

Preplanned Studies

An Analysis of Life-Year Lost Due to COVID-19 — 34 Countries, December 2019–March 2021

Shan Jiang^{1,*}; Dan Cai^{2,*}; Daqin Chen²; Yawen Jiang^{2,#}

Summary

What is already known about this topic?

The coronavirus disease 2019 (COVID-19) pandemic has caused severe health consequences. Though most COVID-19 deaths occurred among very old people, their life-year loss might be very large because of their life expectancy at that age.

What is added by this report?

This study quantified how many years of life were lost due to COVID-19 in 34 countries. COVID-19 caused 9 to 21 years of life lost (YLL) per deceased patient. East Asia and Oceania had substantially lower per capita YLL than North America and Europe. Among all countries included, the United States had the greatest total YLL, Peru had the largest YLL per 100,000 people, and Mexico had the largest YLL per 100,000 COVID-19 patients.

What are the implications for public health practice?

The YLL quantification indicated that the vulnerable population, especially the elderly, should be protected under careful public health measures to reduce their YLL. It also implied that it might be too early to lift anti-epidemic restrictions now, since the extreme disproportionate consequences (total and per-capita YLL) in different countries underscored the scrutinization over the variation in disease control strategies to optimize future disease control and prevention.

The coronavirus disease 2019 (COVID-19) pandemic has caused severe health consequences. This study aimed to estimate the years of life lost (YLL) associated with COVID-19 in different countries. We collected data on COVID-19 cases and deaths up to March 27, 2021 and used a method recommended by the World Health Organization (WHO) to calculate YLL. We assessed the total YLL of each included country and calculated the YLL per 100,000 patients and per 100,000 people. We included 34 countries in the analysis. The US had the greatest total YLL among

all countries. Peru topped the per-capita YLL. Mexico suffered from the greatest YLL per 100,000 patients. COVID-19 caused 9 to 21 YLL per deceased patient. East Asia and Oceania had substantially lower per capita YLL than North America and Europe. The pandemic caused disproportionate consequences (total and per-capita YLL) in different countries, implying that the variation in disease control strategies should be scrutinized to optimize future disease control and prevention.

As of November 2021, over 255 million COVID-19 cases were confirmed globally, almost 3 million of whom lost their lives (1). The spread of the virus remains fast. While numerous studies have provided insights into COVID-19-related mortality, very few emphasized the life expectancies and life-year loss of the deceased. Some argued that the majority of COVID-19 deaths occurred among the “oldest-old” who were proximal to death even without COVID-19 (2). However, the life-year loss of such individuals might be large given their life expectancy at that age (3). Estimating the COVID-19-related life-year loss is important to understand the societal loss and to inform the choice of epidemic containment strategies. YLL, an established measure to assess the impact of premature death, captures the additional time a patient would have lived if the patient did not die prematurely (4). It refers to the difference between the age of death and the life expectancy at that age. Compared with crude mortality and the number of deaths, YLL aims to comprehensively measure the disease burden. There is an absence of cross-country comparison to provide a worldwide landscape of YLL due to COVID-19 (5). This study aimed to provide YLL information for the debate and reflection on the anti-epidemic strategies and the establishment of a comprehensive loss function of COVID-19.

We categorized the COVID-19 patients and population into 9 age groups. The calculation of YLL followed the recommendation by the World Health Organization (Supplementary Materials, available in <https://weekly.chinacdc.cn/>). Accordingly, we

calculated the primary outcomes, including YLL per 100,000 COVID-19 patients and per 100,000 people. Standard errors were estimated using Monte Carlo simulation with 1,000 repetitions standard errors were estimated using Monte Carlo simulation with 1,000 repetitions (6–7). We assumed that the death events were uniformly distributed within each age group, so that we were able to approximate the YLL of each group by multiplying the number of deaths and the life expectancy of the median age of the group (e.g., the life expectancy of age 4.5 represented the mean life expectancy of group 0–9). We collected data of the life expectancy of different ages, demographic data of different countries, COVID-19 cases, deaths, and their age distributions (Supplementary Table S1 available in <https://weekly.chinacdc.cn/>). We included countries with age-specific data available on the incidence and mortality of COVID-19 as of March 2021. Two

analysts collected data independently and cross-checked the data. We used Excel 2016 (Microsoft Corporation, United States, North America) and Crystal Ball (version 11.1.1, Oracle Corporation, United States, North America) for analysis and Monte Carlo simulation.

We developed some secondary outcomes using primary outcomes. By dividing YLL per 100,000 patients and deaths per 100,000 patients, we derived YLL per dead patient, indicating the average YLL for every death caused by COVID-19. The 95% credible interval of YLL per dead patient was calculated by simulating the numerator and denominator simultaneously using Monte Carlo simulation 1,000 times. Moreover, by combining the results of countries in the same continental region, we compared the outcomes in five regions: East Asia, Southeast Asia, Europe, North America, and Oceania.

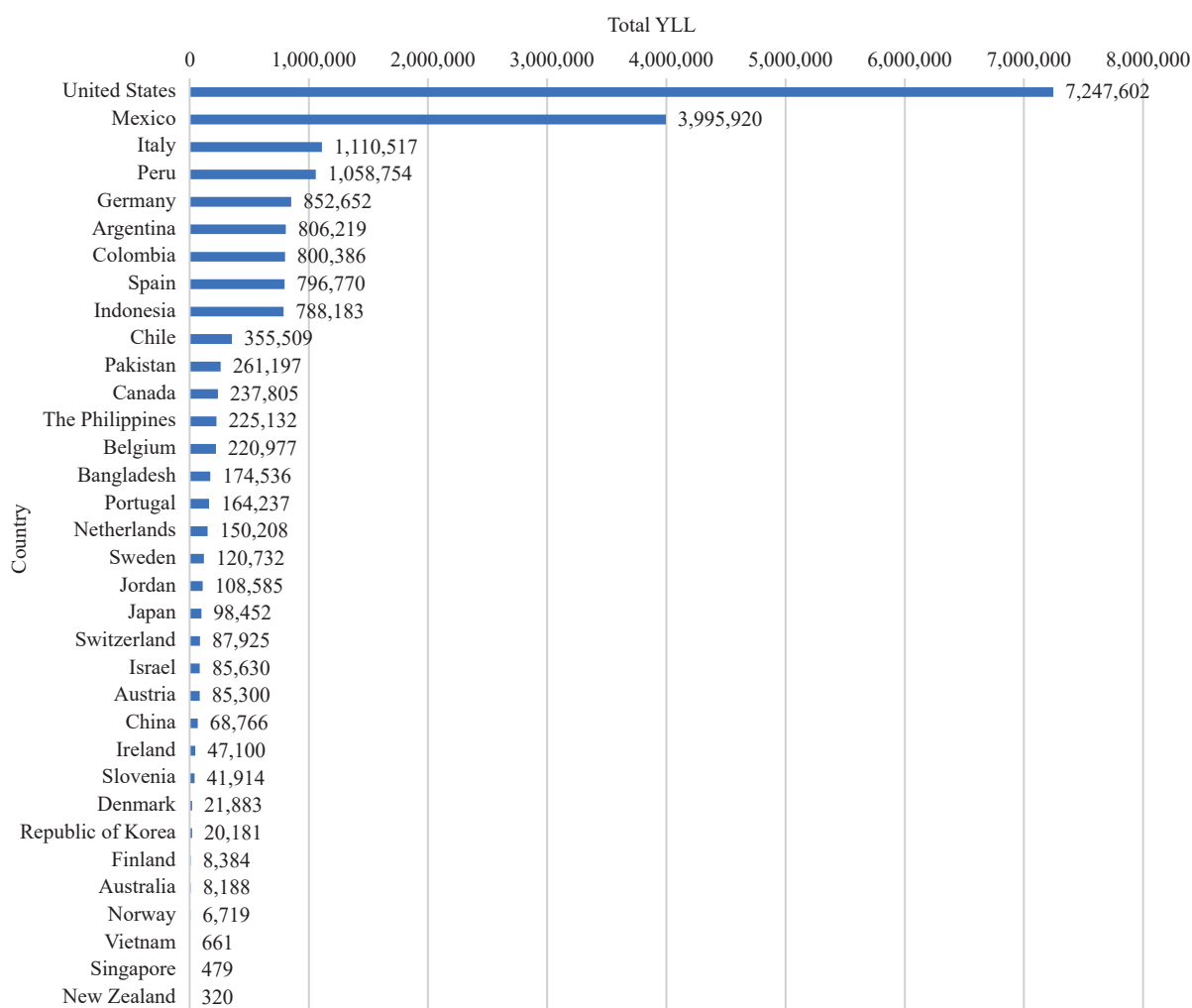


FIGURE 1. Total years of life lost caused by COVID-19 by country.
Note: Countries are sorted in an order of decreasing YLL per 100,000 people.

Among the 34 included countries, the total YLL in the US (7.2 million) was substantially greater than in other countries, almost twice as much as in Mexico (3.99 million). Italy, Peru, Germany, Argentina, Colombia, Spain, and Indonesia had around 1 million YLL. Other countries included had less than 0.36 million. Vietnam, Singapore, and New Zealand had less than 1,000 YLL (Figure 1).

Figure 2 presented the cases, deaths, and YLL for every 100,000 people, in which countries were sorted in an order of decreasing YLL numbers. Peru, Mexico, and the US ranked in the top three in terms of YLL per 100,000 people. Although Peru and Mexico had much fewer per-capita cases than the US, they had similar COVID-19-relevant death rates, leading to a great loss of life years.

Countries with high cases and death rates per 100,000 people usually had a greater loss of life years per 100,000 people, compared with those with low cases and death rates; and vice versa (Supplementary Table S2, available in <https://weekly.chinacdc.cn/>). For example, Slovenia ranked top in terms of COVID-19 cases and deaths per 100,000 people and ranked fourth in per-capita YLL. Belgium ranked second in terms of deaths per 100,000 people and ranked fifth in per-capita YLL. As the first country reporting COVID-19, China's infection and death rates and YLL per capita were among the lowest in the countries included in the analysis.

Some exceptions existed. Although Israel ranked second in terms of infection rate, the death rate was low (71.2 per 100,000 people), leading to a moderate per-capita YLL (989.3). Among countries with lower than 100 YLL per capita, Singapore had a per-capita YLL as low as 8.2, despite that the infection rate in the country was higher than in other countries of this group. This might be because of its low mortality rate among the confirmed cases.

Figure 3 illustrated the YLL by continental region, in which the circle size was indicated by YLL per 100,000 people. With a much more population than other regions, East Asia had a low total YLL, leading to the lowest YLL per 100,000 people. In contrast, North America had the largest total YLL, though its population size was much smaller than that of East Asia. East Asian and Oceanic countries endured the smallest YLL for every 100,000 people (<30).

Supplementary Figure S1 (available in <https://weekly.chinacdc.cn/>) illustrated the results of YLL for every 100,000 COVID-19 patients by country. Mexico ranked first on both indicators. As the first country to report COVID-19, China ranked second

and had a higher mortality rate and YLL per 100,000 patients than other countries except for Mexico. The US had a moderate death rate and YLL per 100,000 patients. The European countries had YLL ranging from 7,000 to 32,000 for every 100,000 patients. Italy had the highest YLL per 100,000 patients in Europe (31,833), while Norway had the lowest (7,389). Singapore had the least deaths and the lowest YLL per 100,000 patients among all countries. Generally, developing countries had a higher death rate and a higher per-patient YLL than developed countries. Supplementary Table S3 (available in <https://weekly.chinacdc.cn/>) demonstrated that the deceased patients lost 9 to 21 years of life on average across countries. Australia had the lowest per-patient YLL (9.008), while Peru had the highest per-patient YLL (20.75).

DISCUSSION

This analysis provided a landscape of COVID-19-related YLL accumulated from the start of the pandemic to March 2021 in 34 countries based on age-specific life expectancy. North America had a greater amount of YLL than other regions, and the US ranked first in terms of total YLL among the countries. East Asian and Oceanic countries had a lower per-capita YLL than other countries. The pandemic had caused 9 to 21 years of life lost for every deceased patient on average.

The YLL per deceased patient reminds us how life-threatening this disease could be. We call attention to the fact that COVID-19 patients may die long before their "time," although the crude mortality does not seem as scary as many other fatal diseases. It may be better to shield the vulnerable population, including the elderly and people with underlying diseases, instead of treating them carelessly (8).

It was reported that China, Republic of Korea, Norway, and Germany responded relatively faster than other countries since their respective first reported death cases and took a short time to enforce social distancing and contact tracing nationwide (9). In contrast, Spain responded relatively slowly to the initial outbreak, whereas Sweden did not take strict measures to limit the transmission (9). We observed that East Asian countries, Norway, and Germany had lower YLL per 100,000 people than those with slow response and/or lax measures, such as Spain. The YLL comparison may underline the importance of future research on quick response to COVID-19 and its health burden such as YLL, which may contribute to the consensus on appropriate anti-pandemic strategies.

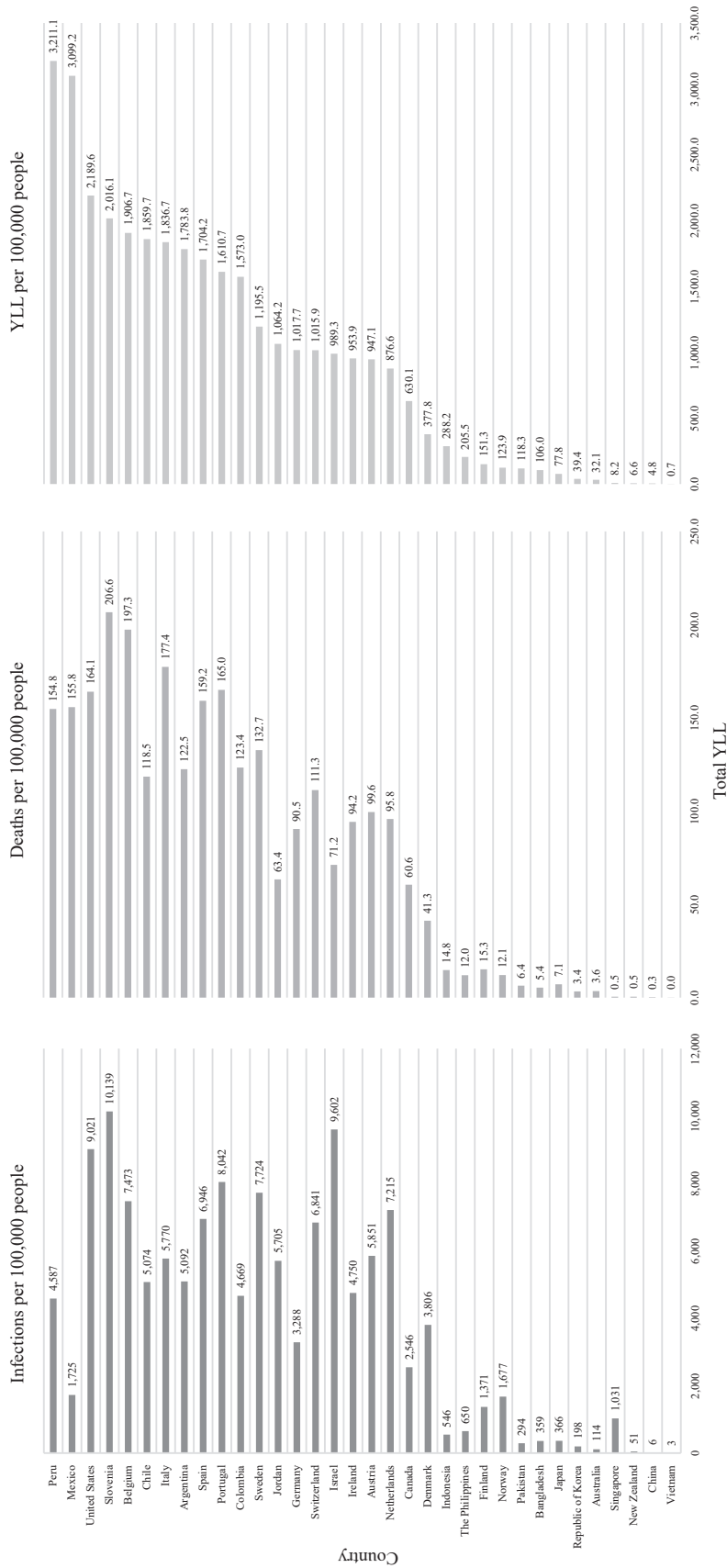


FIGURE 2. COVID-19 cases, deaths and years of life lost (YLL) for every 100,000 people by country. Note: Countries are sorted in an order of decreasing YLL per 100,000 people.

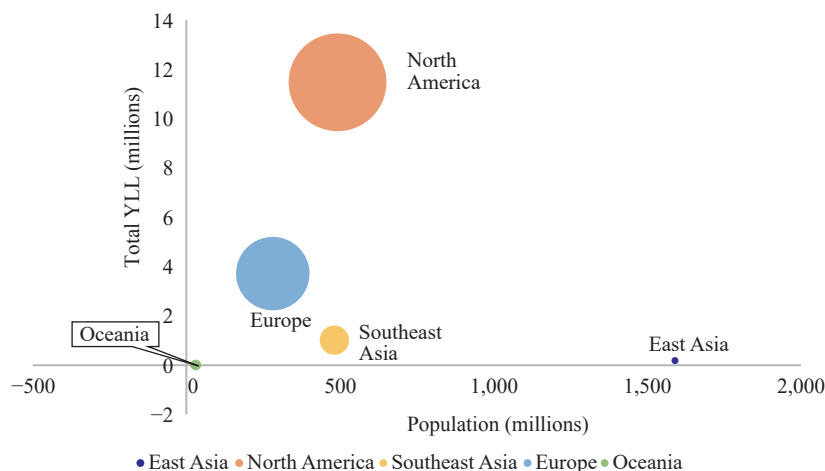


FIGURE 3. Total years of life lost (YLL) due to COVID-19 in some continental regions.

The pandemic continues and the virus keeps mutating. The current predominant pandemic in many countries is caused by the Delta and Omicron variants of coronavirus, which have greater transmissibility than previous variants. Many governments chose to reopen their countries to alleviate the negative impact on the economy of the pandemic. According to the YLL comparison and previous experience (10), it might be too early to lift anti-epidemic restrictions, especially when evidence indicates that vaccination and medication may significantly change the landscape of YLL and save lives (11–12).

The findings of the present analysis should be interpreted with several caveats, including potential underreporting or misclassification of COVID-19 deaths, the heterogeneous data reporting routines across countries, and the exclusion of many countries due to the absence of key data components. Future research should improve data quality and the scope of analyses.

The pandemic caused different total and per-capita life-year losses in different countries. The variation in disease control strategies underlying such disproportionate consequences should be scrutinized to optimize future efforts in disease control and prevention.

doi: 10.46234/ccdcw2022.109

Corresponding author: Yawen Jiang, jiangyw26@mail.sysu.edu.cn.

¹ School of Population and Public Health, University of British Columbia, Vancouver, BC, Canada; ² School of Public Health (Shenzhen), Sun Yat-sen University, Shenzhen City, Guangdong Province, China.

[§] Joint first authors.

Submitted: November 25, 2021; Accepted: May 31, 2022

REFERENCES

- World Health Organization. Coronavirus disease (COVID-2019) situation reports. 2022. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>. [2021-10-31].
- Banerjee A, Pasea L, Harris S, Gonzalez-Izquierdo A, Torralbo A, Shallock L, et al. Estimating excess 1-year mortality from COVID-19 according to underlying conditions and age in England: a rapid analysis using NHS health records in 3.8 million adults. medRxiv, 2020. <http://dx.doi.org/10.1101/2020.03.22.20040287>.
- Chan MS, van den Hout A, Pujades-Rodriguez M, Jones MM, Matthews FE, Jagger C, et al. Socio-economic inequalities in life expectancy of older adults with and without multimorbidity: a record linkage study of 1.1 million people in England. *Int J Epidemiol* 2019;48(4):1340 – 51. <http://dx.doi.org/10.1093/ije/dyz052>.
- Gardner JW, Sanborn JS. Years of potential life lost (YPLL)—what does it measure? *Epidemiology* 1990;1(4):322 – 9. <http://dx.doi.org/10.1097/00001648-199007000-00012>.
- Hanlon P, Chadwick F, Shah A, Wood R, Minton J, McCartney G, et al. COVID-19—exploring the implications of long-term condition type and extent of multimorbidity on years of life lost: a modelling study. *Wellcome Open Res* 2021;5:75. <http://dx.doi.org/10.12688/wellcomeopenres.15849.3>.
- Moran PAP. The estimation of standard errors in monte carlo simulation experiments. *Biometrika* 1975;62(1):1 – 4. <http://dx.doi.org/10.1093/biomet/62.1.1>.
- Chiang CL. The life table and its applications. Malabar: Robert E. Krieger Publishing Company. 1984. https://openlibrary.org/books/OL3500112M/The_life_table_and_its_applications.
- Chen SQ, Jones LA, Jiang S, Jin HJ, Dong D, Chen X, et al. Difficulty and help with activities of daily living among older adults living alone during the COVID-19 pandemic: a multi-country population-based study. *BMC Geriatr* 2022;22(1):181. <http://dx.doi.org/10.1186/s12877-022-02799-w>.
- Hale T, Angrist N, Boby T, Cameron-Blake E, Hallas L, Kira B, et al. Variation in government responses to COVID-19. Blavatnik School of Government Working Paper. 2020. <https://www.bsg.ox.ac.uk/sites/default/files/2020-12/BSG-WP-2020-032-v10.pdf>. [2021-10-31].
- Jiang YW, Cai D, Chen DQ, Jiang S. The cost-effectiveness of conducting three versus two reverse transcription-polymerase chain reaction tests for diagnosing and discharging people with COVID-19: evidence from the epidemic in Wuhan, China. *BMJ Glob Health* 2020;5(7):e002690. <http://dx.doi.org/10.1136/bmjgh-2020-002690>.
- Jiang YW, Cai D, Chen DQ, Jiang S, Si L, Wu J. Economic evaluation of remdesivir for the treatment of severe COVID-19 patients in China under different scenarios. *Br J Clin Pharmacol* 2021;87(11):4386 – 96. <http://dx.doi.org/10.1111/bcp.14860>.
- Jiang YW, Chen DQ, Cai D, Yi Y, Jiang S. Effectiveness of remdesivir for the treatment of hospitalized COVID-19 persons: a network meta-analysis. *J Med Virol* 2021;93(2):1171 – 4. <http://dx.doi.org/10.1002/jmv.26443>.

Supplementary Materials

The COVID-19 patients and population into 9 age groups were categorized (i.e., 0–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and 80 and above). The calculation of YLL followed the recommendation by the World Health Organization (WHO):

$$YLL = \sum_{i=1}^n (D_i \times L_i) \quad (1)$$

where n denotes the number of age groups, D_i is the number of deaths due to COVID-19 in age group i , and L_i is the life expectancy of age group i .

According to equation 1 and the age groups we defined, we developed the calculation of YLL per 100,000 COVID-19 patients and per 100,000 people as follows:

$$YLL \text{ per } 100,000 \text{ patients} = \sum_{i=1}^9 (p_i \times 100,000 \times \mu_i \times L_i) \quad (2)$$

$$YLL \text{ per } 100,000 \text{ people} = \sum_{i=1}^9 (P_i \times 100,000 \times \mu_i \times L_i) \quad (3)$$

where μ_i denotes the mortality rate in age group i due to COVID-19; p_i denotes the proportion of COVID-19 patients in age group i among patients of all age groups; P_i denotes the probability of COVID-19 cases in age group i , which was calculated as the quotient of the number of cases and the number of people in group i . Standard errors were estimated using Monte Carlo simulation with 1,000 repetitions (1–2).

We assumed that the death events were uniformly distributed within each age group, so that we were able to approximate the YLL of each group by multiplying the number of deaths and the life expectancy of the median age of the group (e.g., the life expectancy of age 4.5 represented the mean life expectancy of group 0–9). The life expectancy of different ages was from the WHO country-specific lifetables (3). The demographic data of different countries were from the United Nations World Population Prospects in 2019 (4). We collected data on COVID-19 cases, deaths, and their age distributions from January 1, 2020 to March 27, 2021, using data from WHO and corresponding countries and regions (5–7). We used Microsoft Excel 2016 (Microsoft Corporation, United States, North America) and Oracle Crystal Ball (version 11.1.1 Oracle Corporation, United States, North America) for analysis and Monte Carlo simulation.

We included countries with age-specific data available on the incidence and mortality of COVID-19 as of March 2021. When the data on the age distribution of COVID-19 cases and deaths exactly as of March 27, 2021, were not available, the information with the closest time stamp was carried forward. Due to the lack of information, the age distributions of confirmed cases in the UK were imputed using the pooled data of England and Scotland. When the age groups of the source data in a certain country were not defined coherently with the present analysis, they were mapped to the age groups defined in the present study by assuming a uniform distribution of cases within each age group in the source data. Data on the age distribution of the general population and the life expectancy of included countries were retrieved from PopulationPyramid.net, government websites, and WHO (1–2). Two analysts collected the data independently and cross-checked the data.

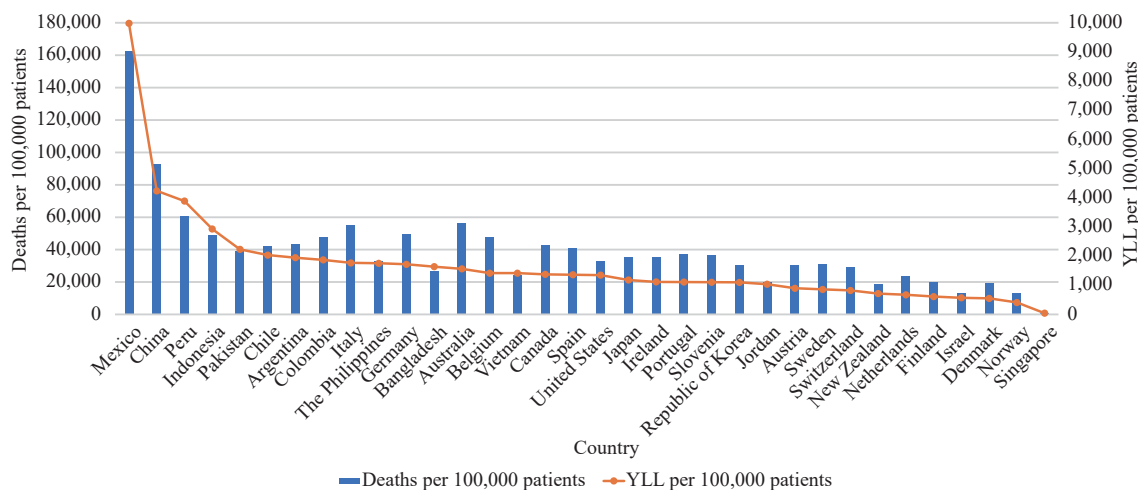
We developed secondary outcomes using primary outcomes such as deaths, YLL per 100,000 people, and YLL per 100,000 patients. By dividing YLL per 100,000 patients and deaths per 100,000 patients, we derived YLL per dead patient, indicating the average YLL for every death caused by COVID-19. The 95% confidence interval of YLL per dead patient was calculated by simulating the numerator and denominator simultaneously using Monte Carlo simulation 1,000 times. Moreover, we categorized the countries into eight regions: East Asia, Southeast Asia, South Asia, West Asia, Europe, North America, South America, and Oceania. We derived regional YLL outcomes by combining the results of countries in the same region. We extracted the data on COVID-19 cases and deaths from the sources listed Supplementary Table S1.

SUPPLEMENTARY TABLE S1. Data sources for COVID-19 cases and deaths in different countries.

| Country/Region | Diagnosis | Death | Data reference |
|-------------------|-----------|---------|----------------|
| China | 90,167 | 4,636 | (8,9) |
| Italy | 3,488,619 | 107,256 | (10) |
| Republic of Korea | 101,757 | 1,722 | (11) |
| Spain | 3,247,738 | 74,420 | (12) |
| Germany | 2,755,225 | 75,780 | (13) |

TABLE S1. (Continued)

| Country/Region | Diagnosis | Death | Data reference |
|-----------------|------------|---------|----------------|
| United States | 29,859,706 | 543,003 | (14,15) |
| Sweden | 780,018 | 13,402 | (16) |
| Norway | 90,934 | 656 | (17) |
| Australia | 29,071 | 909 | (18) |
| Canada | 961,083 | 22,852 | (19) |
| Singapore | 60,288 | 30 | (20,21) |
| Denmark | 220,459 | 2,391 | (22) |
| Japan | 462,459 | 9,028 | (23) |
| Portugal | 820,042 | 16,827 | (22) |
| Netherlands | 1,236,209 | 16,421 | (24) |
| Switzerland | 592,090 | 9,631 | (25) |
| Mexico | 2,224,261 | 200,862 | (22) |
| Vietnam | 2,590 | 35 | (22) |
| The Philippines | 712,442 | 13,159 | (22) |
| Bangladesh | 591,214 | 8,878 | (22) |
| Indonesia | 1,494,589 | 40,449 | (22) |
| Belgium | 866,063 | 22,870 | (26) |
| Austria | 526,948 | 8,968 | (22) |
| Chile | 969,913 | 22,653 | (22) |
| Peru | 1,512,384 | 51,032 | (22) |
| Israel | 649,824 | 14,158 | (27) |
| Finland | 831,084 | 6,165 | (22) |
| Pakistan | 75,973 | 845 | (22) |
| Argentina | 2,375,591 | 62,790 | (22) |
| Colombia | 2,301,389 | 55,368 | (22) |
| Jordan | 582,133 | 6,472 | (22) |
| Ireland | 234,556 | 4,653 | (28) |
| New Zealand | 2,482 | 26 | (29) |
| Slovenia | 210,787 | 4,296 | (30) |



SUPPLEMENTARY FIGURE S1. Deaths and years of life lost for every 100,000 COVID patients.

SUPPLEMENTARY TABLE S2. COVID-19 cases, deaths, and years of life lost for every 100,000 people by country.

| Country | Cases per 100,000 people | 95% CI lower | 95% CI upper | Deaths per 100,000 people | 95% CI lower | 95% CI upper | YLL per 100,000 people | 95% CI lower | 95% CI upper |
|-------------------|-----------------------------|-----------------|-----------------|------------------------------|-----------------|-----------------|---------------------------|-----------------|-----------------|
| Argentina | 5,092 | 5,086 | 5,098 | 123 | 121 | 123 | 1,783.8 | 1,766.1 | 1,800.3 |
| Australia | 114 | 113 | 115 | 4 | 3 | 4 | 32.1 | 29.7 | 34.5 |
| Austria | 5,851 | 5,836 | 5,867 | 100 | 98 | 102 | 947.1 | 926.5 | 970.6 |
| Bangladesh | 359 | 358 | 360 | 5 | 5 | 5 | 106.0 | 103.4 | 108.2 |
| Belgium | 7,473 | 7,457 | 7,489 | 197 | 195 | 200 | 1,906.7 | 1,877.9 | 1,936.0 |
| Canada | 2,546 | 2,541 | 2,551 | 61 | 60 | 61 | 630.1 | 620.5 | 639.5 |
| Chile | 5,074 | 5,063 | 5,083 | 119 | 117 | 120 | 1,859.7 | 1,832.2 | 1,889.8 |
| China | 6 | 6 | 6 | 0 | 0 | 0 | 4.8 | 4.6 | 4.9 |
| Colombia | 4,669 | 4,663 | 4,675 | 123 | 122 | 124 | 1,573.0 | 1,556.9 | 1,588.2 |
| Denmark | 3,806 | 3,790 | 3,821 | 41 | 40 | 43 | 377.8 | 361.7 | 396.0 |
| Finland | 1,371 | 1,361 | 1,380 | 15 | 14 | 16 | 151.3 | 138.0 | 163.5 |
| Germany | 3,288 | 3,285 | 3,292 | 90 | 90 | 91 | 1,017.7 | 1,008.7 | 1,025.7 |
| Indonesia | 546 | 546 | 547 | 15 | 15 | 15 | 288.2 | 284.4 | 290.9 |
| Ireland | 4,750 | 4,731 | 4,769 | 94 | 91 | 97 | 953.9 | 917.3 | 989.8 |
| Israel | 9,602 | 9,581 | 9,620 | 71 | 70 | 73 | 989.3 | 960.5 | 1,018.8 |
| Italy | 5,770 | 5,764 | 5,776 | 177 | 176 | 178 | 1,836.7 | 1,824.1 | 1,850.2 |
| Japan | 366 | 365 | 367 | 7 | 7 | 7 | 77.8 | 76.1 | 79.6 |
| Jordan | 5,705 | 5,691 | 5,721 | 63 | 62 | 65 | 1,064.2 | 1,036.0 | 1,093.9 |
| Mexico | 1,725 | 1,723 | 1,727 | 156 | 155 | 156 | 3,099.2 | 3,083.4 | 3,114.2 |
| Netherlands | 7,215 | 7,202 | 7,227 | 96 | 94 | 97 | 876.6 | 862.0 | 893.1 |
| New Zealand | 51 | 49 | 54 | 1 | 0 | 1 | 6.6 | 3.7 | 9.5 |
| Norway | 1,677 | 1,667 | 1,688 | 12 | 11 | 13 | 123.9 | 112.7 | 135.7 |
| Pakistan | 294 | 293 | 295 | 6 | 6 | 7 | 118.3 | 115.4 | 120.0 |
| Peru | 4,587 | 4,581 | 4,596 | 155 | 154 | 156 | 3,211.1 | 3,181.2 | 3,243.4 |
| The Philippines | 650 | 649 | 652 | 12 | 12 | 12 | 205.5 | 201.1 | 209.6 |
| Portugal | 8,042 | 8,025 | 8,060 | 165 | 163 | 168 | 1,610.7 | 1,582.3 | 1,640.7 |
| Singapore | 1,031 | 1,023 | 1,038 | 1 | 0 | 1 | 8.2 | 4.7 | 11.6 |
| Slovenia | 10,139 | 10,099 | 10,180 | 207 | 201 | 213 | 2,016.1 | 1,942.6 | 2,086.2 |
| Republic of Korea | 198 | 197 | 200 | 3 | 3 | 4 | 39.4 | 36.9 | 41.3 |
| Spain | 6,946 | 6,939 | 6,953 | 159 | 158 | 160 | 1,704.2 | 1,690.2 | 1,718.6 |
| Sweden | 7,724 | 7,706 | 7,740 | 133 | 131 | 135 | 1,195.5 | 1,169.0 | 1,219.0 |
| Switzerland | 6,841 | 6,825 | 6,859 | 111 | 109 | 113 | 1,015.9 | 991.6 | 1,039.7 |
| United States | 9,021 | 9,018 | 9,024 | 164 | 164 | 164 | 2,189.6 | 2,182.7 | 2,196.3 |
| Vietnam | 3 | 3 | 3 | 0 | 0 | 0 | 0.7 | 0.4 | 0.9 |

Note: "Lower" means the lower bound of confidence interval (CI); "upper" means the upper bound of CI.
Abbreviations: 95% CI=95% confidence interval; YLL=years of life lost

SUPPLEMENTARY TABLE S3. Deaths and years of life lost per 100,000 COVID-19 patients by country and years of life lost per death caused by COVID.

| Country | Deaths per 100,000 patients | 95% CI lower | 95% CI upper | YLL per 100,000 patients | 95% CI lower | 95% CI upper | YLL per death for patients | 95% CI lower | 95% CI upper |
|-------------------|-----------------------------|--------------|--------------|--------------------------|--------------|--------------|----------------------------|--------------|--------------|
| Argentina | 2,406 | 2,387 | 2,425 | 35,032 | 34,688 | 35,383 | 14.56 | 14.41 | 14.71 |
| Australia | 3,127 | 2,956 | 3,305 | 28,166 | 26,239 | 30,047 | 9.01 | 8.32 | 9.65 |
| Austria | 1,702 | 1,670 | 1,734 | 16,188 | 15,813 | 16,559 | 9.51 | 9.26 | 9.76 |
| Bangladesh | 1,502 | 1,472 | 1,531 | 29,522 | 28,779 | 30,195 | 19.66 | 19.14 | 20.17 |
| Belgium | 2,641 | 2,609 | 2,672 | 25,515 | 25,131 | 25,897 | 9.66 | 9.50 | 9.80 |
| Canada | 2,378 | 2,349 | 2,406 | 24,743 | 24,397 | 25,123 | 10.41 | 10.25 | 10.57 |
| Chile | 2,336 | 2,309 | 2,362 | 36,654 | 36,063 | 37,211 | 15.69 | 15.45 | 15.95 |
| China | 5,142 | 5,014 | 5,277 | 76,266 | 73,865 | 78,905 | 14.83 | 14.31 | 15.41 |
| Colombia | 2,643 | 2,622 | 2,662 | 33,692 | 33,366 | 33,982 | 12.75 | 12.63 | 12.88 |
| Denmark | 1,085 | 1,045 | 1,125 | 9,926 | 9,482 | 10,390 | 9.15 | 8.69 | 9.62 |
| Finland | 1,112 | 1,043 | 1,180 | 11,036 | 10,148 | 11,888 | 9.92 | 9.15 | 10.80 |
| Germany | 2,750 | 2,733 | 2,768 | 30,947 | 30,723 | 31,201 | 11.25 | 11.15 | 11.35 |
| Indonesia | 2,706 | 2,678 | 2,732 | 52,736 | 52,086 | 53,265 | 19.49 | 19.23 | 19.73 |
| Ireland | 1,984 | 1,930 | 2,038 | 20,080 | 19,409 | 20,814 | 10.12 | 9.74 | 10.50 |
| Israel | 742 | 723 | 760 | 10,303 | 10,000 | 10,625 | 13.89 | 13.44 | 14.35 |
| Italy | 3,074 | 3,058 | 3,091 | 31,833 | 31,627 | 32,055 | 10.35 | 10.28 | 10.43 |
| Japan | 1,952 | 1,916 | 1,989 | 21,289 | 20,801 | 21,772 | 10.91 | 10.62 | 11.17 |
| Jordan | 1,112 | 1,088 | 1,140 | 18,653 | 18,129 | 19,221 | 16.78 | 16.23 | 17.30 |
| Mexico | 9,031 | 8,996 | 9,063 | 179,652 | 178,838 | 180,485 | 19.89 | 19.79 | 20.00 |
| Netherlands | 1,328 | 1,308 | 1,348 | 12,151 | 11,933 | 12,367 | 9.15 | 8.97 | 9.34 |
| New Zealand | 1,048 | 727 | 1,415 | 12,910 | 7,566 | 18,753 | 12.32 | 7.41 | 19.26 |
| Norway | 721 | 670 | 773 | 7,389 | 6,662 | 8,085 | 10.24 | 9.27 | 11.37 |
| Pakistan | 2,179 | 893 | 3,486 | 40,195 | 22,251 | 58,558 | 18.45 | 9.54 | 37.09 |
| Peru | 3,374 | 3,346 | 3,401 | 70,006 | 69,328 | 70,717 | 20.75 | 20.53 | 20.97 |
| Philippines | 1,847 | 1,817 | 1,879 | 31,600 | 30,924 | 32,281 | 17.11 | 16.71 | 17.51 |
| Portugal | 2,052 | 2,023 | 2,081 | 20,028 | 19,685 | 20,387 | 9.76 | 9.57 | 9.93 |
| Singapore | 50 | 32 | 66 | 795 | 457 | 1,109 | 15.97 | 9.99 | 24.23 |
| Slovenia | 2,038 | 1,981 | 2,092 | 19,885 | 19,208 | 20,542 | 9.76 | 9.42 | 10.12 |
| Republic of Korea | 1,692 | 1,615 | 1,764 | 19,833 | 18,762 | 20,762 | 11.72 | 11.08 | 12.41 |
| Spain | 2,291 | 2,274 | 2,308 | 24,533 | 24,289 | 24,764 | 10.71 | 10.59 | 10.82 |
| Sweden | 1,718 | 1,694 | 1,742 | 15,478 | 15,158 | 15,763 | 9.01 | 8.82 | 9.21 |
| Switzerland | 1,627 | 1,598 | 1,657 | 14,850 | 14,502 | 15,188 | 9.13 | 8.91 | 9.34 |
| United States | 1,819 | 1,814 | 1,823 | 24,272 | 24,190 | 24,346 | 13.35 | 13.30 | 13.39 |
| Vietnam | 1,351 | 941 | 1,744 | 25,513 | 15,696 | 35,570 | 18.88 | 11.94 | 29.52 |

Note: "Lower" means the lower bound of confidence interval (CI); "upper" means the upper bound of CI. Abbreviations: 95% CI=95% confidence interval; YLL=years of life lost.

REFERENCES

1. Moran PAP. The estimation of standard errors in monte carlo simulation experiments. *Biometrika* 1975;62(1):1 – 4. <http://dx.doi.org/10.1093/biomet/62.1.1>.
2. Chiang CL. The life table and its applications. Malabar: Robert E. Krieger Publishing Company. 1984. https://openlibrary.org/books/OL3500112M/The_life_table_and_its_applications.
3. World Health Organization. WHO life tables by country. World Health Organization. 2018. <https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-ghe-life-tables-by-country>. [2021-10-31].

4. United Nations. World population prospects 2019: highlights. 2019. <https://www.un.org/development/desa/publications/world-population-prospects-2019-highlights.html>. [2021-10-31].
5. World Health Organization. Coronavirus disease (COVID-2019) situation reports. 2022. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>. [2021-3-27].
6. CDC. Coronavirus disease 2019 (COVID-19). 2020. <https://stacks.cdc.gov/view/cdc/89585>. [2021-10-31].
7. National Health Commission of the People's Republic of China. The latest situation of the new coronavirus pneumonia epidemic situation as of 24:00 on June 30. 2020. <http://www.nhc.gov.cn/xcs/yqtb/202007/a98e49570be24eaf88de98e6e6217fc8.shtml>. [2021-10-31]. (In Chinese).
8. National Health Commission of the People's Republic of China. The latest situation of the new coronavirus pneumonia epidemic situation as of 24:00 on May 28. 2020. <http://www.nhc.gov.cn/xcs/yqtb/202005/874765e641254eb4acea9d5e945f4e01.shtml>. [2021-3-31]. (In Chinese).
9. The Norel Coronavirus Pneumonia Emergency Response Epidemiology Team. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Chin J Epidemiol* 2020;41(2):145 – 51. <http://dx.doi.org/10.3760/cma.j.issn.0254-6450.2020.02.003>. (In Chinese).
10. Italy Higher Institute of Health. Integrated surveillance of COVID-19 in Italy. <https://www.epicentro.iss.it/en/coronavirus/>. [2021-10-31].
11. Republic of Korea MOHW. Coronavirus disease-19, Republic of Korea. 2020. http://ncov.mohw.go.kr/bdBoardList_Real.do?brdId=1&brdGubun=11&ncvContSeq=&contSeq=&board_id=&gubun=. [2021-3-31].
12. Ministry of Health, Social Services and Equality. Current situation. <https://www.msbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov-China/situacionActual.htm>. [2021-10-31].
13. Robert Koch Institute. Coronavirus disease 2019 (COVID-19) daily situation report of the robert koch institute. 2022. https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/Gesamt.html. [2021-3-31].
14. CDC. Coronavirus disease 2019 (COVID-19). 2022. <https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html>. [2021-3-31].
15. GitHub. Coronavirus-data. 2020. <https://github.com/topics/coronavirus-data>. [2021-3-31].
16. The Public Health Agency of Sweden. Confirmed cases in Sweden - daily update. 2022. <https://www.folkhalsomyndigheten.se/smittskydd-beredskap/utbrott/aktuella-utbrott/covid-19/bekraftade-fall-i-sverige>. [2021-3-31].
17. Norwegian Institute of Public Health. Daily report and statistics about coronavirus and COVID-19. 2020. <https://www.fhi.no/en/id/infectious-diseases/coronavirus/daily-reports/daily-reports-COVID19/>. [2021-3-31].
18. Australia ABC. Charting the COVID-19 spread in Australia. 2020. <https://www.abc.net.au/news/2020-03-17/coronavirus-cases-data-reveals-how-covid-19-spreads-in-australia/12060704?nw=0>. [2020-3-31].
19. Government of Canada. Epidemiological summary of COVID-19 cases in Canada. 2022. <https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html>. [2021-3-31].
20. Ministry of Health, Singapore. COVID-19 statistics. 2022. <https://www.moh.gov.sg/covid-19/statistics>. [2021-3-31].
21. Singapore COVID19. Dashboard of the COVID-19 virus outbreak in Singapore. 2022. <https://co.vid19.sg/singapore/>. [2020-3-31].
22. World Health Organization. WHO coronavirus disease (COVID-19) dashboard. 2022. <https://covid19.who.int/>. [2021-3-31].
23. COVID-19 information and resources. <https://corona.go.jp/en/dashboard/>.
24. Coronavirus dashboard, Netherlands. <https://coronadashboard.government.nl/>. [2021-3-31].
25. COVID-19 Switzerland. 2022. <https://www.covid19.admin.ch/en/overview>. [2021-3-31].
26. Belgium COVID-19 epidemiological situation. 2022. <https://datastudio.google.com/embed/reporting/c14a5cfc-cab7-4812-848c-0369173148ab/page/ZwmOB>. [2021-3-31].
27. Israel COVID-19 data tracker, ministry of health, Israel. 2020. <https://www.gov.il/en/departments/guides/information-corona>. [2021-3-31].
28. Ireland's COVID-19 data hub, government of Ireland. <https://covid19ireland-geohive.hub.arcgis.com/>. [2021-3-31].
29. COVID-19: current cases, ministry of health, government of New Zealand. 2022. <https://www.health.govt.nz/covid-19-novel-coronavirus/covid-19-data-and-statistics/covid-19-current-cases>. [2021-3-31].
30. Data on COVID-19 epidemic in slovenia, government of Slovenia. 2022. <https://www.gov.si/en/topics/coronavirus-disease-covid-19/actual-data/>. [2021-3-31].