Trends and Socio-Economic Inequalities in Life Expectancy in Australia during the Pandemic: The Interaction of Covid-19, Other Respiratory Infections and Non-Communicable Diseases

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Abstract

Australia experienced a distinctive life expectancy trend during the COVID-19 pandemic, rising sharply in 2020 during relatively stringent restrictions before falling in the two subsequent years. This study uses multiple cause of death data to assess the contribution of COVID-19, respiratory infections and non-communicable diseases to trends and inequalities in life expectancy. We estimated life expectancy at birth using death registration data from 2017-23 and applied decomposition techniques to quantify the contribution of age and cause to trends. Causes of death were classified according to whether respiratory infections and/or COVID-19 was reported on the death certificate and, for each, the accompanying underlying cause of death. Differences were analysed by capital city and area-level socio-economic quintile.

Of the increase in life expectancy in 2020, over half was due to lower deaths with respiratory infections, especially in the oldest ages, and most of the decline in 2022 resulted from higher COVID-19 mortality. Although annual changes in life expectancy varied by capital city and socioeconomic quintile, the differences in these trends throughout the 2020–2023 period were small. In the city of Melbourne, which was the worst affected capital city, life expectancy in 2020-23 was unchanged compared with pre-pandemic levels. COVID-19 was most often the underlying cause when it was involved in the death. However, for respiratory infections and deaths not involving either COVID-19 nor respiratory infections the underlying cause was mostly a non-communicable disease such as cardiovascular disease.

The findings highlight the high utility of multiple cause of death data compared with underlying cause of death data when analysing life expectancy trends and the effect of pandemic-related restrictions, particularly regarding mortality from respiratory infections.

Extended Abstract

Background

The life expectancy of Australia exhibited a distinctive trend during the COVID-19 pandemic. It was one of the few high-income countries where life expectancy increased sharply in 2020, when relatively stringent restrictions were introduced by Australia's Federal, State, and Territory Governments to control the spread of COVID-19.(1-4) Previous analyses of the contribution of changes in cause-specific mortality to life expectancy trends, both in Australia and internationally, have focused on measuring both COVID-19 and other causes according a single underlying cause of death. However, such measurement limits our understanding of the role of cause-specific mortality during the pandemic.

The introduction and relaxation of pandemic-related restrictions introduced not only prevented the spread of COVID-19 but also reduced the circulation of respiratory infections such as pneumonia and influenza for which the spread is most commonly airborne.(5, 6) Pneumonia is commonly reported as an immediate cause of death in Part 1 of the death certificate with another condition reported as the underlying cause, most often a non-communicable disease. Hence, an increase in life expectancy caused by reduced pneumonia infection and mortality during pandemic restrictions is often shown in mortality statistics as instead due to lower non-communicable disease mortality, as occurred in Australia.(3) COVID-19, on the other hand, is most commonly the underlying cause of death.(7)

This study uses multiple cause of death data in Australia to measure the contribution of causes of death to changes in life expectancy. It firstly focuses on COVID-19 and respiratory infections such as pneumonia and influenza (i.e. excluding COVID-19), based on whether they were reported anywhere on the death certificate (as an underlying or contributory cause), to assess the direct impact of non-pharmaceutical interventions on life expectancy. Remaining deaths, neither respiratory infections nor COVID-19 reported, represent trends in life expectancy that may be related to the more indirect impacts of lockdowns and their relaxation, such as mortality from injuries (e.g. road traffic accidents), and factors unrelated to the pandemic represented in fluctuations in mortality from other causes. This analysis is conducted by age group, capital city and area-level socio-economic quintile to assess whether there was a differential impact on Australian sub-populations. We compare the analysis of COVID-19 and respiratory infections (underlying or contributory cause) to analysis based solely on the underlying cause and reconcile differences between the two approaches by measuring the underlying causes of death for each of COVID-19, respiratory infections and other causes.

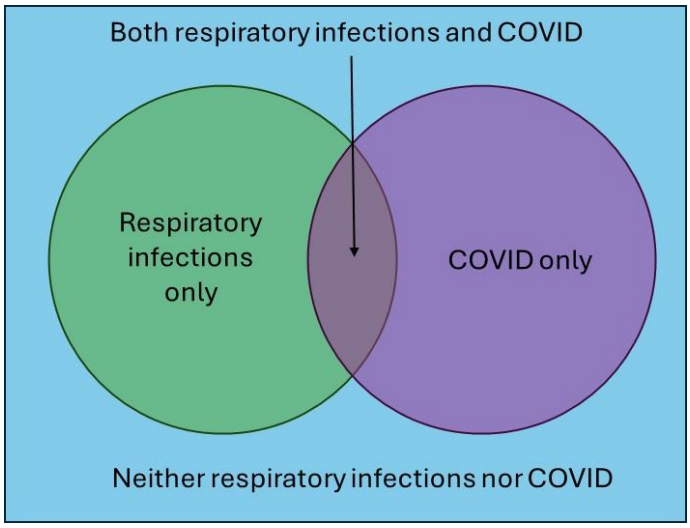
Methods

We used Australian death registration data from 2017-23 available in the Australian Bureau of Statistics (ABS) Person Level Integrated Data Asset (PLIDA).(8, 9) We analysed all diseases and conditions reported on the death certificate, i.e. multiple cause of death data. National population data were available from the ABS.(10) Using the death and population data, we estimated life expectancy at birth for each sex and standard life expectancy decomposition techniques to measure the contribution of age and cause to changes in life expectancy at birth.(11) We classified causes of death based on both underlying (UC) and contributory causes (CC; i.e., any disease or condition reported on the death certificate but not the UC). This comprises the following mutually exclusive categories of causes (see

Figure 1) to identify how much the change in life expectancy is contributed to by each category.:

- respiratory infections – pneumonia, influenza, other respiratory infections (acute bronchitis/ bronchiolitis, unspecified acute lower respiratory infection) – without COVID-19
- respiratory infections and COVID-19
- COVID-19 without respiratory infections
- neither respiratory infections nor COVID-19 (i.e. all other deaths)

Figure 1: Classification of causes of death (underlying or contributory cause)

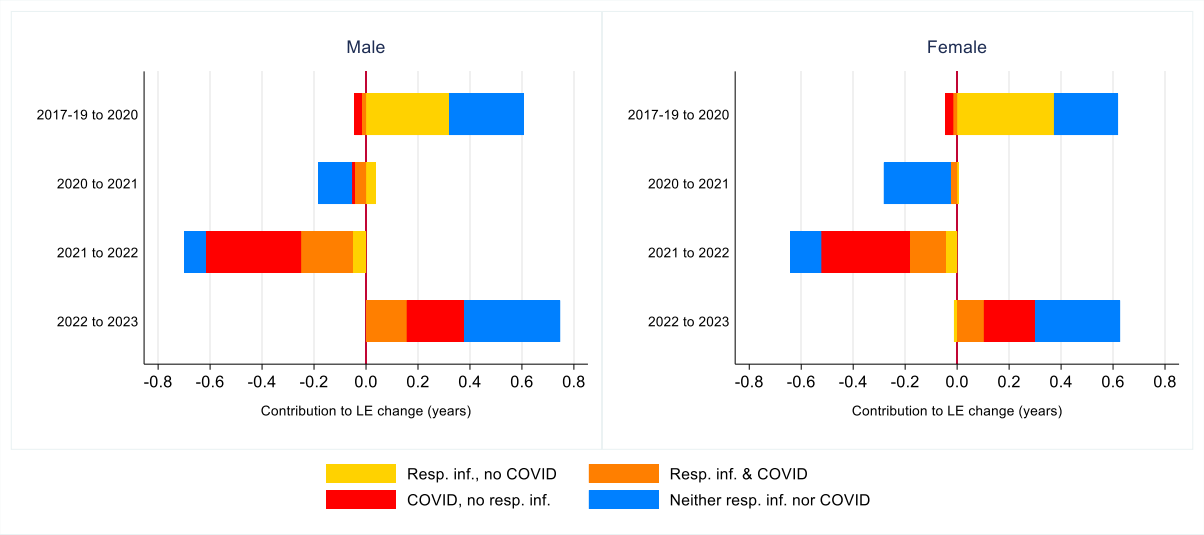


Life expectancy was also analysed according to quintiles of the ABS Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) 2021 and by capital city classification (derived from the ABS Greater Capital City Statistical Areas.:Greater Sydney, Greater Melbourne, other capital cities (Brisbane, Adelaide, Perth, Australian Capital Territory), outside capital cities (including the state of Tasmania and the Northern Territory)).(12, 13) We then analysed underlying causes of death of deaths where 1) a respiratory infection was the CC or UC, 2) where COVID-19 was the CC or UC and 3) where neither a respiratory infection nor COVID-19 were the CC or UC. Categories 1) and 2) are not mutually exclusive.

Results

Australian life expectancy at birth rose by over half a year from 2017-19 to 2020, fell moderately in 2021 and then declined sharply in 2022 by to reach a level lower than in 2017-19. However, in 2023 life expectancy rebounded strongly to offset the 2022 declines. Of the increase in life expectancy in 2020, over half was due to lower mortality with respiratory infections (as UC or CC) while the remainder contribution was from deaths without both respiratory infections and COVID-19 (Figure 2). Almost all the decline in life expectancy in 2021 was due to higher mortality without respiratory infections and COVID-19. In 2022, the sharp decline in life expectancy was predominantly due to higher mortality with COVID-19, whether with a respiratory infection or not. Approximately half of the large rise in life expectancy in 2023 was contributed by lower mortality without COVID-19 or respiratory infections, with almost all the remainder due to lower mortality with COVID-19 and a respiratory infection or, more commonly, without a respiratory infection. The largest annual fluctuations in life expectancy, including the contribution of respiratory infections to life expectancy change, occurred in ages 80 years and above.

Figure 2: Contribution of respiratory infections & COVID (UC or CC) to life expectancy change

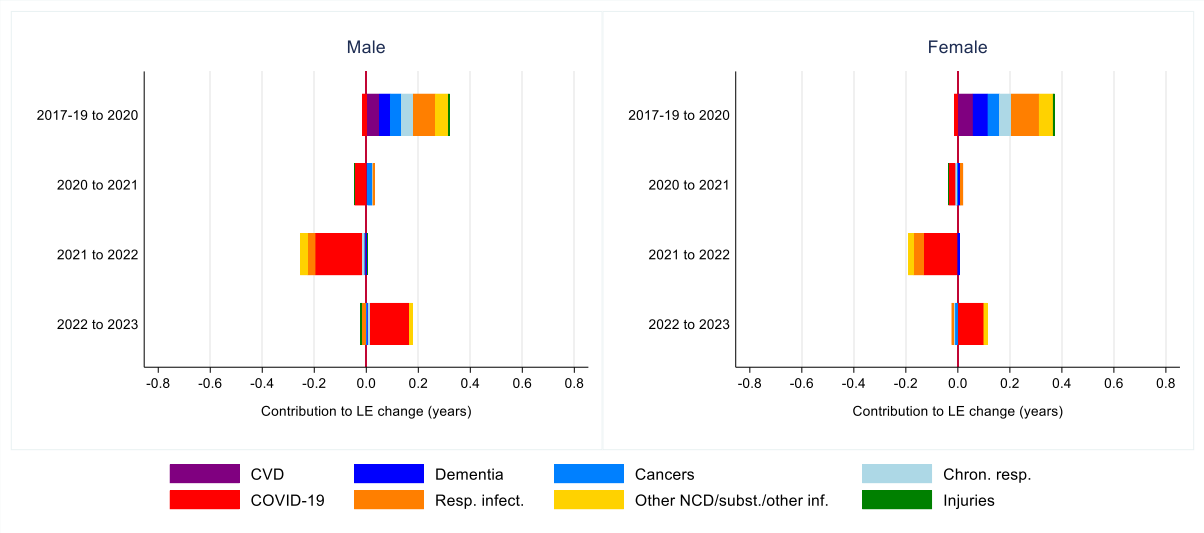


All four regions in the capital city classification experienced a rise in sex-specific life expectancy in 2020, with “other capital cities” being highest for females but lowest for males and Melbourne being third-highest for each. Sydney had the largest decline in 2022 of almost 1.0 years for males (entirely from deaths with COVID-19) and over 1.2 years for females (just over half due to deaths with COVID-19). However, in 2023 Sydney had the largest increase of over 0.9 years while for Melbourne it was over 0.7 years for each sex. Over the combined period 2020-23 compared with 2017-19, life expectancy in Melbourne was almost unchanged, but as not substantially lower than in other locations.

According to area socio-economic index quintile, the largest increase in life expectancy in 2020 for females was in Q4 (2nd-most advantaged quintile) with over 1.2 years compared with a slight increase in Q5 (most advantaged), with the increase for males being relatively similar, with the lowest for Q5 and highest for Q2 (2nd-most disadvantaged). Lower mortality with a respiratory infection had a similar impact across quintiles for males but a larger impact in Q3 (middle quintile) and Q4 for females. Higher COVID-19 mortality in 2022 affected life expectancy declines of all quintiles similarly, except for being lower for Q5 for males. Over the entire period 2020-23, the largest increase for males was in Q3 and lowest in Q4 and Q5. For females, the largest increase was in Q4 and Q3 with no change in Q1 and Q2 and a small decline in Q5.

The lower deaths with respiratory infections excluding COVID-19 in 2020 that contributed most of the life expectancy increase in 2020 had a wide range of underlying causes of death, none of which contributed more than one-quarter of the total increase (Figure 3). The most common was respiratory infections itself, along with cardiovascular diseases, cancers, dementia, chronic respiratory disease and other non-communicable diseases/other infections/substance-related disorders. However, when deaths with respiratory infections contributed to falling life expectancy in 2022 it mostly occurred with COVID-19 as the underlying cause. The sharp decline in life expectancy due to deaths with COVID-19 in 2022 and subsequent increase in 2023 almost entirely had COVID-19 as the underlying cause. For deaths without COVID-19 and a respiratory infection, the contribution to increases in life expectancy in 2020 occurred most commonly with cardiovascular diseases, followed by cancers for males and chronic respiratory disease for females.

Figure 3: Contribution of underlying causes to life expectancy trends where respiratory infections UC or CC



Discussion

The large fluctuations Australia's life expectancy during the pandemic reflect the relatively stringent lockdowns introduced in Australia in March 2020 and the after-effects following their relaxation in early 2022. Just over half the rise in life expectancy in 2020 was due to lower mortality involving respiratory infections such as pneumonia and influenza but not involving COVID-19, with this having a disproportionately large impact on people aged 80 years and above. This corresponds with previous findings of the impact of the lockdowns on reducing circulation of pneumonia and influenza compared with previous years and that older age groups are particularly affected by these infections, as shown in previous years where there have been bad flu seasons.(5, 6) The remainder of the increase in life expectancy in 2020 was due to deaths not involving respiratory infections nor COVID-19 (over 40% of the change), which had a much younger age contribution than deaths with respiratory infections excluding COVID-19, and for which the most common underlying cause was cardiovascular diseases with the remainder almost entirely other non-communicable diseases. The sharp decline in life expectancy in 2022 after the cessation of restrictions was mostly due to much higher mortality from COVID-19, which was nine times higher than in either 2020 or 2021, whether with or without a respiratory infection. However, this temporary decline was almost equally offset by an increase in 2023 that was half due to lower mortality from COVID-19 (both with and without a respiratory infection), which disproportionately affected older age groups, likely because of their susceptibility to mortality from COVID-19.

The direction of annual life expectancy trends were similar according to capital city classification, with the main differences being their magnitude. Life expectancy still increased in Melbourne in 2020, especially large for males, despite it having the largest number of COVID-19 deaths, due to a strong decline in deaths with respiratory infections due to its relatively strict lockdown. However its relatively large fall in 2021 was mostly due to deaths not involving COVID-19 and respiratory infections, likely an example of mortality displacement following its strong lockdowns. Melbourne had the worst life expectancy trend over all of 2020-23, remaining unchanged from 2017-19, but the fact it did not worsen and

was not markedly lower than the rest of the country demonstrates the effectiveness of its strict lockdowns in response to the virus spreading.(14)

The lack of clear patterns in life expectancy by area socio-economic quintile, aside from a fall in the most advantaged quintile, is most likely because of the geographic nature of the spread of the virus and the effectiveness of lockdowns in Melbourne and Sydney, which have disproportionately high numbers of socio-economically advantaged areas, at preventing more mortality.(13) These results for Australia results differ from the United States during the pandemic, where the life expectancy gap between counties in the lowest and highest socio-economic decile widened by over two years during a period when life expectancy fell sharply, as well as Denmark which had a more similar life expectancy trajectory to Australia but where life expectancy inequalities widened according to family income.(15, 16)

This study demonstrates the high utility of multiple cause of death data when analysing life expectancy trends and the role of restrictions during the COVID-19 pandemic. They overcome certification guidance and coding rules that lead to the selection of the underlying cause of death but which mask the contributions of co-morbidities to death. The factors that increased and reduced life expectancy in Australia are best understood though the interaction of COVID-19, respiratory infections and non-communicable diseases. Underlying cause of death data have been the most widely used in analyses of pandemic mortality trends, which largely is a result of data availability from country statistical offices. However, these have limited value, especially where respiratory infection mortality is present. Some of the limitations of this analysis include the quality of reporting of causes of death on the death certificate. While COVID-19 mortality reporting in Australia was regarded as relatively complete, the quality of reporting of other causes, including respiratory infections, can only be identified with closer examination of mortality data linked with other data sources. We only analysed data by the socio-economic status of areas of an average size of 10,000, and analysis of individual level data which is available with linkage with the Census would maybe show more granular information less associated with the geographic location of the area.

Australia's life expectancy has performed relatively well compared with other high-income countries during the pandemic. Undoubtedly some of this has been due to the relatively stringent restrictions imposed at the commencement of the pandemic, which reduced respiratory infection mortality significantly and which our multiple cause analysis showed contributed to the large rise in life expectancy in 2020. Analysis of multiple causes of death, such as this, on a routine basis can reveal much about the mortality dynamics within a population, especially the interaction of COVID-19, respiratory infections and non-communicable diseases.

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