Epidemic Features of COVID-19 and Potential Impact of Hospital Strain During the Omicron Wave — Australia, 2022

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Summary

What is already known about this topic?

Hospitals have experienced a surge in admissions due to the increasing number of Omicron cases. Understanding the epidemiological features of coronavirus disease 2019 (COVID-19) and the strain it places on hospitals will provide scientific evidence to help policymakers better prepare for and respond to future outbreaks.

What is added by this report?

The case fatality rate of COVID-19 was 1.4 per 1,000 persons during the Omicron wave. Over 90% of COVID-19-related deaths occurred in individuals aged 60 years or older, with pre-existing chronic conditions such as cardiac conditions and dementia, particularly among males aged 80 years or older.

What are the implications for public health practice?

Public health policy is essential for preparing and preserving medical resource capacity, as well as recruiting additional clinicians and front-line staff in hospitals to address the increased demand. High-risk individuals should be prioritized for healthcare, vaccines, and targeted interventions.

In the past three years, coronavirus disease 2019 (COVID-19) has become one of the major public health crises worldwide. As severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) sequences mutated and vaccination coverage increased, the severity of COVID-19 appears to have gradually decreased. Many countries, including Australia, have gradually allowed SARS-CoV-2 to circulate in communities. This study aimed to summarize the epidemic features of COVID-19 and explore the impact of hospital strain during the Omicron wave in Australia. A Quasi-Poisson regression model was used to explore the associations between the number of deaths, intensive care unit (ICU) admissions, and hospital admissions caused by COVID-19. Results showed that the single-day maximum numbers of deaths, hospital admissions, and ICU admissions caused by COVID-19 in Australia were 1,875,571, and 224 during the Omicron wave, respectively. Additionally, 73.5% of confirmed cases and 72.5% of deaths were recorded at the Omicron wave. About 92.9% of the deaths caused by COVID-19 occurred in people over 60 years old, with the highest risk in males and pre-existing chronic conditions, including chronic cardiac conditions and dementia, especially for those over 80 years old. The research findings could help policymakers to better prepare for and respond to future outbreaks.

We aimed to summarize the epidemic features and explore the impact of hospital strain on the COVID-19 Omicron wave in Australia. Data were obtained from Our World in Data (*1*) and the Australian Bureau of Statistics. The formulas for case fatality rate (CFR), case hospitalization rate (CHR), case ICU rate (CICUR), and mortality fatality index (MFI) caused by COVID-19 can be found in the Supplementary Material (available in https://weekly.chinacdc.cn/). To more comprehensively understand the severity of COVID-19, we developed MFI considering COVID-19 confirmed cases and deaths, and the population. CFR, CHR, MFI, and CICUR were described chronologically using scatter plots with regression lines. The stringency index, a composite measure of the government's prevention and control of COVID-19 developed by OxCGRT (*2*), was based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100=strictest). Spearman's rank correlation was used to detect the correlation coefficients (r). Since the number of patients in hospitals caused by COVID-19 was a count and its mean and variance were unequal, a Quasi-Poisson regression model was used to overcome the overdispersion and assess the associations between the number of deaths, ICU, and patients in hospitals caused by COVID-19. Chi-square tests were used for mortality comparisons by sex and age groups. All statistical analyses were completed using R version

4.1.3 software (R Foundation for Statistical Computing, Vienna, Austria).

On December 15, 2021, the Omicron strain of COVID-19 was detected in Australia and quickly displaced previous variants, with the Omicron strain accounting for 100% of SARS-COV-2 sequences by February 14, 2022. As of December 19, 2022, the total number of confirmed cases of COVID-19 in Australia was 10,979,204, with an infection rate of 43.2%. The total number of deaths caused by COVID-19 was 16,712, and the mortality rate was 60 per 100,000 persons. Of these, 73.5% of the confirmed cases and 72.5% of the deaths caused by COVID-19 occurred during the Omicron wave. About 92.9% of the deaths caused by COVID-19 occurred in people over 60 years old (Figure 1A), and the mortality of men in all age groups was significantly higher than that of women (Figure 1B and Supplementary Table S1, available in

https://weekly.chinacdc.cn/). During the Omicron wave (from February 14 to December 19, 2022), the CFR caused by COVID-19 was 1.4 per 1,000 persons overall, and the CFR was 1.5, 6.6, 27.5, and 69.5 per 1,000 persons in the 60–69, 70–79, 80–89, and 90+ years age groups, respectively (Figure 1A). After the stringency index reduced to its lowest level on July 6, 2022, the CFR, CHR, MFI, and CICUR gradually reached their peak (lasting for about 4 months) (Figure 2). The CFR was 1.02 per 1,000 persons between February 14 and July 6, 2022, and 2.49 per 1,000 persons between July 6 and December 19, 2022 (Supplementary Table S2, available in https://weekly.chinacdc.cn/). Additionally, the daily death rate per million had a peak after the stringency index reduced to its lowest level (Supplementary Figure S1, available in https://weekly.chinacdc.cn/). During the Omicron wave, the single-day maximum number of deaths,
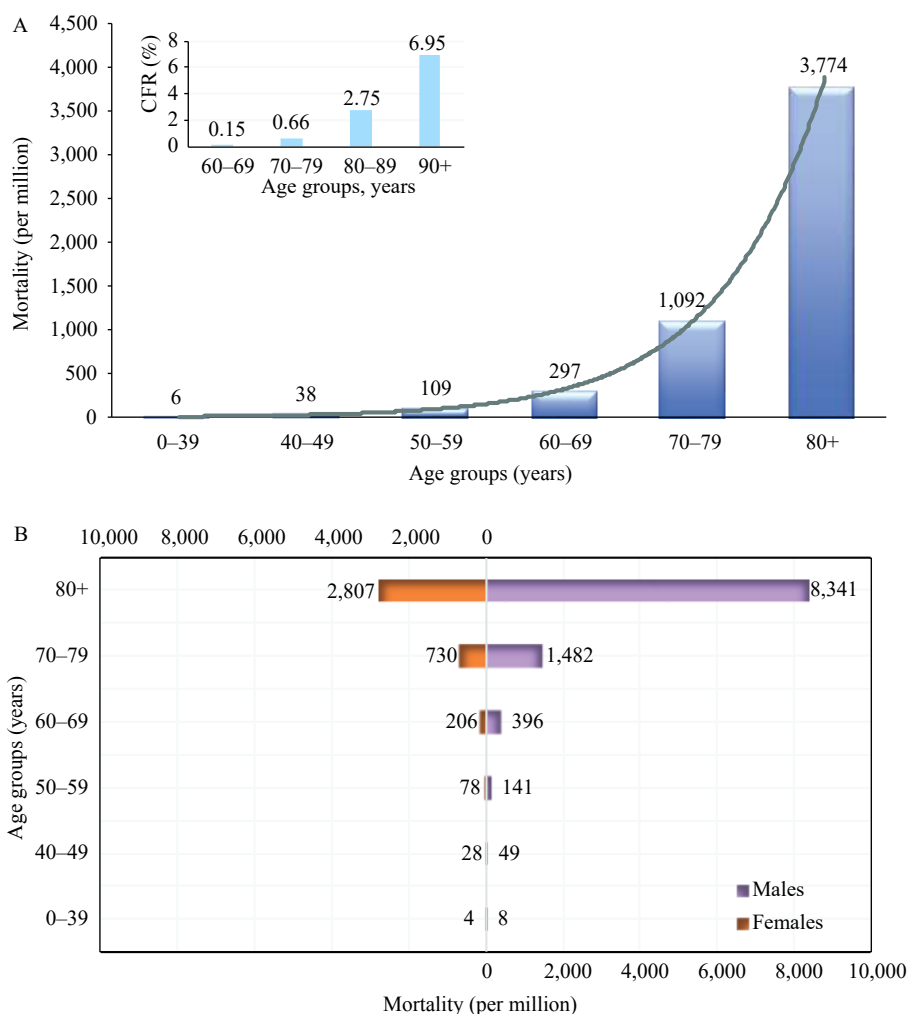

FIGURE 1. Deaths caused by COVID-19 by (A) age during Omicron period and (B) sex up to November 2022 in Australia.
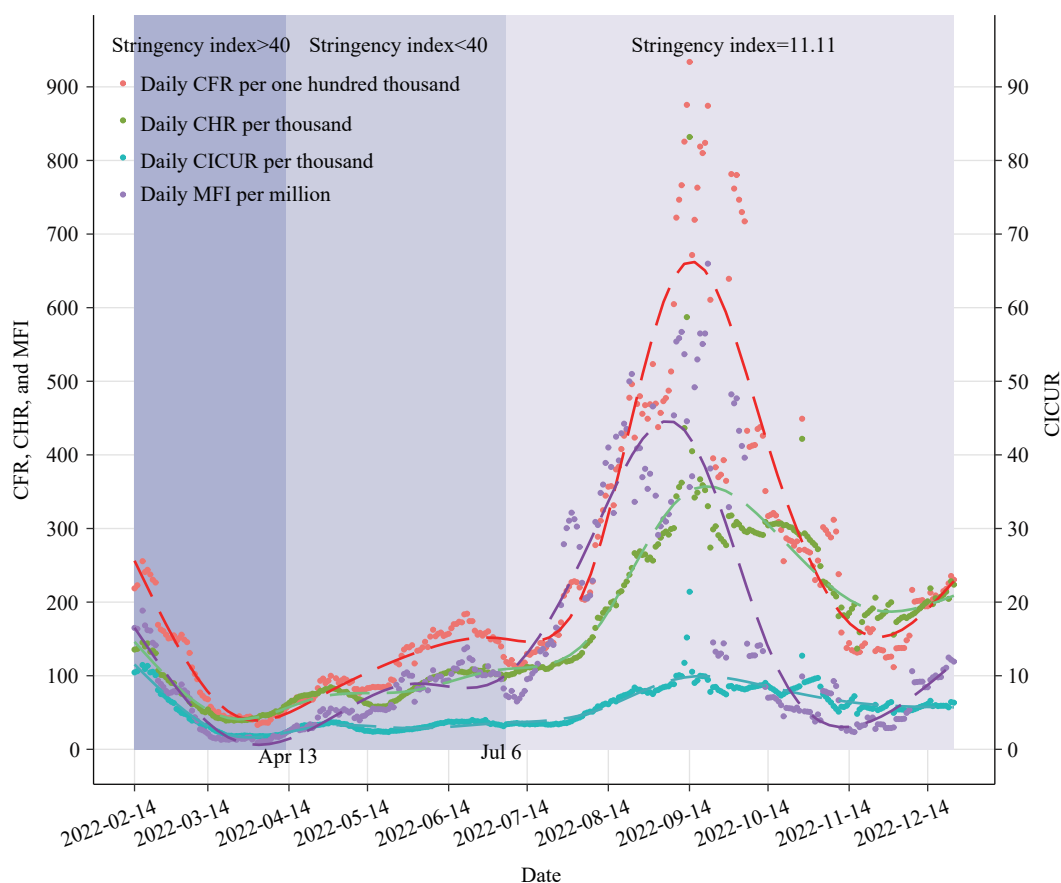Abbreviation: COVID-19=coronavirus disease 2019.

FIGURE 2. The trends of case fatality rate, case hospitalization rate, and case ICU rate in Australia during the Omicron period.

Note: CFR, CHR, MFI, and CICUR are described chronologically using regression lines ('dash line') and scatter plots ('dotted'). The stringency index is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100=strictest).

Abbreviation: ICU=intensive care unit; CFR=case fatality rate; CHR=case hospitalization rate; MFI=mortality fatality index; CICUR=case ICU rate.

hospital admissions, and ICU admissions caused by COVID-19 were 187, 5571, and 224, respectively. Furthermore, the number of deaths (r=0.82, P<0.01) and ICU admissions (r=0.70, P<0.01) increased with the increase in the number of COVID-19 hospital admissions (Figure 3). The CFR (r=0.86, P<0.01), MFI (r=0.59, P<0.01), and CICUR (r=0.90, P<0.01) increased with the increase in CHR (Supplementary Figure S2, available in https://weekly.chinacdc.cn/). Of the deaths caused by COVID-19, 39.3% had a history of chronic cardiac conditions, 30.3% had a history of dementia, and 17.8% had a history of chronic respiratory disease (Supplementary Figure S3, available in https://weekly.chinacdc.cn/). Pneumonia (61.0%) and respiratory failure (14.9%) were the main causes of death caused by COVID-19 (Supplementary Figure S4, available in https://weekly.chinacdc.cn/). In December 2022, only 20.0% of detected cases were

reinfections in the Australian Capital Territory, and the proportion of reinfection increased over time (Supplementary Figure S5, available in https://weekly.chinacdc.cn/).

DISCUSSION

In February 2022, Australia reopened its international borders (share of residents with a complete initial vaccine protocol: 78.1%). By April 2022 (share of residents with a complete initial vaccine protocol: 82.0%), Australian jurisdictions had begun to lift mask mandates, and airport mask mandates were removed in June 2022. When the stringency index decreased to its lowest level in July (share of residents with a complete initial vaccine protocol: 82.7%), community levels of COVID-19 peaked and remained at this level for four months. Our findings indicated
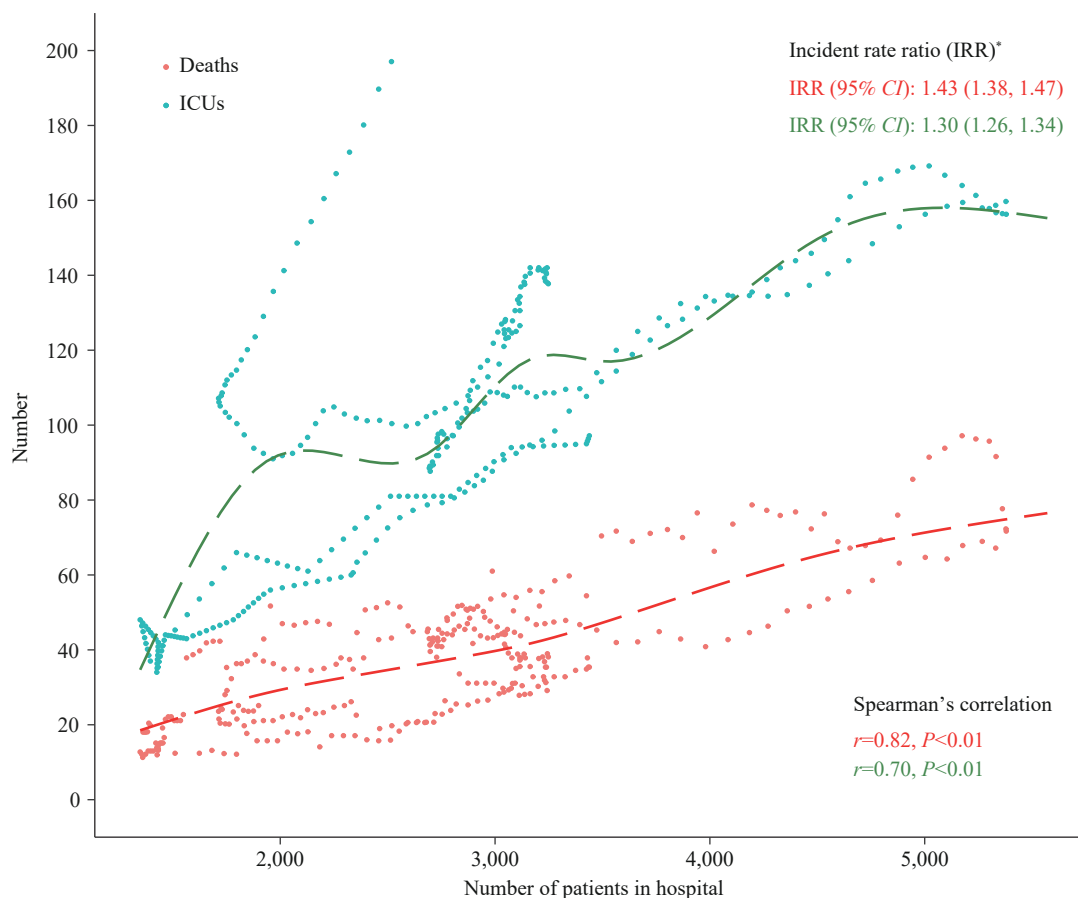
FIGURE 3. Scatter plot and Spearman's correlation between number of deaths, ICU, and patients in hospitals caused by COVID-19 in Australia during the Omicron period.
Note: The dash lines were the fitted curve using regression lines. Incident rate ratio in daily number of deaths and ICUs for 1,000-increase in daily number of patients in hospitals caused by COVID-19 in Quasi-Poisson regression model.

that the CFR, MFI, and CICUR increased significantly with the increase in CHR during the Omicron wave, which is consistent with several previous studies (3–4). This increase in hospital burden contributed to the rise in COVID-19 deaths. Vaccination and non-pharmaceutical interventions (NPIs) will remain important measures to suppress the peak of the epidemic and reduce hospital strain (5). Additionally, a new Omicron subvariant XBB was detected in Australia at the end of September 2022, and its proportion of SARS-COV-2 sequences had risen to 3.0% as of January 16, 2023 (1).

This study found that 92.9% of deaths in Australia occurred in people over 60 years old, with the highest risk in men and those with pre-existing chronic conditions, including chronic cardiac conditions and dementia. Research has shown that individuals diagnosed with dementia have three times the risk of developing severe COVID-19 compared with those without dementia (6), which may be due to social isolation, delayed clinical care, and worsening mental health (7). Additionally, risk factors for dementia (such as age, obesity, and cardiovascular and metabolic diseases) are also risk factors for SARS-CoV-2 infection and severe COVID-19 (8). People with dementia may have difficulty understanding and following public health recommendations, so it is essential to provide additional support during the COVID-19 outbreak (9).

This study has several limitations. First, we do not have individual clinical information about deaths due to COVID-19 in Australia during the Omicron wave. However, 72.5% of the deaths attributed to COVID-19 occurred during the Omicron wave, suggesting that the distribution of deaths included in this study is a good representation of the Omicron wave. Second, case numbers may be underestimated due to inadequate detection, which could lead to overestimation of the CFR, CHR, and CICUR. Nevertheless, the quality of the reported data is

unlikely to vary significantly within the temporal scales of our analysis.

The epidemiological features of COVID-19 in Australia provide an important reference for other countries currently experiencing high levels of COVID-19 transmission during the Omicron wave. To reduce mortality and relieve strain on healthcare systems, health authorities should prioritize the following: 1) Minimizing the chance of infection through strengthening NPIs and vaccinating vulnerable populations; 2) Providing effective COVID-19 health education strategies to reduce fear and confusion; 3) Mitigating the risk of co-infections by improving access to non-hospital care, outdoor fever/testing clinics, and telehealth services; 4) Developing effective early warning systems to improve the efficiency and accuracy of surveillance and management of COVID-19 (*10*).

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SUPPLEMENTARY MATERIAL

Definition

Stringency Index

The indicators of government response include nine policies recorded on an ordinal scale, namely, school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls. The stringency index is composed of a series of individual policy response indicators. For each indicator, we create a score by taking the ordinal value and subtracting half a point if the policy is targeted rather than general, if applicable. We then rescale each of these by their maximum value to create a score between 0 and 100, with a missing value contributing 0. These scores are then averaged to obtain the composite indices. This calculation is described in the equation below, where k is the number of component indicators in an index and I_j is the subindex score for an individual indicator. Sources: A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker) | Nature Human Behaviour (Source: https://www.nature.com/articles/s41562-021-01079-8).

$$\text{Stringency Index} = \frac{1}{k} \sum_{j=1}^{k} I_j$$

Daily CFR, **CHR**, **CICUR**, **MFI**

The outcomes included daily case fatality rate (CFR), case hospitalization rate (CHR), case ICU rate (CICUR), and mortality fatality index (MFI) caused by COVID-19, calculated as follows:

$$\text{Daily CICUR} = \frac{\text{7 days moving average of daily number of patients in ICU}}{\text{7 days moving average of daily number of new confirmed cases 10 days earlier}} \times 1,000,000$$

$$\text{Daily CHR} = \frac{\text{7 days moving average of daily number of patients in the hospitals}}{\text{7 days moving average of daily number of new confirmed cases 10 days earlier}} \times 1,000,000$$

$$\text{Daily CFR} = \frac{\text{7 days moving average of daily number of new confirmed deaths}}{\text{7 days moving average of daily number of new confirmed cases 10 days earlier}} \times 1,000,000$$

$$\text{Daily MFI} = \frac{\text{7 days moving average of daily number of new confirmed deaths}^2}{\text{7 days moving average of daily number of new confirmed cases 10 days earlier} \times \text{Total population}} \times 1,000,000$$

When calculating the daily CFR, we keep consistent with Our World in Data using the number of new confirmed cases 10 days earlier since confirmed cases often do not die on the same day. Furthermore, the deaths caused by COVID-19 in this report have been coded to ICD-10 code U07.1 COVID-19, virus identified or U07.2 COVID-19, virus not identified as the underlying cause of death.

SUPPLEMENTARY TABLE S1. Deaths caused by COVID-19 by sex and age groups during Omicron wave in Australia.

Age group, years	Sex	Death	Frequency	χ^2	P-value
0–39				5.633	0.018
	Males	No	6,632,889		
	Males	Yes	51		
	Females	No	6,505,979		
	Females	Yes	29		
40–49				9.153	0.002
	Males	No	1,616,847		
	Males	Yes	79		
	Females	No	1,667,830		
	Females	Yes	47		
50–59				28.373	<0.001
	Males	No	1,541,189		
	Males	Yes	217		
	Females	No	1,611,329		
	Females	Yes	126		
60–69				83.845	<0.001
	Males	No	1,336,528		
	Males	Yes	529		
	Females	No	1,429,210		
	Females	Yes	294		
70–79				256.834	<0.001
	Males	No	952,498		
	Males	Yes	1,414		
	Females	No	1,028,023		
	Females	Yes	751		
80+				1601.200	<0.001
	Males	No	459,055		
	Males	Yes	3,861		
	Females	No	632,252		
	Females	Yes	1,780		

SUPPLEMENTARY TABLE S2. The cases, deaths and case fatality rates caused by COVID-19 during the Omicron wave (from February 14, 2022 to December 19, 2022).

| Outcome	February 14 to July 5	July 6 to December 19	February 14 to December 19
COVID-19 confirmed cases	5,420,219	2,644,402	8,064,621
COVID-19 confirmed deaths	5,526	6,582	12,108
Case fatality rates	0.102%	0.249%	0.150%
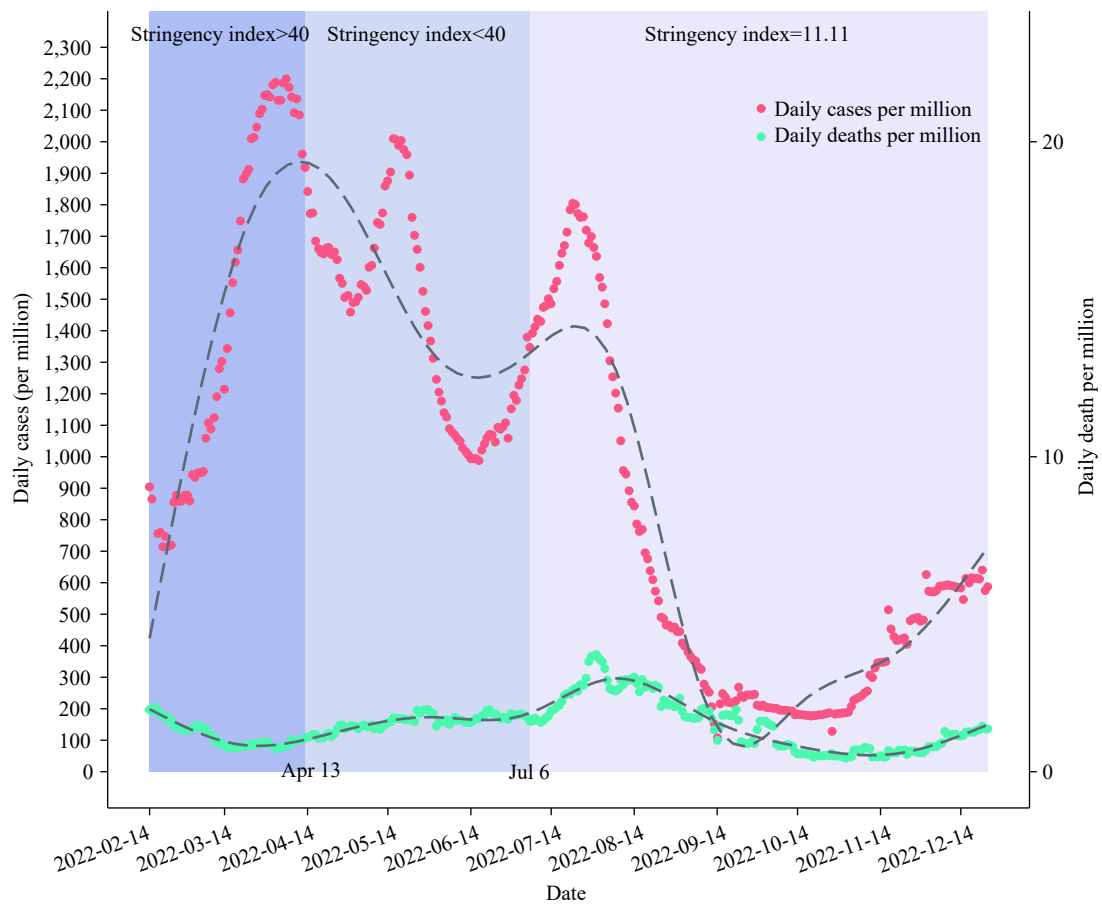
SUPPLEMENTARY FIGURE S1. The trends of confirmed cases and deaths in Australia during the Omicron wave.
Note: The dash lines were fitted curve using regression lines.
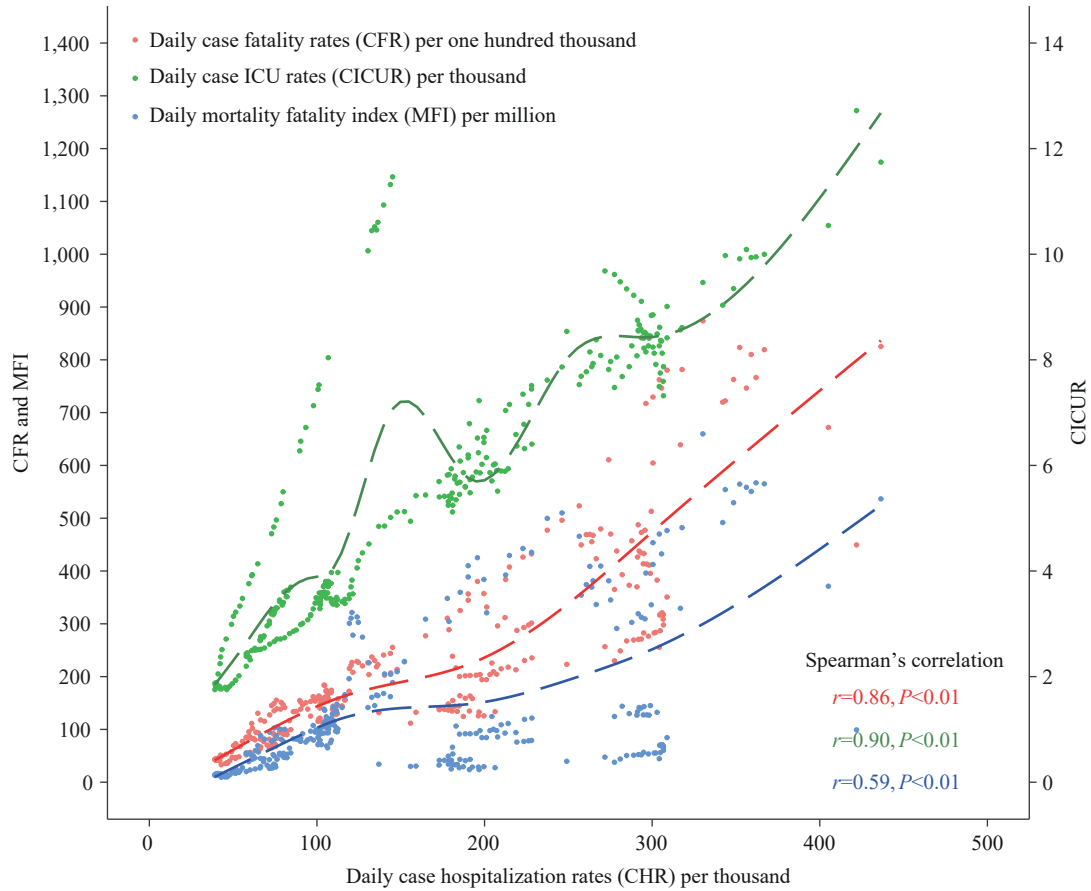
SUPPLEMENTARY FIGURE S2. Scatter plot and Spearman's correlation between case fatality rate, case ICU rate and patients in hospitals in Australia during the Omicron wave.
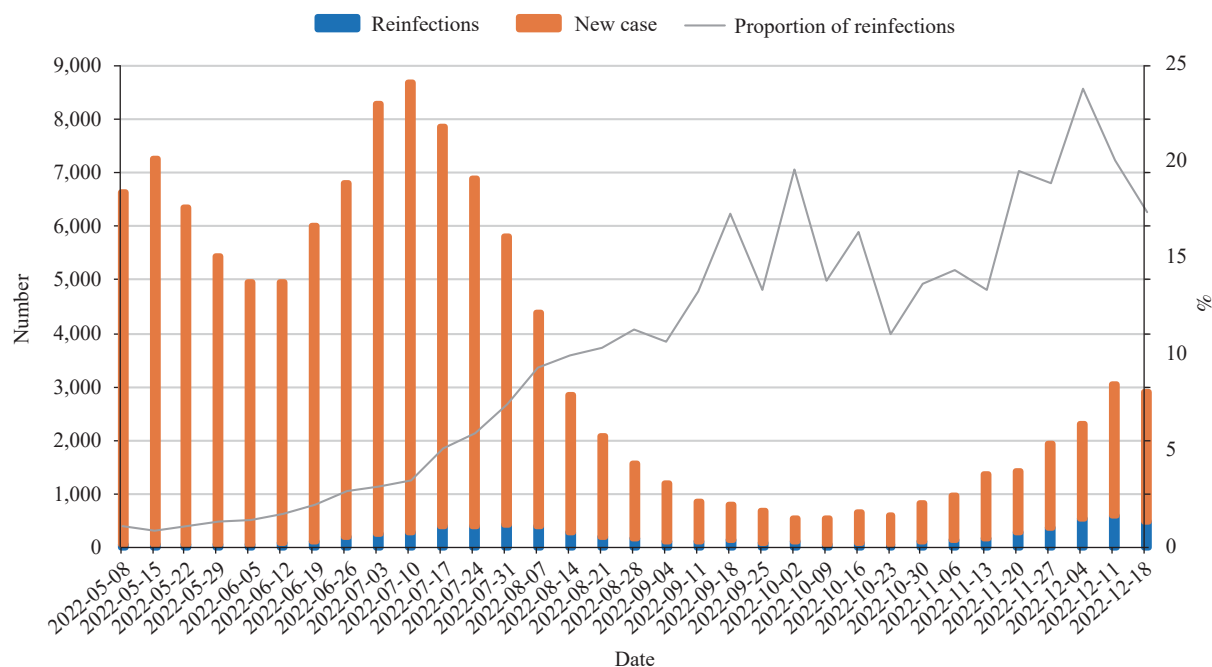Note: The dash lines were the fitted curve using regression lines.
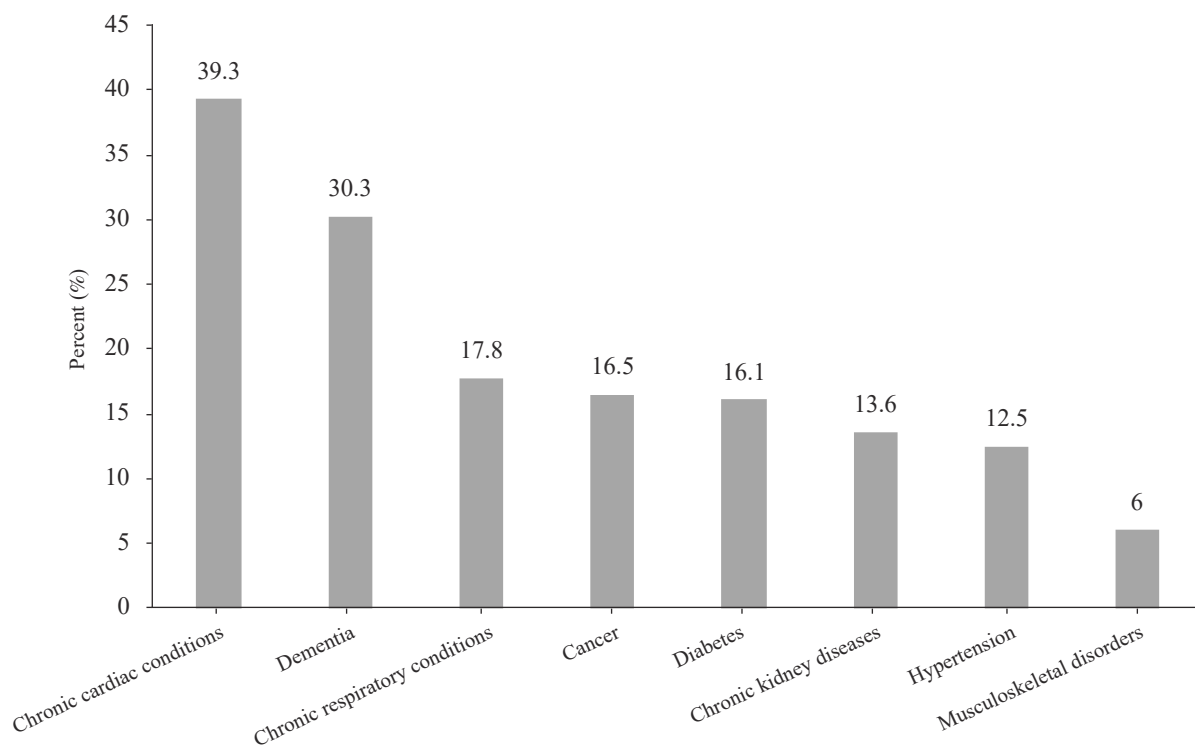
SUPPLEMENTARY FIGURE S3. Deaths caused by COVID-19: pre-existing chronic conditions in Australia between 2020 and 2022.
Source: https://www.abs.gov.au/
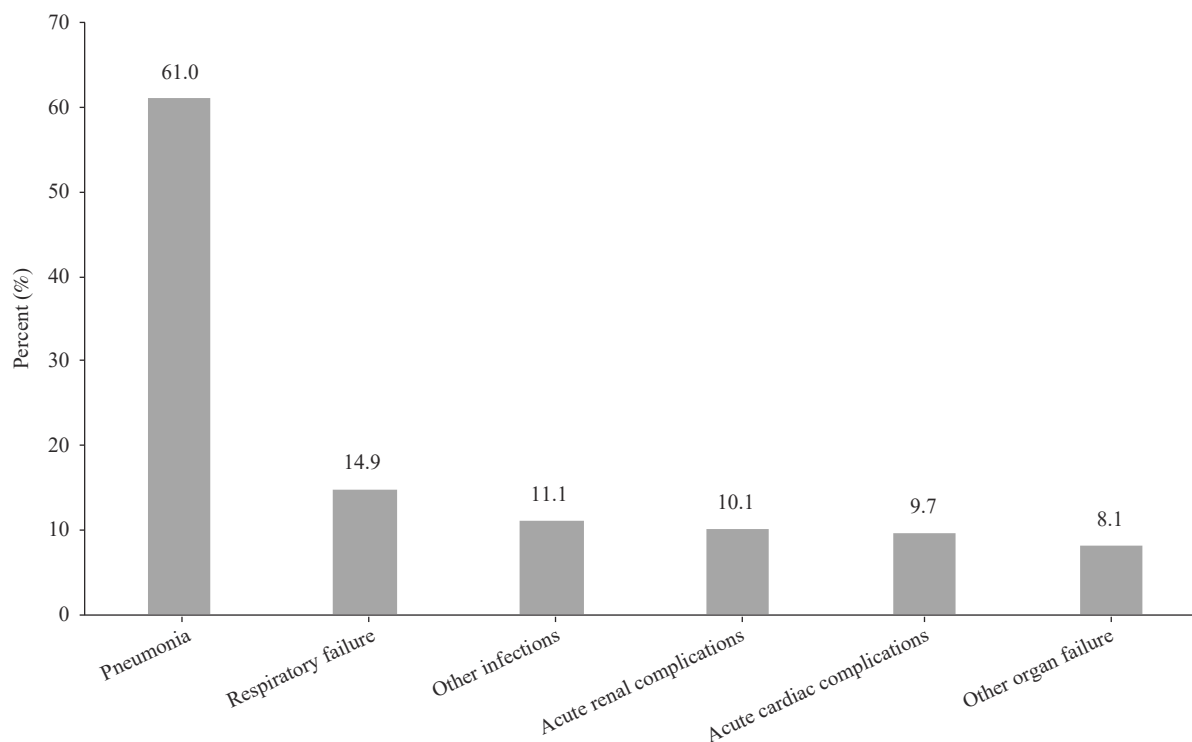
SUPPLEMENTARY FIGURE S4. Deaths caused by COVID-19: conditions in the causal sequence in Australia between 2020 and 2022.
Source: https://www.abs.gov.au/

SUPPLEMENTARY FIGURE S5. Weekly reported cases by previous infection status in the Australian Capital Territory in 2022.
Source: https://www.abc.net.au/news/2023-01-04/latest-surge-infecting-people-who-have-not-had-covid19/101794332