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Understanding the impact of lockdowns on short-term excess mortality in Australia

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ABSTRACT

During 2020 and 2021, Australia implemented relatively stringent government restrictions yet had few COVID-19 deaths. This provides an opportunity to understand the effects of lockdowns and quarantining restrictions on short-term mortality and to help provide evidence in understanding how such public health policies can impact on health. Our analysis is based on preliminary mortality data collected by the Australian Bureau of Statistics. Rates were estimated by disease and over time and compared with mortality statistics in the period 2015–2019. Comparing deaths in 2020-2021 with 2015–2019 show the annual mortality rate (per 100 000 people) fell by 5.9% from 528.4 in 2015–2019 to 497.0 in 2020–2021. Declines in mortality are across many disease categories including respiratory diseases (down 9.4 deaths per 100 000), cancer (down 7.5 deaths per 100 000) and heart disease (down 8.4 deaths per 100 000). During 2020 and 2021, Australian age-standardised mortality rates fell by 6%. This drop was similar for men and women, and was driven by a reduction in both communicable and non-communicable causes of death. Such evidence can help inform public health policies designed to both control COVID-19 and other infectious diseases.

SUMMARY BOX

⇒ Analysis of short-term excess mortality suggests that lockdowns are not associated with large numbers of deaths in Australia.
⇒ This decline in short-term mortality was due to declines in both communicable and non-communicable causes of death.
⇒ Google mobility data indicates that the drop in deaths tracked reductions in movement outside the home.
⇒ Virtual working and other online activities may be a means to reduce mortality from both communicable and non-communicable causes of death.

INTRODUCTION

A recent commentary[1] in this journal has highlighted the ongoing debate about the overall impact of 'lockdowns' which they define as a restrictive set of non-pharmaceutical interventions aimed at preventing spread of COVID-19. An important element of this debate is the impact of these measures on overall mortality. While lockdowns have proved effective in reducing transmission[2] and deaths from COVID-19[3] some have argued it comes at a high cost. For example, signatories of the Great Barrington Declaration[4] argued that 'Current lockdown policies are producing devastating effects on short and long-term public health… [including]… worsening cardiovascular disease outcomes, fewer cancer screenings and deteriorating mental health'. The Declaration called on governments to end stay-at-home orders, and focus on building herd immunity in the broader population.

One of the countries that is highlighted in the commentary[1] is Australia, which had lockdowns without experiencing large numbers of COVID-19 cases and deaths in the first 2 years of the pandemic (this changed in 2022, after lockdowns were lifted). By the end of 2021, Australia had fewer than 100 COVID-19 deaths per million people, less than one-sixth of the worldwide death rate.[5] Yet while Australia's COVID-19 death rate was relatively low during that period, its movement restrictions were relatively stringent. Across 34 advanced nations, Australia had the seventh-most stringent lockdown in 2020 and 2021 (see online supplemental appendix 1). In those years, Australia is unusual in having both a low death rate from COVID-19 and stringent lockdowns.

While previous international comparisons noted Australia 'did not have large numbers of excess deaths',[6] the country has not been included in many previous international comparisons due to incomplete data. To address this gap, we explore excess deaths in Australia using recently released mortality data collected by the Australian Bureau of Statistics. This allows us to understand both disease and temporal patterns, which provide insights into short-term impacts of lockdowns on mortality.

Our analysis is based on provisional mortality data collected by the Australian Bureau of Statistics. For all-cause mortality, these data cover the full universe of deaths. For cause-specific mortality, the data cover only doctor-certified deaths (excluding the 11%–14% of deaths that are certified by a coroner).[7] Full details of our data are provided in online supplemental appendix 2. Our analysis compares deaths in 2020-2021 with deaths in the period 2015–2019 using age-standardised death rates. Following the Australian Bureau of Statistics, we refer to this as 'excess mortality', but it is important to acknowledge that it represents only a simple comparison of two time periods. In this sense, our measure of excess mortality differs from the WHO's measure of excess deaths, which also takes into account factors such as the average ambient temperature. As well as looking at the entire period, we also study mortality rates by week, enabling us to analyse the relationship between mortality and population mobility.

To better understand the fall in mortality, it is instructive to look at how it tracks government lockdowns and population movements. For this purpose, we use one indicator of the impact of lockdowns, Google Community Mobility reports,[8] which show daily mobility trends in six categories of places: grocery and pharmacy, parks, transit stations, retail and recreation, residential, and workplaces. For each category, these figures are expressed as a deviation from the baseline in early-2020, and account for day-of-week effects. More detail about these data are provided in online supplemental appendix 2.

MORTALITY TRENDS

Table 1 shows that the annual age-standardised mortality rate (per 100 000 people) fell from 528.4 in 2015–2019 to 497.0 in 2020–2021. This represents a 5.9% fall in the mortality rate. This figure is similar for males and females (for an explanation of why the percentage change for persons is slightly smaller than the figure for either males or females, see online supplemental appendix 2). Looking at causes of death, we find declines in mortality across the board. In absolute terms, the mortality drop is largest for respiratory diseases (down 9.4 deaths per 100 000), cancer (down 7.5 deaths per 100 000) and heart disease (down 8.4 deaths per 100 000). In proportional terms, the mortality drop is largest for respiratory diseases (down 20.5%) and the respiratory disease subcategory of influenza and pneumonia (down 41.8%).

Strikingly, while Australia experienced an average of around 600 influenza deaths each year in 2015–2019, influenza claimed fewer than 50 lives in 2020. In 2021, fewer than five Australian deaths were recorded from influenza (see online supplemental appendix 2 for details).

In figure 1, we analyse the seasonal nature of these effects, plotting weekly deaths across the year. During 2015–2019, the weekly death rate shows a marked seasonal effect, rising from around 9.5 deaths per 100 000 in summer to around 11.5 deaths per 100 000 in winter. By contrast, the years 2020–2021 saw less seasonality in Australian deaths, with the weekly mortality rate averaging around 9 deaths per 100 000 in summer and 10 deaths per 100 000 in winter.

Figure 2 shows the six mobility trends indicators, with a horizontal line depicting the baseline. As these data show, the COVID-19 pandemic significantly reduced visits to retail and recreation, parks, transit stations and workplaces, and substantially increased the amount of time spent in residences. The decreased time in public places and workplaces coincided with the two lockdown periods: April–May 2020 (when all Australians were

Table 1 Australia's 2020–2021 mortality reduction

	Age-standardised deaths per 100 000 people			
	2015–2019	2020–2021	Change	Change (%)
Persons	528.4	497.0	–31.4	–5.9
Males	625.8	587.8	–38.1	–6.1
Females	443.0	416.5	–26.4	–6.0
Respiratory diseases	45.7	36.3	–9.4	–20.5
Influenza and pneumonia	10.1	5.9	–4.2	–41.8
Chronic lower respiratory conditions	25.0	20.5	–4.4	–17.7
Cancer	155.5	148.0	–7.5	–4.8
Ischaemic heart diseases	47.1	38.8	–8.4	–17.7
Cerebrovascular diseases	30.6	25.7	–4.9	–15.9
Dementia	40.8	40.9	0.1	0.3
Diabetes	14.5	14.5	0.0	–0.1

Source: Authors' analysis, based on Australian Bureau of Statistics, Provisional Mortality Statistics. Cause-specific mortality is based only on doctor-certified deaths.

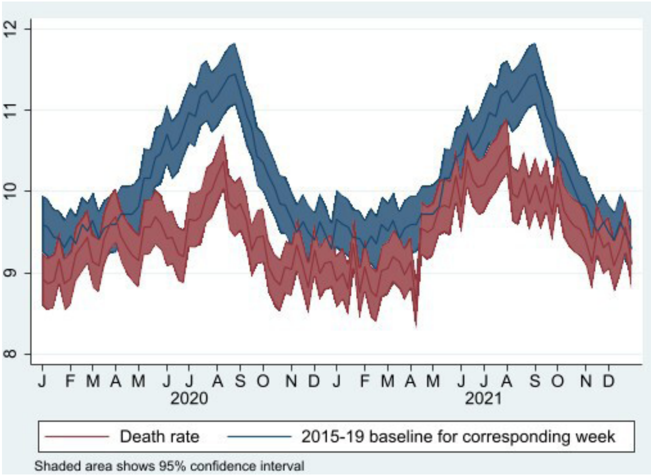

Figure 1 Australia's weekly death rate per 100 000 (age-standardised).

under lockdown) and August–September 2021 (when two-thirds of Australians were under lockdown). Visits to grocery stores and pharmacies show a slightly different pattern: spiking as Australians stocked up at the start of lockdowns, and steadily rising over the 2 years (perhaps reflecting increased demand for medicines).

Alongside these mobility indicators, we show the share of the Australian population under lockdown. We also show how age-adjusted mortality compared with previous years. To do this, we take the age-adjusted death rate for each week in 2020 and 2021, and estimate the ratio of that mortality rate to the mortality rate for the corresponding week in the period 2015 –2019. Thus, a ratio of 1.1 indicates that the death rate was 10% higher than in prior years, while a ratio of 0.9 indicates that the death rate was 10% lower than the historical average. This chart shows that the death rate fell sharply as social distancing increased. By mid-2020, the death rate was around 10% below its historical average. The death rate then returned close to its historical average in late-2020, before dropping (that is, improving) in late-2021, a period in which Australia's largest two states were under lockdown.

How does mobility track mortality? In figure 3, we present scatterplots of the mobility levels (relative to baseline) against the death rate (relative to prior years). Each dot denotes the figures for a single week. These data show that higher rates of activity in retail and recreation, grocery and pharmacy, transit stations, and workplaces were associated with higher mortality rates, while greater levels of activity in parks and more time spent in residences were associated with lower levels of mortality.

The simple bivariate regressions are significant at the 1% level for retail and recreation, grocery and pharmacy, transit stations, workplaces and residences. The association between time spent in parks and mortality is statistically insignificant. Finally, we show the relationship between mortality and the share of the population under official lockdown. Consistent with the mobility data, this relationship is negative and statistically significant at the 3% significance level.

EXPLAINING THE MORTALITY DECLINE

Australia was among a small number of countries that saw a decline in overall age-standardised mortality during 2020–2021. This decline in mortality was due to declines in both communicable and non-communicable causes of death. Using Google mobility data, we provide suggestive

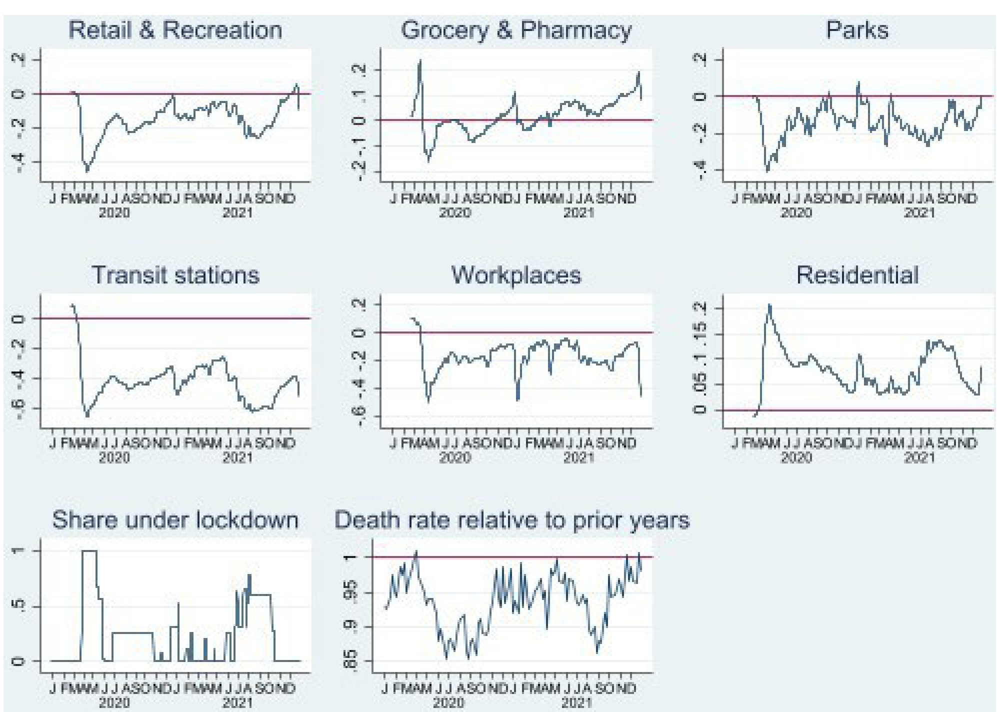

Figure 2 Trends in mobility, lockdowns and mortality.

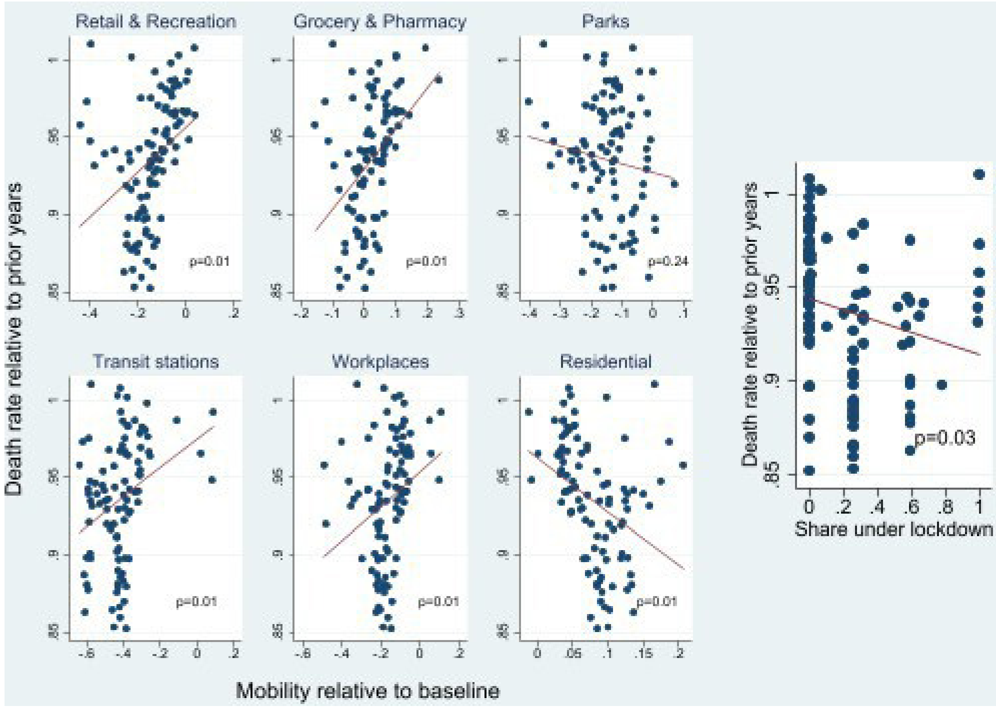

Figure 3 Mobility trends and mortality (each dot depicts a single week).

evidence that the drop in deaths tracked reductions in movement outside the home. In the short term, government lockdowns and social distancing appear to have significantly reduced overall mortality at least in the short term, which may help shape future public policy.

While the reduction in mortality from infectious diseases can explained by social distancing measures, the reduction in deaths from non-communicable conditions such as cancer and heart disease are more surprising. In the case of cardiovascular disease (which contributes to around one third of the reduction in deaths), possible explanations could be people spending greater time indoors over winter months (which are traditionally known to have high excess deaths),[9] faster access to emergency services,[10] lower pollution[11] and a reduction in cardiovascular events following influenza.[12]

Explanations for the reductions in cancer deaths are more difficult to identify and might be due to potential limitations in the coding of deaths for people with multimorbidities.[13] A recent analysis indicates that unlike other countries COVID-19 did not impact on provision of many healthcare services. For example, a recent analysis has indicated that COVID-19 pandemic did not disrupt cancer care in Australia.[14] It is possible that reductions in influenza may also have played a role, given evidence that influenza mortality rates are higher among cancer patients than the general population.[15]

It will be important to continue track mortality in countries such as Australia to see if there are long-run mortality impacts of lockdowns, for example, from the disruption of breast cancer screening services[16] or declining levels of physical exercise[17] both of which may lead to an increase in mortality rates over the longer term.

Although our analysis of overall deaths includes coroner-reported deaths, our cause-specific mortality figures are based only on doctor-certified deaths, excluding coroner-reported deaths and so exclude deaths from suicides, accidents and assaults (see online supplemental appendix 2). A recent international analysis of suicides in the early stages of the pandemic (which included data from Australia) has shown that rates 'remained largely unchanged or declined in the early months of the pandemic'.[18] Future research should look separately at suicides and homicides when full data become available.

It should also be noted that excess deaths can be calculated using a variety of different methodologies which can produce some variation in results, although consistently 2020 is a year of below average mortality for many diseases.[19] Further, the Australian Bureau of Statistics is not the only source of data on deaths. The World Mortality Dataset[20] is a valuable resource used by numerous international organisations to compare excess deaths across countries that could be used in future analyses.

Another caveat is that we are considering only the impact on mortality and do not capture the impact on morbidity from poor mental health or from family, domestic and sexual violence.[21] For example, a recent Australian study using a quasi-experimental design has shown that lockdowns were 'associated with a modest negative change in overall population mental health'.[22] Quality-adjusted life-years could be a useful broader metric, capturing both the negative and positive health impacts of home working and virtual interactions in a single measure. This could provide the basis of an evaluative framework of COVID-19 pandemic response policies.[23] Additional impacts of lockdowns such as disruption to economic activity and schooling also need to be considered.

Beyond the pandemic, it is also worth considering whether a move to virtual working and other online activities may be a means to reduce mortality from a range of diseases such as respiratory infections during the winter months. One must also weigh against the potential benefits in mortality, the impact on other aspects of health such as general well-being from social interaction. While large-scale randomised studies[24] have shown that home working can increase productivity, the potential for it as a health intervention in randomised studies has received less attention.[25] Given the mortality benefits observed here at a population level, it would worth exploring if the health and social impacts of home working and virtual activities could be evaluated using large-scale randomised trials.

CONCLUSION

Our results do provide some evidence that, at least in terms of short-run mortality, some of the concerns that led to the Great Barrington Declaration have not eventuated. Comparisons of deaths in 2020-2021 with 2015–2019 shows a drop in the annual mortality rate across many disease categories including respiratory diseases, cancer and heart disease. Hence, social distancing measures in Australia may have averted thousands of non-COVID deaths during the first phase of the pandemic. Understanding how patterns of mortality are impacted by public health interventions such as lockdowns can help provide a better evidence base for dealing with infectious diseases such as COVID-19, which is likely to remain endemic for the foreseeable future.

Contributors AL conceived the idea, acquired the data and undertook the analysis and contributed to the writing-up. PC contributed to the interpretation of the analysis and the writing up.

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Patient consent for publication Not applicable.

Ethics approval As this study is based on publicly available databases without any identifying individual information, ethical approval was not needed.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement The data in this study were obtained from publicly available databases. Replication files are available on request from the authors.

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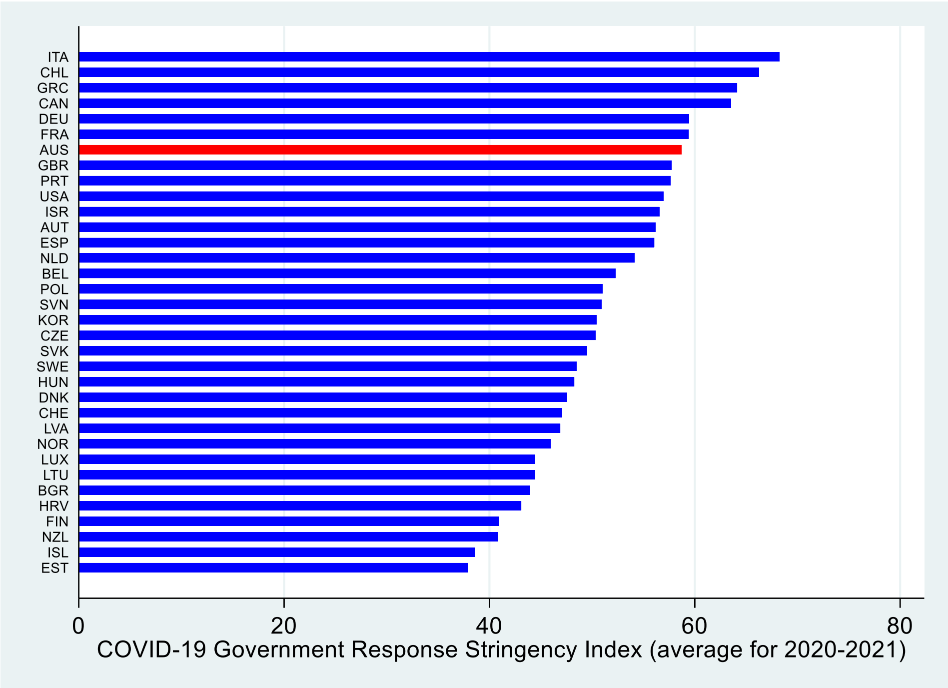
Supplementary Material for: *Understanding the impact of lockdowns on short-term excess mortality in Australia*

Appendix 1: Stringency of Government Response to COVID-19

One way to compare lockdowns across countries is to analyze the stringency of government restrictions, as measured by the Oxford COVID-19 Government Response Tracker (https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker). This 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, where 100 is the strictest possible value. Figure A1 shows these indices across 34 advanced nations.

Figure A1: Stringency of Government Response to COVID-19



The mean unweighted stringency index is 52. Australia's average stringency index in 2020-2021 was 59, making it the seventh-highest of the 34 countries.

It is worth noting that the Government Response Stringency Index is based on the most stringent response in any local jurisdiction in the country. Thus a strict lockdown in a single Australian state raises the index for the entire country. For the purposes of Figures 2 and 3 of our paper, we calculate a population-weighted lockdown figure for Australia, based on the

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daily lockdown rules in each state and territory. However, we do not report that number in Figure A1, since it would not be comparable with other countries. Just as a strict lockdown in the state of Victoria raises the Government Response Stringency Index for Australia, so too a strict lockdown in the state of New York raises the Government Response Stringency Index for the United States. In both cases, a population-weighted approach would produce a lower estimate than a metric that reflects the most restrictive jurisdiction.

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Appendix 2: Data

Mortality

In June 2020, the Australian Bureau of Statistics (ABS) began publishing preliminary mortality data[7]. In the April 2022 data release, which we used in our analysis, the all-cause mortality figures include both deaths that are certified by a doctor (around 86-89 percent of all deaths) and those certified by a coroner (11-14 percent of all deaths).

However, cause-specific mortality figures are based only on doctor-certified deaths, excluding coroner-reported deaths. The ABS notes that while there is variation across jurisdictions, deaths are generally reportable to a coroner where:

- the person died unexpectedly and the cause of death is unknown;
- the person died in a violent or unnatural manner;
- the person died during, or as a result of, an anesthetic;
- the person was 'held in care' or in custody immediately before they died; or
- the identity of the person who died is unknown.

Consequently, the portion of our analysis that focuses on specific causes of death does not include violent causes of death, such as suicides, accidents and assaults.

At a national level, the ABS breaks down deaths according to selected causes of death. These categories were chosen by the ABS based on their status as leading causes of death in Australia, and the proportion of doctor certified deaths:

- Ischaemic heart disease (I20-I25)
- Cerebrovascular diseases (I60-I69)
- Respiratory diseases (J00-J99), which are further broken down into:
    - Chronic lower respiratory diseases (J40-J47)
    - Influenza and pneumonia (J09-J18)
- Pneumonia (J12-J18)
- Cancer (C00-C97, D45, D46, D47.1 or D47.3-D47.5)
- Diabetes (E10-E14)
- Dementia, including Alzheimer Disease (F01, F03 or G30).

Following World Health Organization guidelines, deaths from COVID-19 are classified as ICD-10 U071 and U072 ('Codes for Special Purposes'), and are not included among deaths from respiratory diseases.

Data are compiled by weeks, with each week running from Monday to Sunday (following the International Organization for Standardization week date system).

All mortality figures are age-standardized death rates, calculated using quarterly population estimates and short-term projections. For more details on the methodology, see ABS (2021). Note that in Table 1, the percentage change in mortality from 2015-2019 to 2020-2021 is fractionally smaller for all persons (-5.9 percent) than for either males (-6.1 percent) or females (-6.0 percent). This occurs because the average age-standardized mortality rate for persons is not simply the average of the age-standardized mortality rate for males and females. Carrying out age-standardization separately for men and women means that the sex-specific estimates cannot simply be combined to obtain an estimate for all persons.

The Australian Bureau of Statistics is not the only source of data on deaths. The World Mortality Dataset is a valuable resource used by numerous international organizations to compare excess deaths across countries (see Ariel Karlinsky and Dmitry Kobak. 2021. 'Tracking excess mortality across countries during the COVID-19 pandemic with the World Mortality Dataset.', *eLife*, vol 10, article e69336). As we note in the main text, that dataset uses a more complex model to estimate excess deaths. While the Australian Bureau of Statistics' measure of excess deaths is based on comparing deaths in 2020 and 2021 with deaths in 2015 to 2019, the World Mortality Dataset's model of excess deaths takes into account not only pre-pandemic mortality rates, but also factors such as temperature.

Our paper also makes special note of influenza deaths. There are two ways of calculating influenza deaths. One is to use the ABS *Provisional Mortality Statistics*, Table 3.3, taking influenza deaths as the difference between the categories 'influenza and pneumonia' and 'pneumonia'[7]. This shows 45 influenza deaths 2020 and 2 in 2021. The other approach is to use the influenza surveillance report. This recorded 36 influenza deaths in 2020 and zero in 2021: Department of Health, 2021, *Australian Influenza Surveillance Report No. 16*, Reporting fortnight: 25 October to 07 November 2021, Australian Government, Canberra. We err on the conservative side by using the source with the higher number of influenza deaths.

Mobility

Google Community Mobility Trends are created from aggregated data from users who have turned on the Location History setting in their device. Google reports that the methodology for estimating the figures is akin to the approach used for its ‘Popular Times’ information provided for businesses in Google Maps.

The Community Mobility Trends data track six categories of locations:

1. Grocery & pharmacy: Mobility trends for places like grocery markets, food warehouses, farmers markets, specialty food shops, drug stores, and pharmacies.
2. Parks: Mobility trends for places like local parks, national parks, public beaches, marinas, dog parks, plazas, and public gardens.
3. Transit stations: Mobility trends for places like public transport hubs such as subway, bus, and train stations.
4. Retail & recreation: Mobility trends for places like restaurants, cafes, shopping centers, theme parks, museums, libraries, and movie theaters.
5. Residential: Mobility trends for places of residence.
6. Workplaces: Mobility trends for places of work.

According to Google LLC (2021), these figures are expressed as a deviation from the baseline, which is the median value, for the corresponding day of the week, during the five-week period from 3 January 2020 to 6 February 2020.

The residential measure tracks duration, while the other five categories track the total number of visitors to these places. Thus a figure of 10 percent in workplaces reflects that 10 percent more people are at workplaces than on that corresponding day of the week in early-2020, while a figure of 10 percent in residential reflects that people are spending 10 percent more hours in residences than on that corresponding day of the week in early-2020.

Since the mobility data are daily while the mortality data are weekly, we average the mobility figures across the week corresponding to the mortality data. Figure 2 shows weekly averages rather than daily figures.

Lockdowns

Our analysis is based on a spreadsheet compiled by the Australian Parliamentary Library, listing for each date since 1 March 2020 whether each state and territory in Australia is under lockdown. The Parliamentary Library used the definitions set out in the Oxford Covid-19 Government Response Tracker, and defined a jurisdiction as being in lockdown based on three criteria.

Workplace closing (OxCGRT code C2):

0 - no measures

1 - recommend closing (or recommend work from home) or all businesses open with alterations resulting in significant differences compared to non-Covid-19 operation

2 - require closing (or work from home) for some sectors or categories of workers

3 - require closing (or work from home) for all-but-essential workplaces (eg grocery stores, doctors)

Restrictions on gatherings (OxCGRT code C4):

0 - no restrictions

1 - restrictions on very large gatherings (the limit is above 1000 people)

2 - restrictions on gatherings between 101-1000 people

3 - restrictions on gatherings between 11-100 people

4 - restrictions on gatherings of 10 people or less

Stay at home requirements (OxCGRT code C6):

0 - no measures

1 - recommend not leaving house

2 - require not leaving house with exceptions for daily exercise, grocery shopping, and 'essential' trips

3 - require not leaving house with minimal exceptions (eg allowed to leave once a week, or only one person can leave at a time, etc)

A jurisdiction is defined as being in lockdown if $C2 \geq 2$, $C4 = 4$ and $C6 \geq 2$. Where a significant part of a jurisdiction was under lockdown, the Parliamentary Library coded the jurisdiction as under lockdown. Since the lockdown data are daily while the mortality data are weekly, we average the lockdown figures across the week corresponding to the mortality data (eg. if a state is under lockdown for 3 of the 7 days, the lockdown variable for that state would be coded as 0.43). We then combine these state figures into a national average, weighting by the population in each state and territory as of December 2020.