Excess mortality, rather than case fatality rate, is a superior indicator to assess the impact of COVID-19 pandemic

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Since the end of 2021, the world has been grappling with a series of coronavirus 2019 (COVID-19) outbreaks caused by the highly transmissible Omicron variant. Though the Omicron variant has a fatality rate that is lower than other variants and high vaccine coverage, more countries have lifted their non-pharmaceutical interventions (NPIs) and tried to combine natural infection and vaccine immunity to achieve herd immunity so as to coexist with the virus. Although the case fatality rate has declined significantly since the Omicron epidemic (dropping to 0.2%–0.4% after May 1, 2022; obtained from https://ourworldindata.org/coronavirus#explore-the-global-situation), using case fatality rate to guide policy-making or adjustment may be biased.

Case fatality rate is usually calculated by dividing the number of deaths from COVID-19 by the number of confirmed cases. However, the “correct” numerator is hard to obtain due to the different rules for coding causes of death. For example, if a cancer patient diagnosed with COVID-19 died, the primary cause of death may be coded as COVID-19 in some countries and as cancer in others. Additionally, the real denominator is difficult to obtain due to the huge difference in testing ability in various countries.

Also, excess mortality may be a more suitable indicator for informing policy-making. Excess mortality refers to the number of deaths from COVID-19 by the number of confirmed cases. However, the “correct” numerator is hard to obtain due to the different rules for coding causes of death. For example, if a cancer patient diagnosed with COVID-19 died, the primary cause of death may be coded as COVID-19 in some countries and as cancer in others. Additionally, the real denominator is difficult to obtain due to the huge difference in testing ability in various countries.

Excess mortality refers to the number of deaths from all causes during a crisis beyond what we would have expected to see under “normal” conditions and is a more comprehensive measure of the total impact of COVID-19 pandemic on deaths than fatality rate. This is because excess mortality captures not only the confirmed deaths but also COVID-19 deaths that were not diagnosed and reported, as well as deaths from other causes that are attributable to the overall crisis conditions. The excess mortality could be calculated as follows:

\[ \text{Excess mortality} = \frac{\text{reported mortality}}{\text{expected mortality}} \]

Reported mortality refers to the number of deaths reported by the official statistical department, which are normally obtained from government offices such as the National Statistics Offices, Population Registries, Ministries of Health, and Ministries of Public Health. Expected mortality refers to the mortality estimated based on historic trends of reported mortality by several models, like the autoregressive integrated moving average, Holt-Winters, over-dispersed Poisson generalized linear, and Bayesian structural time series models.1–3

According to estimates by the World Health Organization, approximately 14.9 million excess deaths related to the COVID-19 pandemic occurred during 2020–2021.4 In addition to the reported 5.4 million COVID-19 deaths, 9.5 million additional deaths were directly or indirectly caused by the COVID-19 pandemic.4 Similarly, a recent report documented that the estimated number of excess deaths due to COVID-19 was 3.07 times greater than the reported number (18.2 versus 5.94 million) during 2020–2021, with higher numbers in India (4.07 million), the United States (1.13 million), Russia (1.07 million), Mexico (798,000), Brazil (792,000), Indonesia (736,000), and Pakistan (664,000)1 (Figure 1). A study conducted in China observed that during January to March 2020, the number of deaths in Wuhan increased by 5,954 compared with the same period in 2019 (33% increase in overall mortality rate).2

![Figure 1. Global distribution of estimated excess mortality rate due to the COVID-19 pandemic, for the cumulative period 2020–2021](https://example.com/figure1.png)
Excess deaths during the COVID-19 pandemic could be comprised of three components: (1) COVID-19 deaths, (2) deaths caused by limited access to health services due to high levels of COVID-19 infections, and (3) deaths caused by strict lockdown policy, which did not allow people to access hospitals for care despite there being health services resources.

For COVID-19 deaths, more than 6.2 million reported deaths have been attributed to COVID-19 as of April 20, 2022. In 2020, COVID-19 climbed to the top ten causes of death globally. However, due to the limited detectability and imperfect death registration systems, the actual number of COVID-19-related deaths was higher than the reported number.

A considerable number of deaths were caused by the overwhelmed health system being occupied by COVID-19 infections. The super transmissibility of Omicron could cause a large number of infections within a short period. Together with the imperfect tiered diagnosis and treatment strategy, the medical systems would be overwhelmed soon. To take Hong Kong Special Administrative Region, China, as an example, the proportion of hospital beds occupied by patients with COVID-19 ranged from 1.06% to 5.69% in January, but this proportion increased to 6.09%–32.70% in February and reached its peak at 33.82%–64.32% in March (calculated based on the data from Hong Kong Hospital Authority: https://www3.ha.org.hk), when Omicron outbreak occurred. During that period, patients with COVID-19 without severe symptoms occupied the hospital beds, which could impede other patients who were more in need of hospitalization. Further, the occupied hospital beds could prevent patients with other acute critical diseases from being hospitalized.

Even with spare health resources, the strict lockdown policy could reduce accessibility of treatments. For example, most hospitals do not offer treatment until the patients provide negative nucleic acid results within a short period, potentially reducing their willingness to get treatment and delay the time of treatment. The delayed treatments could lead to unnecessary excess deaths. In addition, a previous study observed a higher incidence of anxiety and depression during the COVID-19 pandemic, potentially contributing to higher suicide attempts and suicide-related deaths. In addition to the increased excess deaths, some causes of deaths decreased during the COVID-19 pandemic. For instances, the NPIs against COVID-19 had the co-benefits of reducing the mortality of other infectious disease. Moreover, the lockdown decreased traffic flow, thereby potentially reducing traffic-related motor vehicle deaths.

In summary, using the decreasing case fatality rate of Omicron infections to adjust prevention strategies may be biased. Excess deaths are a more suitable indicator to measure the severity of the COVID-19 pandemic. The tiered diagnosis and treatment strategy, as well as the NPIs, should be gradually optimized against COVID-19 in the future.

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DECLARATION OF INTERESTS
The authors declare no competing interests.