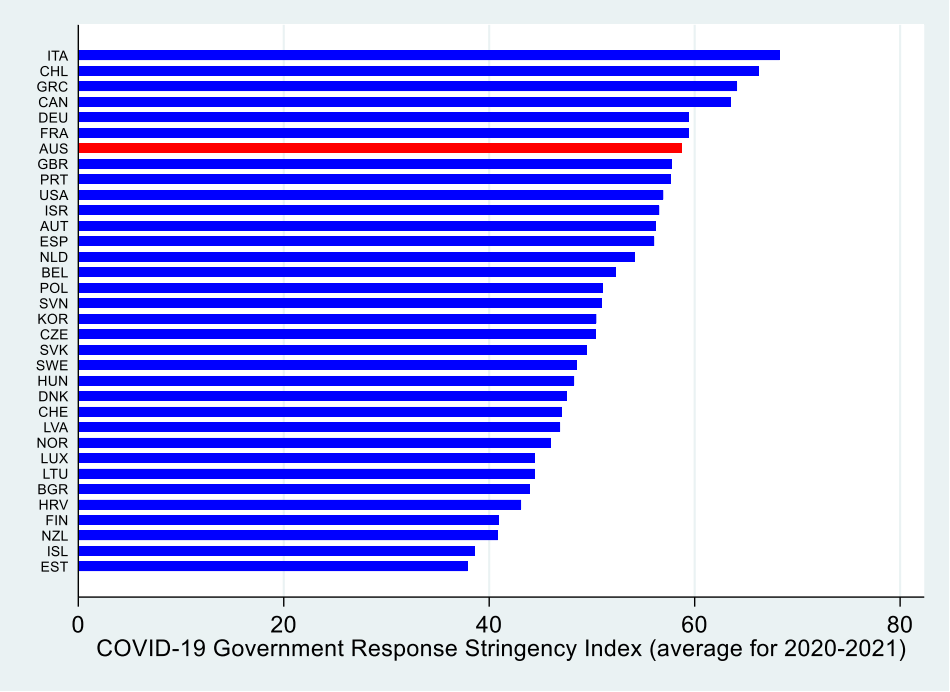
Supplementary Material for: ***Understanding the impact of lockdowns on short-term excess mortality in Australia***

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).

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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.

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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

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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≥2, C4=4 and C6≥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.

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