official COVID-19 death rate by 2.4 to 6.8 times, depending on the data source. There was a sharp increase in mortality in Russia in 2020 among people over 50 years of age, and with the increase in age, mortality increased. The main reasons for the sharp increase in mortality were coronary heart disease, cerebrovascular diseases, and respiratory diseases, among others.

Keywords: COVID-19 pandemic; demographics; vital movement; mortality, geopolitics.

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Movimiento de población natural y COVID-19: datos de Rusia

Resumen

La pandemia de COVID-19 es altamente infecciosa, por lo que paralizó los sistemas de salud de muchos países provocando una alta tasa de mortalidad. Se cuestionan los datos oficiales sobre muertes por COVID-19 en muchos sitios, y las cifras se consideran varias veces más altas que los datos oficiales. En este sentido, el objetivo del estudio fue determinar el impacto de la pandemia de COVID-19 en el movimiento natural de la población y, además, evaluar la tasa de mortalidad real por COVID-19 en Rusia a partir de la construcción de modelos predictivos de mortalidad. El estudio utilizó datos de la Organización Mundial de la Salud y del Servicio de Estadísticas del Estado Federal de Rusia; se utilizaron modelos lineales y polinomiales para construir modelos de mortalidad. El estudio reveló una subestimación de la tasa oficial de mortalidad por COVID-19 de 2,4 a 6,8 veces, según la fuente de datos. Se produjo un fuerte aumento de la mortalidad en Rusia en 2020 entre las personas mayores de 50 años y, con el aumento de la edad, la mortalidad aumentó. Las principales razones del fuerte aumento de la mortalidad fueron las cardiopatías coronarias, las enfermedades cerebrovasculares y las enfermedades respiratorias, entre otras.

Palabras clave: Pandemia COVID-19; demografía; movimiento vital; mortalidad, geopolítica.

Introduction

In December 2019, the world learned about the emergence of COVID-19, a new infectious disease, or Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (Huang *et al.*, 2020). The epidemic that began in December 2019 has now spread to all continents and countries of the world. As of July 15, 2021, there were 188,128,952 confirmed cases of COVID-19, including 4,059,339 deaths (World Health Organization, 2021). The mortality rate from COVID-19 is different in different countries, and there are countries with a high mortality rate (for example, Peru – 590.22 deaths per 100.000 population, Hungary – 307.21, Bosnia and Herzegovina -294.56), as well as with a low mortality rate (for example, Tanzania – 0.04 deaths per 100.000 population, Lao – 0.04, Burundi – 0.07) (World Health Organization, 2021).

Today, some countries have managed to cope with cases of the disease with a high degree of recovery, and they have developed sustainable

methods of treatment (Are and Ekum, 2020). At the end of 2020 and at the beginning of 2021, vaccines against COVID-19 were developed, which are now being actively used for vaccination all over the world. As of July 15, 2021, 3,402,275,866 doses of vaccine have been given (World Health Organization, 2021). New coronavirus strains are of particular concern today (Bollinger and Ray, 2021), however, at the moment they do not fundamentally affect the overall strategy for overcoming the crisis caused by the pandemic.

The COVID-19 pandemic has had a great impact on public relations, the economy, and the financial system of the countries of the world (Nusratullin *et al*., 2021). However, the most negative consequence of the pandemic is an increase in the death rate of the population. The increase in mortality was not only due to the disease itself, but due to the lack of bed capacity, equipment, insufficient financing of the health care system, and inability to provide planned medical care in the existing situation. (Gerli *et al*., 2020). The pandemic also had a negative impact on the birth rate, as due to stress in 2020, there was a decrease in marriage and birth rates. In addition, the closure of borders and tightening of the rules for crossing them led to a decrease in migration (Ryazantsev *et al.,* 2021).

If we talk about mortality from COVID-19 in Russia, then the official data are as follows. In Russian Federation, from 3 January 2020 to 15 July 2021, there have been 5 882 295 confirmed cases of COVID-19 with 146 069 deaths. As of 12 July 2021, a total of 47 572 228 vaccine doses have been administered (World Health Organization, 2021). These data indicate that the COVID-19 pandemic has greatly affected the demographic situation in Russia.

However, it should be noted that the official data on deaths from COVID-19 cannot explain the real numbers of depopulation. The natural population decline within the year in Russia in 2020 increased by 2.2 times compared to 2019 and amounted to 702,072 people, which is 0.5% of the population of all of Russia (Federal State Statistics Service of Russia, 2021). In this regard, the problem of determining the true impact of the COVID-19 pandemic on mortality in Russia has become topical.

It is quite difficult to assess the direct impact of coronavirus on mortality in a particular country since different countries apply different standards for the causes of death partition (Middelburg and Rosendaal, 2020). In this study, we will assess mortality from COVID-19 by constructing predictive mortality models based on data for 2011-2019 and forecasting for 2020 within the established trend. And then we will compare the results obtained and the official data on mortality from COVID-19.

The purpose of this study is to determine the impact of the COVID-19 pandemic on the natural population movement and to assess the real

mortality from COVID-19 in Russia based on the construction of predictive mortality models. To achieve this goal, it is necessary to solve the following tasks:

1) To analysed data on the natural population movement in Russia.
2) To build predictive models of mortality in Russia as a whole and for causes of death in particular.
3) to compare the results obtained with official data and draw conclusions.

1. Literature Review

With the spread of COVID-19 since the end of 2019, the first studies have focused primarily on the spread and dynamics of the spread of the virus. The main epidemiological, clinical and laboratory characteristics of COVID-19 disease, as well as treatment data and clinical outcomes of patients, are disclosed in the work of Huang *et al.* (2020), Liu *et al.* (2020), Ferguson *et al.* (2020).

The first predictions of the spread of the new coronavirus were made in the studies of Read *et al.* (2020), Zhao *et al.* (2020), Li *et al.*, (2020), and in addition, they draw attention to the seriousness of the problem of the rapid spread of COVID-19. The first assessment of the impact of the new epidemic on the health systems of countries was carried out in the works of Tang *et al.* (2020), Yang *et al.* (2020).

Further research was aimed at finding ways to reduce the incidence of new COVID-19 cases, as well as the causes of asymptomatic cases. A study by Wu and McGoogan (2020) and Oran and Topol (2020) confirmed that people with asymptomatic COVID-19 disease are carriers of the disease and can actively infect people around them. Adeniyi *et al.* (2020) confirm that compliance with hygiene rules and rules of conduct in the conditions of the spread of infectious diseases reduces the rate of spread of a new coronavirus infection.

Today, there are many studies on the consequences of the COVID-19 epidemic on various areas of human activity. For example, the United Nations (2020) report shows that in 2020, the world gross domestic product declined by an estimated 4.3%, and in developed countries, it dropped by 5.6%. 420 million jobs were lost in the last two quarters of 2020. This is considerably superior to the global recession in 2009, when production went down by only 1.7%.

The economic impact of COVID-19 is assessed by Chudik *et al.* (2020). The results of the analysis show that the global recession will be prolonged

and no country will escape its consequences, regardless of the strategies to mitigate the consequences of COVID-19. Iluno *et al.* (2021) found that there is a non-linear relationship between mortality from COVID-19 and economic well-being, with mortality from COVID-19 negatively affecting well-being.

You can also highlight a separate block of research related to the interpretation, analysis and modelling of data on mortality from COVID-19. In their study, Sornette *et al.* (2020) have analysed the statistics of mortality from the epidemic of a new coronavirus infection in a number of countries. According to the data obtained, it has been revealed that the highest mortality rate per million inhabitants is observed in Western countries. The main reason for the relatively more severe COVID-19 epidemic in Western countries is the large number of older people, with the exception of Norway and Japan where other factors predominate.

Ivanaj and Oukhallou (2020) have analysed the economic and institutional determinants of COVID-19 mortality in their study. As a result, it was found that economic variables do not have a direct impact on COVID-19 mortality, while institutional variables such as the quality of regulation, government effectiveness and control of corruption, etc. have a significant and consistent downward correlation with COVID-19 mortality in different countries. These results support the claim that investing in institutions enhancing helps reduce mortality from infectious diseases.

Analyzing the scientific works of Aronov *et al.* (2020), Drapkina *et al.* (2020), Ferraro *et al.* (2020) regarding the modelling of COVID-19 morbidity and mortality from it, we should note that preliminary prognoses regarding official data are overestimated. This could be due to the more efficient operation of the health care system, or due to the underestimation of the official death rate from COVID-19. Further research has shown that the second reason is much more common.

Gerli *et al.* (2020) have assessed the spread of the COVID-19 virus, described its trends in the 27 countries of the European Union, Switzerland, and Italy, and have made predictions of mortality from it. Shojaee *et al.* (2020) have estimated the number of deaths in Italy, Iran and South Korea from COVID-19. Al-Raeei (2020) has calculated the COVID-19 pandemic mortality rates for China, the United States, Russia, and the Syrian Arab Republic. Sebastiani *et al.* (2020), Chintalapudi *et al.* (2020), Onder *et al.* (2020) have done a great job assessing the spread of the new coronavirus, described the trends in the spread of Covid-19 in Italy and have made the first mortality prognoses from it. Anastassopoulou *et al.* (2020) и Gao *et al.* (2020) have built the first projections of the number of deaths from COVID-19 in China. Sánchez-Villegas and Daponte Codina (2020) have studied the COVID-19 epidemic and gave mortality prognoses in Spain. Semenova *et al.* (2020) have predicted the number of deaths from COVID-19

in Kazakhstan. Vandoros (2020) has studied the impact of COVID-19 on mortality in England and Wales.

As part of this study, we will build predictive models of mortality in Russia as a whole and then compare them with actual data for their reasons and draw conclusions about the true scale of mortality from COVID-19.

2. Methodology

The study used data from the World Health Organization, 2021 and the Federal State Statistics Service of Russia, 2021 for 2011-2020. The work used data on the number of deaths, births, data on the natural movement of the population, fertility and mortality rates including by age groups, data on causes of death, and data on life expectancy.

To build a mortality model for Russia as a whole, a polynomial model of the second degree was used. Let y be the dependent variable and x the independent variable, polynomial regression is a special case of multiple regression with one independent variable x. A one-parameter polynomial regression model with the k order can be expressed as:

$$y_i=\beta_0+\beta_1 x_i+\beta_2 x_i^2+\cdots+\beta_k x_i k+e_i,\ i=1,2,\cdots,\ n; \quad (1)$$

where k is the order of the polynomial, the βs are the unknown parameters to be estimated, and e is the error term.

If $k = 1$, then equation (1) becomes:

$$y_i=\beta_0+\beta_1 x_i+e_i;i=1,2,\cdots,n. \quad (2)$$

Equation (2) is a simple linear model.

If $k = 2$, then equation (1) becomes:

$$y_i=\beta_0+\beta_1 x_i+\beta_2 x_i^2+e_i;i=1,2,\cdots,n. \quad (3)$$

To build models of mortality due to their causes, a polynomial model of the first degree, or simply a linear model, was used (2). The choice of models for making a prognosis was carried out in the framework of their reliability.

3. Results and Discussion

Analysing the natural movement of the population in Russia over the past 10 years, it should be noted that it has a negative trend and can be characterised as depopulation. In society, the institution of the family is being transformed and value attitudes towards children are changing, women begin to give birth to fewer children and do it much later (Ryazantsev *et al.*, 2021). In Russia, simple reproduction of the population is not ensured (2.14-2.15 children per woman of the reproductive age). The total fertility rate in Russia from 2011 to 2020 is shown in Figure 1.

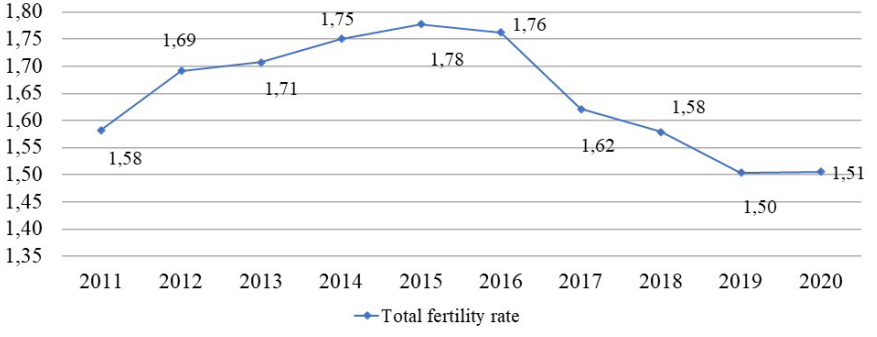

Figure 1. Total fertility rate in Russia from 2011 to 2020

Source: Federal State Statistics Service of Russia, 2021.

The total fertility rate in Russia from 2011 to 2015 grew steadily from 1.58 to 1.78, but since 2016 it has seen a sharp drop to 1.51 in 2020. The decline in the birth rate also affects the natural movement of the population in Russia. But in 2020, a new factor is added to the negative trend of declining fertility, the COVID-19 pandemic. Table 1 shows data on the number of deaths and births in Russia over the past 10 years.

Table 1. The number of births, deaths and natural increase in Russia for the period of 2011-2020

	2011	2012	2013	2014	2015
Number of births within a year	1796629	1902084	1895822	1942683	1940579
Number of deaths within a year	1925720	1906335	1871809	1912347	1908541
Natural increase within a year	-129091	-4251	24013	30336	32038
	2016	2017	2018	2019	2020
Number of births within a year	1888729	1690307	1604344	1481074	1436514
Number of deaths within a year	1891015	1826125	1828910	1798307	2138586
Natural increase within a year	-2286	-135818	-224566	-317233	-702072

Source: Federal State Statistics Service of Russia, 2021.

Table 1 clearly shows that from 2011 to 2015, there is a clear trend towards an increase in the number of births from 1.80 million to 1.94 million, but in 2016 this trend was reversed and in 2020 the number of births was 1.44 million. As for the number of deaths, its trend is clearer and there is a gradual decrease in mortality from 1.93 million to 1.80 million, but only in 2020, there is a sharp jump to 2.14 million. These trends can be traced more clearly in Figure 2.

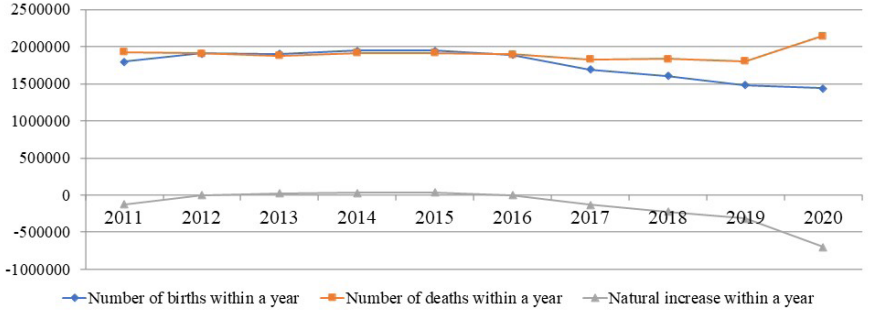

Figure 2. The number of births, deaths and natural increase in Russia for the period of 2011-2020

Source: Federal State Statistics Service of Russia, 2021

The presented dynamics of fertility and mortality in Russia led to the fact that positive population growth in 2013-2015 was replaced by negative population growth since 2016 and sharply increased in 2020 and amounted to a natural population decline of 0.7 million people in a year.

The decline in the number of births has a long-term trend that has been observed since 2016. The decrease in the total number of births is mainly explained by the decrease in the number of women giving birth at an early age (15-24 years) and mean age of childbearing (from 25-34 years). It should be noted that in recent years there has been an established trend in the number of women giving birth at the age of 35 and older (Table 2, Figure 3).

Table 2. Age-specific fertility rates (the average number of births per 1000 women aged per year, years)

	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
15-19 years	26.70	27.30	26.60	26	24	21.50	18.39	16.10	14.60	14.10
20-24 years	87.50	91.30	89.90	89.80	90	87.20	81.20	78.40	74.80	73.59
25-29 years	99.80	106.60	107.60	110.20	112.60	111.50	100.10	96.50	91.20	92.60
30-34 years	68.20	74.30	76.20	79.80	83	84.40	77.20	76.09	71.59	70.80
35-39 years	31.40	34.90	36.79	39	39.79	41	39.20	39.70	38.70	39.20
40-44 years	6.30	7	7.40	8.10	8.30	8.80	8.69	8.90	8.90	9.19
45-49 years	0.30	0.30	0.30	0.40	0.40	0.50	0.50	0.50	0.50	0.60
50-54 years	0	0	0	0	0	0	0	0	0.10	0.10

Table 2 and Figure 3 show the demographic problem of the Russian society, when women are giving birth less and less, and the number of children in families is decreasing, of which there are mainly 1-2, rarely 3 or more. The decline in the number of births from year to year in Russia is a long-term trend and is more associated with economic problems (Nusratullin *et al.,* 2020), with changes in society and the psychology of people.

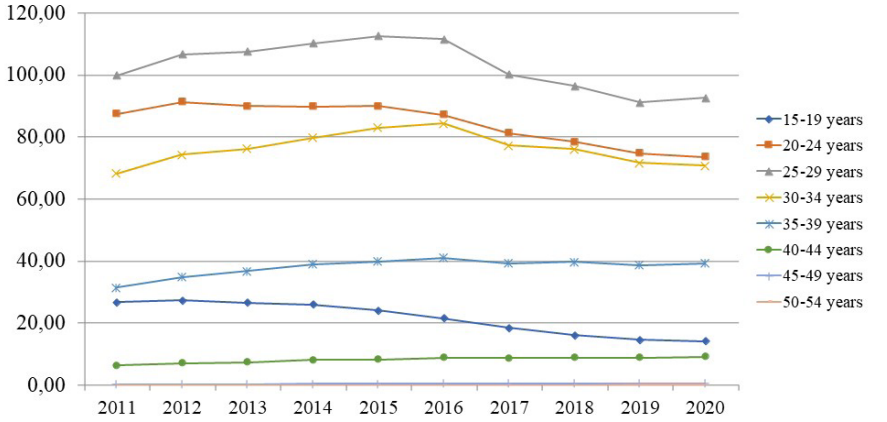

Figure 3. Age-specific fertility rates (the average number of births per 1000 women aged per year, years)

Source: Federal State Statistics Service of Russia, 2021

However, as mentioned above, the increase in mortality in 2020 to 2.13 million people compared with 1.79 million people in 2019 is not a consequence of the current trend, but it is more associated with the COVID-19 factor. But if we turn to official statistics, in 2020, 59,019 people died from COVID-19 in Russia (Starostina and Tkachev, 2021). This suggests a conclusion either about the presence of another factor in the increase in mortality, or about the underestimation of official data on mortality from the pandemic.

To answer this question, let us first find the number of "excess deaths" in 2020, and for this we will build a predictive mortality model based on data for 2011-2019. To build the trend line of the time series, the following models were tested: exponential, linear, logarithmic, and polynomial. The resulting models and the degree of their reliability are presented in Table 3.

Table 3. Mortality models in Russia and the degree of their reliability

Model type	Model	Degree of the reliability, R^2
Exponential	$y = 9\ 224\ 452\ 819\ 288.89e^{-0.01x}$	$R^2 = 0.73$
Linear	$y = -14\ 243.78x + 30\ 575\ 568.86$	$R^2 = 0.73$

Logarithmic	y = -28 695 655.05ln(x) + 220 201 611.33	R^2 = 0.73
Second-order polynomial	y = -17 655.77x^2 + 71 109 098.34x - 71 596 504 001.33	R^2 = 0.96

Source: calculated by the authors.

As can be seen from the table, the most reliable mortality model in Russia is polynomial. We will build it and predict mortality in Russia in 2020 according to the data of 2011-2019.

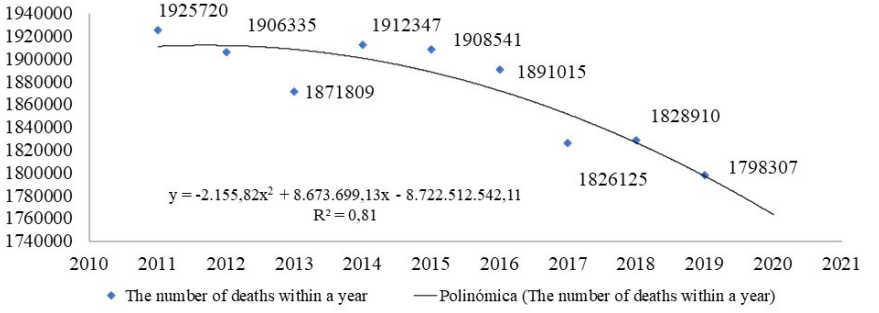

Figure 4. Polynomial mortality model in Russia according to 2011-2019 data

Source: calculated by the authors.

According to the model obtained, the number of deaths in 2020 was expected in the amount of 1,751,773 deaths, but according to the actual data, the number of deaths in Russia was 2,138,586 deaths. That is, the number of excess deaths in Russia was 386,813 deaths. These figures are in no way combined with the data on the number of deaths from COVID-19 which according to official data in 2020 amounted to 57,019 (Starostina and Tkachev, 2021). To clarify the reasons for the sharp increase in mortality, let us further consider the age at which the increase in mortality occurred and their causes.

Age-specific death rates are calculated as the ratio of the deceased people of the corresponding sex and age during the calendar time to the average annual number of people of this age per 1000 people. This indicator shows how often people of a certain age die. Usually, the older the population group, the higher the mortality rate. Let`s consider this indicator in Table 4 and Figure 5.

Table 4. Age-specific death rates

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1-4 years	0.50	0.50	0.40	0.40	0.40	0.40	0.30	0.30	0.30	0.30
5-9 years	0.30	0.30	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
10-14 years	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.20	0.20	0.20
15-19 years	0.80	0.80	0.80	0.80	0.70	0.70	0.60	0.60	0.60	0.60
20-24 years	1.60	1.50	1.50	1.40	1.30	1.10	1	1	0.90	1
25-29 years	2.70	2.50	2.40	2.29	2	1.80	1.60	1.50	1.40	1.40
30-34 years	4.09	4	3.90	3.70	3.40	3.10	2.70	2.50	2.40	2.50
35-39 years	4.90	4.80	4.80	5	4.80	4.50	4.09	4	3.80	4
40-44 years	5.90	5.60	5.60	5.70	5.70	5.50	5.09	5.20	5.20	5.70
45-49 years	8	7.50	7.30	7.30	7.10	6.80	6.30	6.40	6.40	7.30
50-54 years	10.90	10.30	9.90	9.80	9.60	9.40	8.60	8.69	8.50	9.69
55-59 years	15.50	14.70	14	13.90	13.50	13.20	12.40	12.30	12.10	13.90
60-64 years	21.80	20.80	20.10	19.80	19.50	19.10	18	18	17.60	20.60
65-69 years	28.60	27	26	26.20	26.20	26.40	25.10	25.30	24.40	29.60
70-74 years	41.50	41.20	40.10	39.10	38.40	36.70	34.29	34	34.10	42.60
75-79 years	64.40	61.80	58.40	58.20	58	57.10	56	55.70	53.40	64
80-84 years	102	101.70	98.90	96.70	95.20	92.20	87.10	84	82.70	100.70
85 years older	174.40	173.70	171.80	171.50	172.50	171.20	168.90	168.50	163.69	190.20

Source: Federal State Statistics Service of Russia, 2021.

As can be seen from the table and the figure, the greatest increase in mortality by age group occurred among the population over 50, and the older is the age group, the higher the rate of increase in mortality is. In the population aged 41 to 49, the mortality rate increased insignificantly, but in the population under the age of 41, it practically did not change.

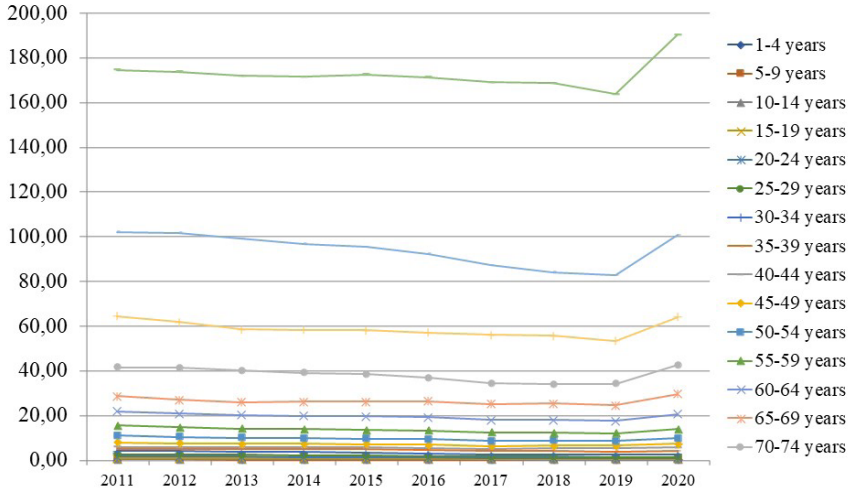

Figure 5. Age-specific death rates

Source: Federal State Statistics Service of Russia, 2021.

Mortality data by age group indirectly suggests that their causes are associated with the COVID-19 pandemic, since the main blow falls on older people (Polidori *et al,*. 2021), when the cause of death is not only the virus itself, but also its complications. Let us consider further for what main groups of causes there was an increase in mortality (Table 5, Figure 6).

Table 5. The number of deaths by main classes and individual death causes per year

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Infectious and parasitic diseases	33672	32084	31808	32103	34372	35335	35045	34626	32918	30173
Coronary heart disease	568182	562957	529824	492303	494638	481780	461786	453306	442328	508657
Cerebrovascular diseases	332804	323003	310531	295602	290300	279818	264468	263573	260594	278618
Respiratory diseases	74219	70793	74068	78312	75813	70332	62032	61150	59188	96539
Diseases of the digestive system	88910	88867	88431	96689	101956	98215	92989	95430	98271	107399
External causes	199358	193774	185353	186779	177590	167543	152741	144612	137633	139583
Alcohol poisoning	16288	15226	14549	15400	15242	14021	12276	11045	9876	10206
Suicide	31144	29735	28779	26606	25476	23119	20278	18206	17192	16546

Murder	16795	15408	14427	12921	11984	10569	9048	7986	7302	6859
Malignant neoplasms	289535	287789	288636	286900	296476	295729	290662	293704	294400	291461
Blastemas	292445	290880	291775	290400	300232	299652	294587	297996	298699	295910
Circulatory diseases	1076458	1055592	1001799	940489	930102	904055	862895	856127	841207	938536
All types of transport accidents	29658	30203	29191	28829	24821	21610	20161	19092	17787	17041

Source: Federal State Statistics Service of Russia, 2021.

Based on the data in Table 5 and Figure 6, by groups of causes of death such as infectious and parasitic diseases, diseases of the digestive system, external causes, cases of alcohol poisoning, suicide, murder, malignant neoplasms, blastema's, all types of transport accidents, the change in mortality occurred within the established trends, and the calculations carried out confirmed this hypothesis. However, according to the groups of causes of death such as coronary heart disease, cerebrovascular diseases, respiratory diseases, diseases of the circulatory system, the situation is radically different. There is an abnormal increase in mortality for these reasons.

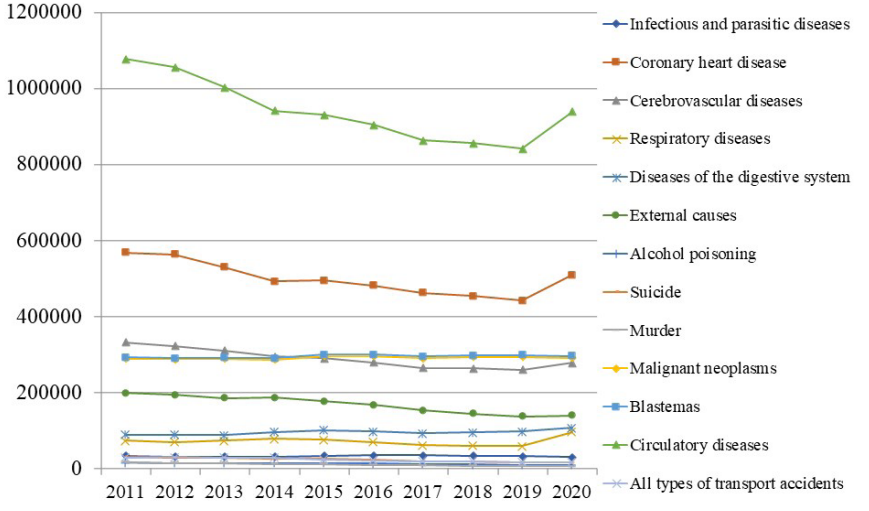

Figure 6. The number of deaths by main classes and individual death causes per year

Source: Federal State Statistics Service of Russia, 2021.

To calculate the "excess mortality" due to the indicated reasons in 2020, we will build reliable mortality rate models based on the data of 2011-2019 (Table 7). To do this, we will build polynomial models of the first degree, or simply linear models.

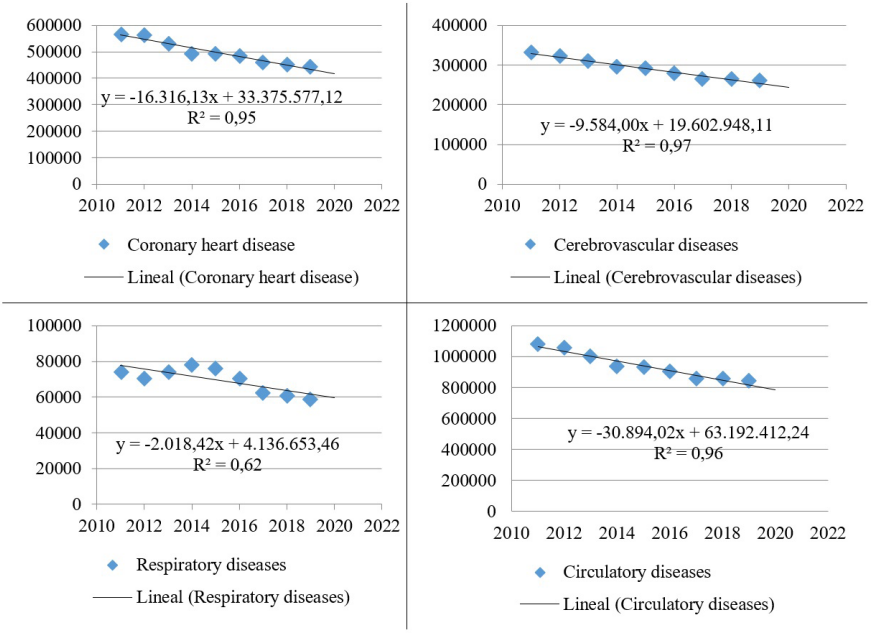

Figure 7. Polynomial models of the first degree of mortality in Russia by their causes according to 2011-2019 data

Source: calculated by the authors.

Based on the models obtained in Figure 7, we will calculate the predicted values of mortality by cause and find the number of "excess deaths" (Table 6).

Table 6. The number of "excess deaths" due to their causes in 2020.

	2020 (actual facts)	2020 (prognosis)	The number of "excess deaths" due to their causes
Coronary heart disease	508 657	416 995	91 662

Cerebrovascular diseases	278 618	243 268	35 350
Respiratory diseases	96 539	594 45,	37 094
Circulatory diseases	938 536	786 492	152 044
Total	x	x	316 150

Thus, in 2020, there were 91,662 "excess deaths" due to coronary heart disease, 35,350 – due to cerebrovascular diseases, 37,094 – due to respiratory diseases, 152,044 – due to diseases of the circulatory system, and total 316,150 "excess deaths". These data also indirectly indicate that they are associated with the COVID-19 pandemic, since the main complications in COVID-19 disease are these reasons (Polidori *et al.,* 2021).

Again, the results obtained are in no way comparable with the official data, according to which 59,019 people died from COVID-19 in Russia in 2020 (Starostina and Tkachev, 2021). They are more comparable with the results we obtained earlier, namely, 386,813 "excess deaths".

Our data on the real number of deaths in Russia from COVID-19 is also comparable with the findings of other scientists. The Ryazantsev *et al.* (2021) study also noted the excess mortality in the amount of 324,000 people in Russia in 2020. According to the authors, more than a third of these losses are associated with coronavirus infection, directly or indirectly. The Lifshits and Neklyudova (2020) econometric analysis showed that in Russia the real mortality rates were underestimated by more than 2 times, and as new data became available, the results were confirmed.

According to Lifshits and Neklyudova (2020) real indicators began to be underestimated in May 2020, both in the number of cases and in the number of deaths. Kobak (2021) argues that data on additional deaths in Russia in 2020 paint a much darker picture of the death toll from Covid-19 than the official daily updated figures. Analysis of excess mortality in Russia from April to November yielded a dismal 264,100 additional deaths from COVID-19 in Russia.

It should be noted that at the beginning of 2021 Federal State Statistics Service of Russia published statistics according to which the number of deaths from COVID-19 itself was 57,019, deaths associated with the consequences of COVID-19 amounted to 103,968 deaths, which totally works out 162,249 deaths (Starostina and Tkachev, 2021). However, these data are also not comparable with the results obtained by us and other scientists.

Conclusions

The natural population movement in Russia over the past 10 years has a negative trend and can be characterised as depopulation. The total fertility rate in Russia from 2011 to 2015 grew steadily from 1.58 to 1.78, but since 2016 it has seen a sharp drop to 1.51 in 2020. From 2011 to 2015, there is a clear trend towards an increase in the number of births from 1.80 million to 1.94 million, but in 2016 this trend is reversed and in 2020 the number of births was 1.44 million. As for the number of deaths, its trend is clearer and there is a gradual decrease in mortality from 1.93 million to 1.80 million in 2019, but only in 2020, there is a sharp spike to 2.14 million.

According to official data, the number of deaths from COVID-19 itself was 57,019 deaths, and those associated with the consequences of COVID-19 are 103,968 deaths, which is a total of 162,249 deaths. Within the framework of our study, from 316,150 to 386,813 "excess deaths" from COVID-19 were identified by constructing predictive models of mortality in general and for their reasons. Thus, an underestimation of the official mortality rate from COVID-19 was revealed from 2.4 to 6.8 times, depending on the data source.

A sharp spike in mortality in Russia in 2020 occurred among people over 50, and, with increasing age, mortality increased. The main reasons for the sharp increase in mortality were coronary heart disease, cerebrovascular diseases, respiratory diseases, and diseases of the circulatory systems. Understanding the true catastrophe of COVID-19 in Russia will allow us to critically evaluate the actions of state and municipal authorities, as well as draw the right conclusions on how to get out of this catastrophic situation.

Bibliographic references

ADENIYI, Michael; EKUM, Matthew; ILUNO, C; OGUNSANYA, A; AKINYEMI, J; OKE, S; MATADI, M. 2020. "Dynamic Model of COVID-19 disease with exploratory data analysis" In: Scientific African. Vol. 9. No. 14, pp. 166-182.

AL-RAEEI, Marwan. 2020. "Te forecasting of COVID-19 with mortality using SIRD epidemic model for the United States, Russia, China, and the Syrian Arab Republic" In: AIP Advances. Vol. 10, No. 6, pp. 70-82.

ANASTASSOPOULOU, Cleo; RUSSO, Lucia; TSAKRIS, Athanasios; SIETTOS, Constantinos. 2020. "Data-based analysis, modelling and forecasting of the COVID-19 outbreak" In: Plos One. Vol. 15, No. 3, pp. 114-123.

ARE, Stephen Olusegun; EKUM, Matthew Iwada. 2020. "COVID-19 pandemic data visualization with moment about midpoint: exploratory and expository analyses" In: Asian Journal Probability Statistics. Vol. 8, No. 4, pp. 15-37.

ARONOV, Iosif; MAKSIMOVA, Olga; GALKINA, Nataliia. 2020. "COVID-19 Highest Incidence Forecast in Russia Based on Regression Model" In: International Journal of Mathematical Engineering and Management Sciences. Vol. 5, No. 5, pp. 812-819.

BOLLINGER, Robert; RAY, Stuart. 2021. New Variants of Coronavirus: What You Should Know. Johns Hopkins Medicine. Available online. In: https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/a-new-strain-of-coronavirus-what-you-should-know. Date of consultation: 05/05/2021.

CHINTALAPUDI, Nalini; BATTINENI, Gopi; AMENTA, Francesco. 2020. "COVID-19 virus outbreak forecasting of registered and recovered cases after sixty day lockdown in Italy: A data driven model approach" In: Journal of Microbiology Immunology and Infection. Vol. 53, No. 3, pp. 396-403.

CHUDIK, Alexander; MOHADDES, Kamiar; PESARAN, Hashem; RAISSI, Mehdi; REBUCCI, Alessandro. 2020. Economic consequencies of COVID-19: A counterfactual multi-country analysis. Research-based policy analysis and commentary from leading economists. Available online. In: https://voxeu.org/article/economic-consequences-covid-19-multi-country-analysis. Date of consultation: 05/05/2021.

DRAPKINA, Oksana; SAMORODSKAYA, Irina; SIVTSEVA, Marina; KAKORINA, Ekaterina; BRIKO, Nikolay; CHERKASOV, Sergey; ZINSERLING, Vsevolod; MALKOV, Pavel. 2020. "COVID-19: urgent questions for estimating morbidity, prevalence, case fatality rate and mortality rate" In: Cardiovascular Terapy and Prevention. Vol. 19, No. 3, article №2585.

FEDERAL STATE STATISTICS SERVICE OF RUSSIA. 2021. Statistical Dashboard. Available online. In: https://showdata.gks.ru/finder/. Date of consultation: 05/05/2021.

FERGUSON, Neil; LAYDON, Daniel; NEDJATI-GILANI, Gemma; IMAI, Natsuko; AINSLIE, Kylie. 2020. Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College COVID-19 Response Team. Available online. In: https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/report-9-impact-of-npis-on-covid-19/. Date of consultation: 05/05/2021.

FERRARO, Ottavia Eleonora; PUCI, Mariangela Valentina; MONTOMOLI, Cristina; ROLESU, Sandro; CAPPAI, Stefano; LOI, Federica. 2020. "Official Data and Analytical Forecasts: Diferences and Similarities Among Coronavirus Disease (COVID-19)" In: Frontiers in Medicine. No. 7, No. 239, pp. 363-382.

GAO, Yuanyuan; ZHANG, Zuqin; YAO, Wei; YING, Qi; LONG, Chen; FU, Xinmiao. 2020. "Forecasting the cumulative number of COVID-19 deaths in China: a Boltzmann function-based modeling study" In: Infection Control and Hospital Epidemiology. Vol. 41, No. 7, pp. 841-843.

GERLI, Alberto; CENTANNI, Stefano; MIOZZO, Monica; VIRCHOW, Chistian; SOTGIU, Giovanni; CANONICA, Walter; SORIANO, Joan. 2020. "COVID-19 mortality rates in the European Union, Switzerland, and the UK: effect of timeliness, lockdown rigidity, and population density" In: Minerva medica. Vol. 111, No. 4, pp. 308-314.

HUANG, Chaolin; WANG, Yemin; LI, Xingwang; REN, Lili; ZHAO, Jianping; HU, Yi. 2020. "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China" In: The Lancet. Vol. 395, No. 10223, pp. 497-506.

ILUNO, Christiana; TAYLOR, Jimoh; AKINMOLADUN, Olusegun; ADERELE, Oluwaseun; EKUM, Matthew. 2021. "Modelling the effect of Covid-19 mortality on the economy of Nigeria" In: Research in Globalization. Vol. 3, No. 100050, pp. 1200-1242.

IVANAJ, Ernest; OUKHALLOU, Youssef. 2020. The Economic and Institutional Determinants of COVID-19 Mortality. Munich Personal RePEc Archive. Available online. In: https://mpra.ub.uni-muenchen.de/103895/. Date of consultation: 05/05/2021.

KOBAK, Dmitry. 2021. "Excess mortality reveals Covid's true toll in Russia" Significance. Vol. 18, No. 1, pp. 16-19.

LI, Qun; GUAN, Xuhua; WU, Peng; WANG, Xiaoye; ZHOU, Lei; TONG, Yeqing. 2020. "Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia" In: The New England Journal of Medicine. No. 382, pp. 1199-1207.

LIFSHITS, Marina; NEKLYUDOVA, Natalia. 2020. "COVID-19 mortality rate in Russian regions: forecasts and reality" In: R-economy. Vol. 6, No. 3, pp. 171-182.

LIU, Yin; GAYLE, Albert A; WILDER-SMITH, Annelies; ROCKLÖV, Joacim. 2020. "The reproductive number of COVID-19 is higher compared to SARS coronavirus" In: Journal of Travel Medicine. Vol. 27, No. 2, pp. 06-19.

MIDDELBURG, Rutger A; ROSENDAAL, Frits. 2020. "COVID-19: How to make between-country comparisons" In: International Journal of Infectious Diseases. Vol. 96, pp. 477-481.

NUSRATULLIN, Ilmir; KUZNETSOVA, Svetlana; GAZIZYANOVA, Yuliya; KUTSENKO, Ekaterina; BEREZHNAYA, Lubov. 2020. "Socio-economic development of Russia in terms of the BRICS countries' development" In: Amazonia Investiga. Vol. 9, No. 27, pp. 52-61.

NUSRATULLIN, Ilmir; MROCHKOVSKIY, Nikolay; YARULLIN, Raul; ZAMYATINA, Natalia; SOLNTSEVA, Oksana. 2021. The "Financial Implications of the Coronavirus COVID-19 Pandemic: A Review" In: Cuestiones Politicas. Vol. 39, No. 68, pp. 325-342.

ONDER, Graziano; REZZA, Giovanni; BRUSAFERRO, Silvio. 2020. "Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy" In: Jama-Journal of the American Medical Association. Vol. 323, No. 18, pp. 1775-1776.

ORAN, Daniel; TOPOL, Eric. 2020. "Prevalence of Asymptomatic SARS-CoV-2 Infection: A Narrative Review" In: Annals of internal medicine. Vol. 173, No. 5, pp. 362-367.

POLIDORI, Cristina; SIES, Helmut; FERRUCCI, Luigi; BENZING, Thomas. 2021. "COVID-19 mortality as a fingerprint of biological age" In: Ageing Research Reviews. Vol. 67, article №101308.

READ, Jonathan; BRIDGEN, Jessica; CUMMINGS, Derek; HO, Antonio; JEWELL, Chirs. 2021. "Novel coronavirus 2019-nCoV (COVID-19): early estimation of epidemiological parameters and epidemic size estimates" In: Philosophical Transactions B. Vol. 376, No. 20200265.

RYAZANTSEV, Sergey; IVANOVA, Alla; ARKHANGELSKY, Vladimir. 2021. "Increasing Depopulation in Russia in the Context of the Covid-19 Pandemic: Regional Features" In: Bulletin of the South-Russian State Technical University (NPI) Series Socio-Economic Sciences. Vol. 14, No. 2, pp. 7-20.

SÁNCHEZ-VILLEGAS, Pablo; CODINA, Antonio Daponte. 2020. "Modelos predictivos de la epidemia de COVID-19 en España con curvas de Gompertz. Gaceta Sanitaria" In: Press. Vol. 35, No. 6, pp. 263-290.

SEBASTIANI, Giovanny; MASSA, Marco; RIBOLI, Elio. 2020. "Covid-19 epidemic in Italy: evolution, projections and impact of government measures" In: European Journal of Epidemiology. Vol. 4, No. 35, pp. 341-345.

SEMENOVA, Yuliya; GLUSHKOVA, Natalya; PIVINA, Lyudmila; KHISMETOVA, Zaituna; ZHUNUSSOV, Yersin; SANDYBAEV, Marat; IVANKOV, Alexandr. 2020. "Epidemiological Characteristics and Forecast of COVID-19 Outbreak in the Republic of Kazakhstan" In: Journal of Korean Medical Science. Vol. 35, No. 24, pp. 45-56.

SHOJAEE, Sajad; POURHOSEINGHOLI, Mohamad Amin; ASHTARI, Sara; VAHEDIAN-AZIMI, Amir; ASADZADEH-AGHDAEI, Hamid; ZALI, Mohammad Reza. 2020. "Predicting the mortality due to Covid-19 by the next month for Italy, Iran and South Korea; a simulation study" In: Gastroenterology and hepatology from bed to bench. Vol. 13, No. 2. pp 177-179.

SORNETTE, Didier; MEARNS, Euan; SCHATZ, Michael; WU, Ke; DARCET, Didier. 2020. Interpreting, analysing and modelling COVID-19 mortality data. Nonlinear dynamics, 1–26. Available online. In: https://doi.org/10.1007/s11071-020-05966-z. Date of consultation: 05/05/2021.

STAROSTINA, Julia; TKACHEV, Ivan. 2021. Rosstat named the number of deceased Russians with COVID-19 in 2020. Available online. In: https://www.rbc.ru/economics/08/02/2021/602132e19a7947073f7ddeb5. Date of consultation: 05/05/2021.

TANG, Biao; WANG, Xia; LI, Qian; BRAGAZZI, Nicola Luigi; TANG, Sanyi; XIAO, Yanni; WU, Jianhong. 2020. "Estimation of the Transmission Risk of the 2019-nCoV and Its Implication for Public Health Interventions" In: Journal of clinical medicine. Vol. 9, No. 2, pp. 462-479.

UNITED NATIONS. 2020. World Economic Situation and Prospects 2021. Available online. In: https://www.un.org/development/desa/dpad/publication/world-economic-situation-and-prospects-2021/. Date of consultation: 05/05/2021.

VANDOROS, Sotiris. 2020. "Excess mortality during the Covid-19 pandemic: Early evidence from England and Wales" In: Social Science & Medicine. Vol. 258, article № 113101.

WORLD HEALTH ORGANIZATION. 2021. WHO Coronavirus (COVID-19) Dashboard. Available online. In: https://covid19.who.int/. Date of consultation: 05/05/2021.

WU, Zunyou; MCGOOGAN, Jennifer. 2020. "Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention" In: JAMA. Vol. 13, No. 323, pp. 1239-1242.

YANG, Shu; CAO, Peihua; DU, Peipei; WU, Ziting; ZHUANG, Zian; YANG, Lin; YU, Xuan; ZHOU, Qi; FENG, Xixi; WANG, Xiaohui; LI, Weiguo; LIU, Enmei; CHEN, Ju; CHEN, Yaolong; HE, Daihai. 2020. "Early estimation of the case fatality rate of COVID-19 in mainland China: a data-driven analysis" In: Annals of translational medicine. Vol. 8, No. 4, pp. 128-140.

ZHAO, Shi; LIN, Qianyi; RAN, Jinjun; MUSA, Sahilu; YANG, Guangpu; WANG, Weiming; LOU, Yijun; GAO, Daoz; YANG, Lin; HE, Daihai; WANG, Maggie. 2020. "Preliminary estimation of the basic reproduction number of novel coronavirus (2019-nCoV) in China, from 2019 to 2020: A data-driven analysis in the early phase of the outbreak" In: International journal of infectious diseases: IJID: official publication of the International Society for Infectious Diseases. No. 92. pp 214-217.

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