

## EFFECTS OF THE COVID-19 PANDEMIC ON MORTALITY IN SERBIA IN 2020 <sup>a</sup>

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### Abstract

The coronavirus SARS-CoV-2 causes the systemic disease COVID-19, which killed more people in a few months than all infectious diseases together in this century. COVID-19 was one of the leading causes of death in 2020 in many countries (according to the preliminary data).

By applying the demographic method to final mortality data for 2020, we can give an overview of the situation in Serbia through population mortality indicators.

The effect of COVID-19 on mortality in Serbia in 2020 was higher than anticipated. The surplus of mortality that occurred in 2020 (compared to the three-year average of 2017-2019) is 14,657, an increase in mortality of about 14%. Deaths from COVID-19, according to vital statistics, make up 71% of excess mortality. This increase is also reflected in life expectancy at birth which dropped by 1.55 years. The male population observed higher mortality rates from COVID-19 and a more significant life expectancy drop. Around 4% of those who died from COVID-19 are younger than 50. A person who is 85 or older was almost 100 times more likely to die from the consequences of COVID-19 than a person who is 34 or younger. COVID-19 was the second leading cause of death in Serbia in 2020. One of the few positive things about this pandemic is that violent deaths plummeted.

**Key words:** COVID-19, SARS-CoV-2, pandemic 2020, mortality, Serbia.

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## ПОСЛЕДИЦЕ КОВИД-19 ПАНДЕМИЈЕ НА СМРТНОСТ СТАНОВНИШТВА СРБИЈЕ 2020. ГОДИНЕ

### Апстракт

Коронавирус проузрокује системску болест КОВИД -19 која је за неколико месеци усмртила више људи него све заразне болести у овом веку. Последице по здравље становништва још нису довољно истражене, а према првим подацима КОВИД-19 је међу водећим узроцима смрти 2020. у многим земљама.

На основу коначних резултата за 2020. годину, применом демографског метода анализе података, кроз показатеље смртности становништва, могуће је дати приказ стања у Србији.

Ефекти пандемије на морталитет у Србији су били већи него што се могло очекивати. Вишак морталитета који се догодио 2020. (у поређењу са трогодишњим просеком 2017-2019) је 14.657, што је повећање морталитета за око 14%. Према виталној статистици, смрт од КОВИД -19 чини 71% од прекомерне смртности у Србији. Ово повећање смртности утиче и на очекивано трајање живота при живорођењу које је пало за 1,55 година. Мушка популација има веће стопе морталитета од КОВИД -19 и значајнији пад очекиваног трајања живота у 2020. години. Око 4% умрлих од КОВИД -19 су млађи од 50 година. Особа која има 85 или више година има скоро 100 пута већу вероватноћу да умре од последица КОВИД -19 него особа која има 34 или мање године. КОВИД -19 је други водећи узрок смрти у Србији 2020. Једна од ретких позитивних ствари везаних за ову пандемију је смањење насилних смрти.

**Кључне речи:** КОВИД-19, коронавирус, пандемија 2020, морталитет, Србија.

### INTRODUCTION

Throughout history, infectious diseases have been the most faithful companion of humankind. The smallest microorganisms – the ever-changing viruses – have posed a challenge to the health of the human population over and over again. Pandemics leave especially deep marks<sup>1</sup>, as they can change the arc of history. Infectious diseases have killed more people in written history than all-natural disasters and wars combined (Glezen, 1996). Only in the 20<sup>th</sup> century, we had three influenza pandemics: 1918, 1957, and 1968 and all lasted for about three years (Kilbourne, 2006). The 1918 influenza pandemic (Spanish flu) undoubtedly took the most lives, with some estimates going as high as 50 million deaths globally (Garber, 2021). Other pandemics in the 20<sup>th</sup> century were not as deadly. Overall, infectious diseases, especially since the middle of the 20<sup>th</sup> century in Europe and the developed world, ceased to be among the leading causes of death. This remarkable triumph of humanity led to a loss of public interest and more relaxed behavior of health systems when

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<sup>1</sup> Pandemics due to infectious diseases are most often the result of the emergence of a strain of the influenza virus (i.e. the flu), which is new to the human population and can spread through the population of a larger geographical area, continent or the whole world.

infectious diseases were in question. Attention shifted to chronic, non-communicable diseases until 2020 when the world was shaken by a new pandemic caused by a coronavirus called SARS-CoV-2.

COVID-19 is an infectious disease caused by the newly discovered coronavirus SARS-CoV-2. The clinical features of COVID-19 vary widely, from asymptomatic infection to severe pneumonia with acute respiratory failure. COVID-19 is a systemic disease resulting from the predominant inflammatory response, which can cause severe health conditions, even in young patients (Massabeti, Cipriani & Valenti, 2020). The SARS-CoV-2 virus pandemic should be seen as an extremely high health risk for the population, as 1.8 million deaths with a diagnosis of COVID-19 were reported in 2020, while recent estimates by the World Health Organization (WHO) indicate excess mortality in that period of at least 3 million (WHO, 2021). While at the beginning it seemed that the threat of a current pandemic is less severe than that of the Spanish flu of 1918, mortality from COVID-19 in the coming period may surpass the overall mortality from all infectious diseases in the last 100 years (Goldstein and Lee, 2020) and leave consequences for the health of the population which have not been recorded so far.

Based on the analysis of available data on the SARS-CoV-2 pandemic, different countries have suffered in very different ways. We must be aware that there was no time to establish a uniform methodology for diagnosing a new disease in the year of the pandemic and that the overall quality of data is not at a high level. The quality of the data also varies significantly across different countries. Many countries still lack functional civil registration services and vital statistics systems that can provide accurate, complete, and timely data on births, deaths, and causes of death (WHO, 2021). Thus, researchers often try to give an early snapshot of the situation based on preliminary data. Based on data for 2020 (March to December), Serbia is among the ten countries in the world with the highest excessive mortality (Karlinsky and Kobak, 2021). The other Balkan countries (Northern Macedonia, Bulgaria, Serbia, Albania, Bosnia and Herzegovina) stand out as well. The research based on the preliminary data for 34 European countries showed that the countries in Southern Europe faced the most significant consequences of the pandemic and that those in the north of the continent had the most favorable outcomes (Marinković and Galjak, 2021). The same research underlines no apparent regional regularity and that nearby countries' outcomes can differ dramatically.

In the first months of the pandemic, researchers discovered that men had higher mortality across all age groups (Ahrenfeldt et al., 2020; Goldstein Lee, 2020; Takahashi et al., 2020). The number of deaths is highest in men with pre-existing cardiovascular conditions (Gebhard et al., 2020). Unlike other respiratory diseases, mortality due to COVID-19 does not represent a typical U-shaped curve, an increased risk in infants and children, as well as the oldest-old (Raoult et al., 2020). In previous epidemics, the young population was even more impacted due to the

higher infection rates, which is not the case with the new pandemic (Sasson, 2020). Mortality data by age for many countries in the world indicate that it is the elderly who are the most vulnerable. Many analyses published so far point out that mortality from COVID-19 is concentrated in the elderly (Dowd et al., 2020). People over the age of 70 account for an average of 58% of total mortality from COVID-19 in developing countries, compared to 86% in industrialized nations, according to standardized data from 26 countries (Demombynes, 2020). This finding points out the critical role of the population's age structure in explaining the differences in mortality rates between countries and how the disease spreads. COVID-19 transmission chains that begin in the younger population, depending on the composition of households, eventually reach the old population.

As the pandemic matures, the global death toll rises at an alarming rate. The European continent is in a particularly precarious position since, in addition to having an aging population, it also represents a crossroads of migrant flows. The situation in less developed sections of the world, where the population is on average younger, is also not encouraging. These countries often face a lack of medical material, poor health infrastructure, and poorer education regarding individual health. Serbia is part of a group of countries that could be particularly vulnerable. The population is one of the world's oldest, having a life expectancy at birth among the lowest in Europe (Marinković and Radivojević, 2016). The prevalence of cardiovascular disorders indicates that the so-called cardiovascular revolution has yet to occur, with many individuals in Serbia still suffering from chronic heart and circulatory diseases. Health risk factors (smoking, hypertension, obesity, alcohol, polluted air) are very much present in the population (Marinković, 2017, 2020), and the level of health care and public health lags significantly behind the most developed societies (Marinković, 2021). The large diaspora that ties Serbia to Europe's most significant economic hubs, which have become an important source of the infection's transmission, exacerbates the unfavorable situation. To a large extent, all of the above determines the possible consequences of the SARS-CoV-2 virus epidemic in our country.

The paper's primary objective is to analyze the mortality of Serbia's population in the year 2020. The hypothesis of a more significant increase in mortality among men and a disproportionate increase in mortality among the elderly is being tested. Measuring the contribution of different age cohorts by gender enables us to determine whether the effects of a pandemic on mortality in Serbia are unique or consistent with research in other countries. The analysis of mortality by cause of death should establish whether COVID-19 was a significant cause of death in 2020. It should also confirm the author's thesis that the high prevalence of cardiovascular disease in Serbia, with men and women having a relatively short life expectancy (compared to other European populations), might be a prerequisite for a high number of COVID-19 related deaths.

### *METHODS*

Before analyzing data on mortality in Serbia in 2020, it is necessary to give some methodological explanations. The WHO has developed clear instructions on diagnosing COVID-19 and coding the disease. There are two basic codes (SARS-CoV-2 virus (U071) present and clinical or epidemiological diagnosis of COVID-19, without virus isolation (U072)). It is recommended that when occurring with comorbidities in the form of chronic diseases, the SARS-CoV-2 virus remains the leading cause if it is present in the body. COVID-19 is not coded as a cause of death in cases of violent causes of death or other conditions (myocardial infarction). If a person with an isolated virus dies in the next 14 days, the underlying cause is COVID-19 regardless of other chronic conditions (WHO, 2020). In practice, determining the first cause in the causal chain of those that led to the death is not simple. Even when medical documentation is provided, incorrect conclusions regarding the underlying cause of death are sometimes made. The chances of making a mistake are higher during the year of the pandemic with the heavy demand on the healthcare system. Therefore, the research results on mortality due to COVID-19 must be observed with a dose of caution.

Data from previous epidemics reveals that instances of cases were more accurately diagnosed at the start, but that over time, a growing share of excess mortality is attributed to other causes, most common diseases of the heart or lung (Glezen, 1996). Reported cases of SARS-CoV-2 infection do not represent the overall burden of COVID-19 disease, as case reports depend on patients seeking health care, availability and types of care, and testing capacities. Likewise, not all deaths diagnosed with COVID-19 had the virus as the primary cause of death (Angulo et al., 2021). The main feature of the pandemic is excess mortality, which is defined as the difference between the total number of deaths in a crisis compared to the number expected under normal conditions (WHO, 2021). Excess mortality captures the full scope of the pandemic and avoids all of the problems associated with virus mortality diagnosis. Most importantly, through this indicator, it is possible to see the direct consequences and those that indirectly affect the total mortality of the population.

The paper analyzes the changes in the total mortality of the population of Serbia in 2020 compared to the 2019 or three-year average 2017-2019. The analysis of mortality by age and sex is provided by summarizing specific mortality rates by calculating life expectancy at birth. When it comes to this statistic, it is especially significant to look at the changes induced by the pandemic compared to the prior period. Typically, this indicator is employed in international comparisons and time-series analysis of population mortality. This demographic indicator presupposes that people live from birth to death under the conditions of mortality from the year of observation, which, in the case of epidemic mortality,

implies that the epidemic occurs every year as a person grows old. Despite these limitations, this indicator is indispensable in the analysis of mortality. The method of decomposing<sup>2</sup> life expectancy shows changes in mortality by the age of the male and female population in 2020. Calculations of excess mortality were used to assess the direct and indirect implications of the COVID-19 pandemic in Serbia. For analyzing mortality in Serbia, we used the final vital statistics data published by the Statistical Office of the Republic of Serbia on July 1, 2021 (SORS, 2021). Vital statistics data were obtained at the official request for this research.

## RESULTS

### *Overall Mortality*

In Serbia, the year of the SARS-CoV-2 virus pandemic resulted in a significant increase in overall mortality in 2020. Compared to the previous year, in 2019, the mortality rate is higher by 15% or slightly more than 15,000 people. The total number of deaths in 2020 is 116,850, which is the most significant number of deaths since the establishment of regular vital statistics in Serbia (period 1950-2020). Overall, 17 deaths per 1,000 people represent the highest rate since the middle of the twentieth century. The male population was particularly vulnerable in 2020, and the death rate is 18 deaths per 1,000 inhabitants, twice the lowest average rate during the 1960s. Life expectancy at birth ( $e_0$ ) in 2020 is 74.40 years, 1.55 lower than the previous year. Such a level was last recorded ten years ago (in the period 2010-2011). It is even more important to emphasize that no such drop in  $e_0$  has been recorded in the last 70 years. Data from 1950 onward show that only the 1967-1969 period recorded a significant drop in  $e_0$  (about one year). At that time, the world was also going through a pandemic (Kilbourne 2006). In the previous two decades in Serbia, life expectancy dropped only three times (2000, 2015, 2017), most likely due to the increased effect of seasonal flu. Also, this phenomenon was not present only in Serbia, which is confirmed by the works of foreign authors (Mølbak et al. 2015; Raleigh 2018). Observed by gender, the male population experienced a significantly greater decline in  $e_0$  than the female population in 2020 (1.85 versus 1.16 years).

### *Age Component*

Using the decomposition method on life expectancy, we can accurately look at the contributions of age groups in the male and female population to the changes in 2020 compared to 2019 (Table 1). All age

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<sup>2</sup> The method is described in Preston et al. 2001.

groups aged 35 or more in men contributed to the increase in  $e_0$  with their increased mortality, while in women, the interval was somewhat shorter, 40 or more years. Men aged 65-69 had the most significant negative impact, with a share of 17%. Interestingly, in men, the oldest group of 85 and older (7%) had a smaller share than the old 50-54 years (10%). In women with 16%, the group aged 75-79 years had the most significant effect on the decline of  $e_0$ . In contrast to men, contributions in the female population are more evenly distributed in all age groups of 60 or more years. The decomposition confirmed the thesis that the increase in mortality in the elderly is responsible for the large decline in life expectancy in both sexes in 2020. Especially in the male population, the elderly middle-aged population significantly contributed to the decline. The pandemic's effects on mortality in 2020 are noticeable in both older and older middle-aged men.

*Table 1. Decomposition of life expectancy by sex in Serbia, 2020 compared to 2019*

RS	2019-2020 $\Delta$ m	%	2019-2020 $\Delta$ f	%
0	-0.02	1.18%	0.01	-0.70%
1-4	0.01	-0.54%	0.01	-1.21%
5-9	0.01	-0.40%	0.00	0.38%
10.-14	-0.02	1.13%	0.01	-0.47%
15-19	0.02	-1.24%	0.00	-0.20%
20-24	-0.01	0.53%	0.00	0.02%
25-29	-0.03	1.78%	-0.01	0.64%
30-34	0.00	0.01%	-0.01	1.17%
35-39	-0.06	3.06%	0.02	-1.44%
40-44	-0.07	3.72%	-0.04	3.55%
45-49	-0.09	5.09%	-0.03	2.18%
50-54	-0.19	10.42%	-0.08	7.08%
55-59	-0.17	9.01%	-0.10	8.52%
60-65	-0.17	9.46%	-0.14	12.33%
65-69	-0.32	17.16%	-0.16	13.68%
70-74	-0.25	13.36%	-0.17	14.80%
75-79	-0.23	12.24%	-0.18	15.58%
80-84	-0.12	6.67%	-0.13	11.54%
85+	-0.14	7.36%	-0.15	12.54%
sum	-1.85	100.00%	-1.16	100.00%

Note: m-male, f-female;  $^{2019}e_{0m} = 73.34$ ,  $^{2020}e_{0m} = 71.49$ ,  $^{2019}e_{0f} = 78.58$ ,  $^{2020}e_{0f} = 77.42$ .

Source: Authors' calculation.

### COVID-19 Deaths

The total number of deaths from COVID-19 in 2020 is 10,356. By gender, women accounted for 36% of total mortality from COVID-19. In the year of the pandemic, men had 87% higher mortality rates from COVID-19 than women. The analysis by age shows that COVID-19 burdens the young and middle-aged population the least in Serbia (4% of the total number of deaths with this diagnosis are younger than 50), and the eldest, especially those 70 and older (61% of the total number of COVID-19 deaths). Mortality rates increase with age, and in the oldest 85 or more years, they amount to as many as 928 deaths per 100,000 inhabitants. On the other hand, rates are below 10 per 100,000 until the age of 35. A person who is 85 or older is almost 100 times more likely to die from the consequences of COVID-19 than a person who is 34 or younger. Observed by gender and age groups, men aged 35-44 have a 3.5-4.0 times higher risk of death from COVID-19 than women of the same age. At the age of 70 or more, where the highest number of deaths occurs, the mortality rates in the male population are twice as high (Figure 1).

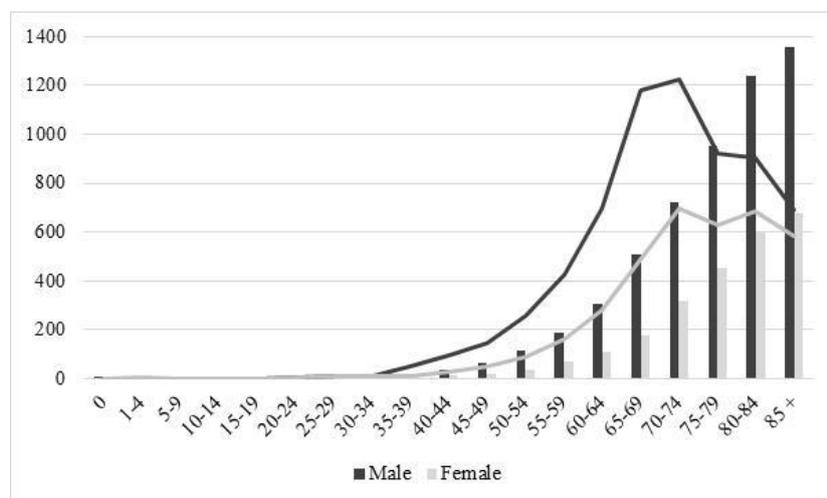


Figure 1. Number of deaths and mortality rates from COVID-19 by age and sex in Serbia in 2020

Note: The lines represent the number of deaths, and the bars the mortality rate (the scale is the same). Rates are per 100,000 inhabitants.

Source: Authors' calculation

### Causes of Death

The analysis of data on the primary cause of death for 2020 shows that long-term trends in the leading causes of death have been disrupted. The traditional growth in the number of deaths from malignant tumors has been halted. The number of deaths from cardiovascular diseases has

increased (following a 15-year decline). Respiratory diseases and infectious diseases have increased their share of total mortality significantly. The most common cause of death category in Serbia is the diseases of the circulatory system (I00-I99)<sup>3</sup>, which make up about half of all deaths annually. In 2020, the number of deaths from this cause totaled 55,305 people, which is an increase of about 2,500 compared to the average from the previous three years (2017-2019). Tumors (C00-D48) have had an annual increase in deaths for 70 years. One of the rare years when the value is not higher than in the previous year is 2020. The number of deaths has decreased by about 600 compared to the three-year average of 2017-2019. Respiratory diseases have been rising for the last 20 years (J00-J99). In the year of the pandemic, there were about 1,300 more deaths than the three-year average. Violent causes (S00-T98) have a declining trend, and in 2020 the decline intensified (there are 8% fewer deaths compared to the three-year average). Of the other significant changes in the leading causes of deaths, the so-called undefined conditions (R00-R99) increased, with 921 more recorded deaths than the previous three-year average.

When looking into a more precise cause of death coding, i.e. not just by a broad category but by a specific cause of death (three-character coding), the diagnosis of COVID-19 is in the second place of the most common causes of death in Serbia in 2020 (Table 2). In the male population, mortality from COVID-19 is the leading cause of death, while in the female population, this cause is in the fifth place.

*Table 2. Top ten causes of death in Serbia in 2020*

Cause of Death	ICD-10	Total	Male	Female
Cardiomyopathy	I42	12.593	5.386	7.207
COVID-19	U07	10.356	6.629	3.727
Cerebrovascular disease	I60-I69	9.853	4.536	5.317
Hypertensive diseases	I10-I15	9.310	3.878	5.432
Ischemic heart diseases	I20-I25	8.793	4.735	4.058
Malignant neoplasm of trachea, bronchus and lung	C33-C34	5.010	3.407	1.603
Diabetes mellitus	E10-E14	3.395	1.530	1.865
Influenza and pneumonia	J09-J18	3.036	1.840	1.196
Malignant neoplasm of breast	C50	1.825	43	1.782
Malignant neoplasm of colon	C18	1.353	804	549

Note: ICD-10 is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems

Source: Authors' calculation

<sup>3</sup> The codes are according to the International Statistical Classification of Diseases and Related Health Problems, 10th revision.

### *Excess Mortality*

Assessing the effect of the SARS-CoV-2 pandemic by looking at confirmed COVID-19 deaths can only lead us to overlook the pandemic's overall impact on population mortality. Excess mortality includes those who died from COVID-19 and those who died from all other causes. This means that both direct and indirect mortality metrics are needed to understand the overall impact of a pandemic. The surplus of mortality that occurred in 2020 (compared to the three-year average of 2017-2019) is 14,657, an increase in mortality of about 14%. Deaths from COVID-19, according to vital statistics, make up 71% of excess mortality.

### *DISCUSSION AND CONCLUSION*

The COVID-19 pandemic is not over, and the tally from 2020 shows only the situation from the first nine months of the health crisis that is shaking up the entire world. The situation in Serbia is quite unfavorable. When the pandemic ends, the final toll and its consequences for the mortality of the population will be unparalleled in the peacetime conditions of our country. With the current number of deaths from COVID-19 and high excess mortality in 2020, Serbia is among the most impacted countries in Europe (Karlinsky and Kobak, 2021; Marinković and Galjak, 2021). It is especially worrying that in addition to the old population, middle-aged men in Serbia also make a big contribution to the decline in  $e_0$ , which is not typical for Western European countries. However, it is for the countries of the Balkans and Eastern Europe.

Life expectancy is a summary indicator of mortality, the value of which was significantly reduced in 2020. The values have returned to the level from the previous decade. Next year, we expect an even more significant decline because the preliminary indicators are significantly less favorable than 2020. However, we should not expect a continuous decline of  $e_0$  in Serbia, nor the stability of this indicator in the coming years at the current level. The end of the pandemic, which resulted in the increased mortality of the elderly and the most vulnerable, will produce a culling effect, i.e. there would be fewer people left to die, leading to a sharp increase in  $e_0$ , which will reach record levels in the years after the health crisis.

In the last 70 years (1950-2020), it has not been recorded that a contagious disease was the leading cause of death, as is now the case in Serbia. The high proportion of COVID-19 deaths in the male population is of particular concern since it has surpassed the traditionally most common diseases – the cardiovascular diseases. It is difficult to predict the end of the pandemic, but an infectious disease is certainly not expected to maintain this share in total mortality in the coming period. Infectious diseases will likely return to below 1%, as before the pandemic. Positive changes are the lowest recorded death rates from violent causes of death

so far. However, this will probably not be the case in 2021. Measures to control the movement of the population, which are the main reason for the lower number of violent deaths, were not in force to that extent in 2021, so a return to the level before the health crisis is expected.

Excess mortality shows that in addition to direct deaths due to COVID-19, there is a significant increase in so-called indirect mortality caused by the pandemic in Serbia. It is difficult to say to what extent it results from an error in reports on the underlying cause of death or an increase in mortality due to inadequate health care for other non-COVID-19 patients. The overload of the health system at the time of the pandemic is evident. However, data and analyses necessary to show that the potential delay in surgical interventions or diagnostic examinations is responsible for the increase in deaths are still missing. A detailed analysis of trends in the leading causes of death, along with data for 2021, could be a way to estimate indirect mortality from COVID-19.

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## ПОСЛЕДИЦЕ КОВИД 19 ПАНДЕМИЈЕ НА СМРТНОСТ СТАНОВНИШТВА СРБИЈЕ 2020. ГОДИНЕ

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### Резиме

Ефекти пандемије на морталитет у Србији су били већи него што се могло очекивати. У односу на претходну, 2019. годину, морталитет је виши за 15% или за нешто више од 15 хиљада лица. Овако драстично повећање морталитета спустило је очекивано трајање живота у Србији за 1.55 година. Мушка популација је посебно угрожена у 2020. години, а стопа смртности duplo виша од најниже просечне стопе током 1960-их. Декомпоновањем је потврђена теза да је раст смртности код старих одговоран за велики пад очекиваног трајања живота код оба пола у 2020. години. Посебно у мушкој популацији треба нагласити и значајан допринос старијег средовечног становништва. Последице пандемије на смртност у 2020. години у Србији видљиве су како код старих, тако и код старијих средовечних мушкараца. Анализа по старости показује да КОВИД-19 најмање оптерећује младо и средовечно становништво у Србији (4% укупног броја умрлих са овом дијагнозом је до 50-те године живота), а највише старе, нарочито 70 или више година (61% од укупног броја КОВИД-19 смрти). Готово 100 пута је већа шанса да од последица КОВИД-19 умре особа 85 или више година него 34 или мање. То значи да су тзв. бејби-бум генерације (рођени непосредно после Другог светског рата) најугроженије. КОВИД-19 је у 2020. години био други најчешћи узрок смрти, одмах после обољења срчаног мишића (142). Анализа података о основном узроку смрти за 2020. показује да су нарушени дугогодишњи трендови код водећих узрока смрти. Традиционални раст броја умрлих од малигнух тумора је прекинут, повећао се број умрлих од кардиоваскуларних оболења (после 15 година смањивања), а болести респираторних органа, као и заразна и инфективна оболења изразито су увећала удео у укупној смртности. Стопа смртности од насилних узрока 2020. године је рекордно ниска.