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Ongoing disparities in COVID-19 vaccine uptake in Australia using survey data – August 2022

ANU Centre for Social Research and Methods

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29th September 2022

Acknowledgements

The ANU Centre for Social Research and Methods COVID-19 Impact Monitoring series has received funding from the Australian Institute of Health and Welfare, with a particular focus of the August 2022 data collection on experiences of 'Long-COVID'. The authors would like to particularly thank Matthew James, Deputy CEO Australian Institute of Health and Welfare, for comments on reports and survey instruments in this series. The opinions and conclusions in this paper should, however, be attributed to the authors only. The survey data is available for download through the Australian Data Archive ([https://data.austlii.edu.au/au/other/dfat/data/australian-data-archive/](#)).

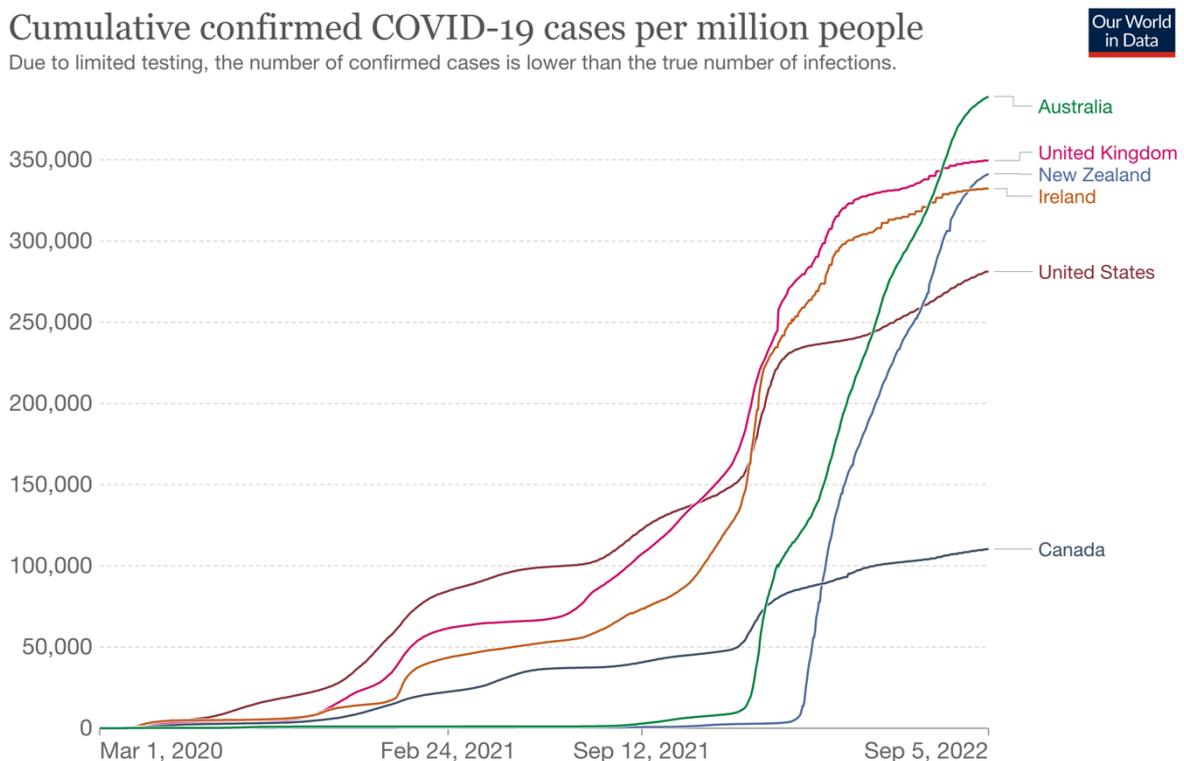
Abstract

On the 8th of August 2022, data collection began for the 12th wave the COVID-19 Impact Monitoring series, with a total of 3,510 responses collected between the 8th and 22nd of August. The aim of this paper is to try to understand some of the reasons why booster uptake in Australia may have stalled, with a focus on the socioeconomic, demographic, and geographic determinants of third and fourth-dose booster uptake. A particular focus of this paper is the relationship between COVID-19 infection and booster uptake, the first time this appears to have been studied quantitatively in Australia. Those with low education, low income, who were born overseas in a non-English speaking country, who do not trust key institutions, who identify as right wing, and who do not consume news from public broadcasters, radio, and newspapers are all less likely to have received a third or fourth COVID-19 vaccine. This paper also shows that those who have had a COVID-19 infection are less likely to have received a COVID-19 booster, potentially explaining why booster uptake has stalled as infections in Australia reached their highest level across the first two-and-a-half years of the pandemic.

1 Introduction and overview

Comparing six of the larger, high-income, English-speaking countries in Europe, North America and the South Pacific, we can see very different COVID-19 experiences since the start of the pandemic. Keeping in mind that the proportion of those who have symptoms or who have been a close contact with a confirmed COVID-19 case who undertake a COVID-19 test has declined substantially in the last few months as the requirements to do so have been relaxed, we can see from Figure 1 that the UK, Ireland and the US had a very high relative number of COVID-19 cases (per million people) in the early stages of the pandemic, with Australia and New Zealand having very few cases up until late 2021/early 2022. Canada has had an experience somewhere in between these two groups. Since early 2022, however, the number of confirmed cases has increased substantially in Australia and New Zealand, with the former now having the highest cumulative confirmed cases per million amongst the six countries.

Figure 1 Cumulative confirmed COVID-19 Cases per million people; Australia, Canada, Ireland, New Zealand, UK, and US – March 2020 to September 2022



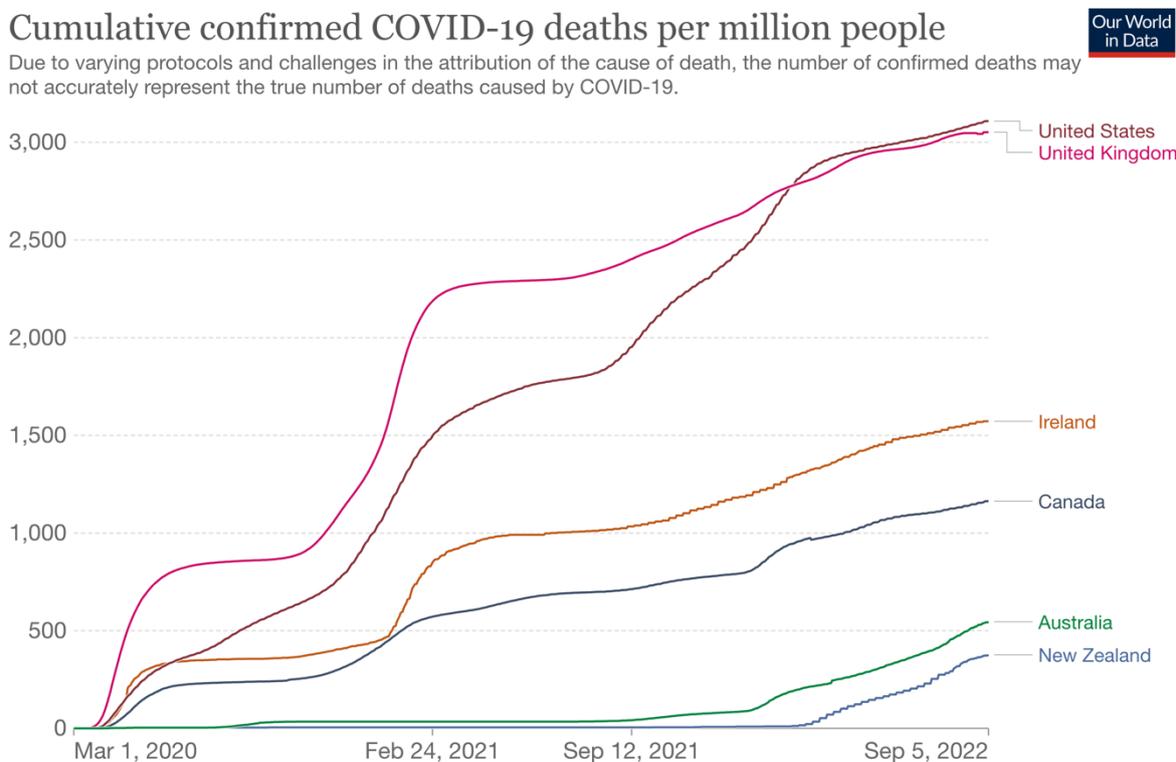
Source: Johns Hopkins University CSSE COVID-19 Data

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Deaths due to COVID-19 tell a slightly different story (Figure 2). The UK and US had high COVID-19 mortality rates in 2020 and 2021, with mortality continuing to increase in 2022 such that there have been more than 3,000 COVID-19 deaths per million people in those two countries over the COVID-period. Canada and Ireland have had a steady number of COVID-19 deaths (with some clear upswings), but mortality rates that are far lower than their two large neighbouring countries. Australia and New Zealand, on the other hand, had virtually zero COVID-19 deaths up until late-2021, with deaths only increasing in late 2021/early 2022 respectively. However, despite the fact that cumulative case numbers in these two countries

are now at or above those in the other four countries in the figures, cumulative deaths per million people are still relatively low.

Figure 2 Cumulative confirmed COVID-19 deaths per million people; Australia, Canada, Ireland, New Zealand, UK, and US – March 2020 to September 2022

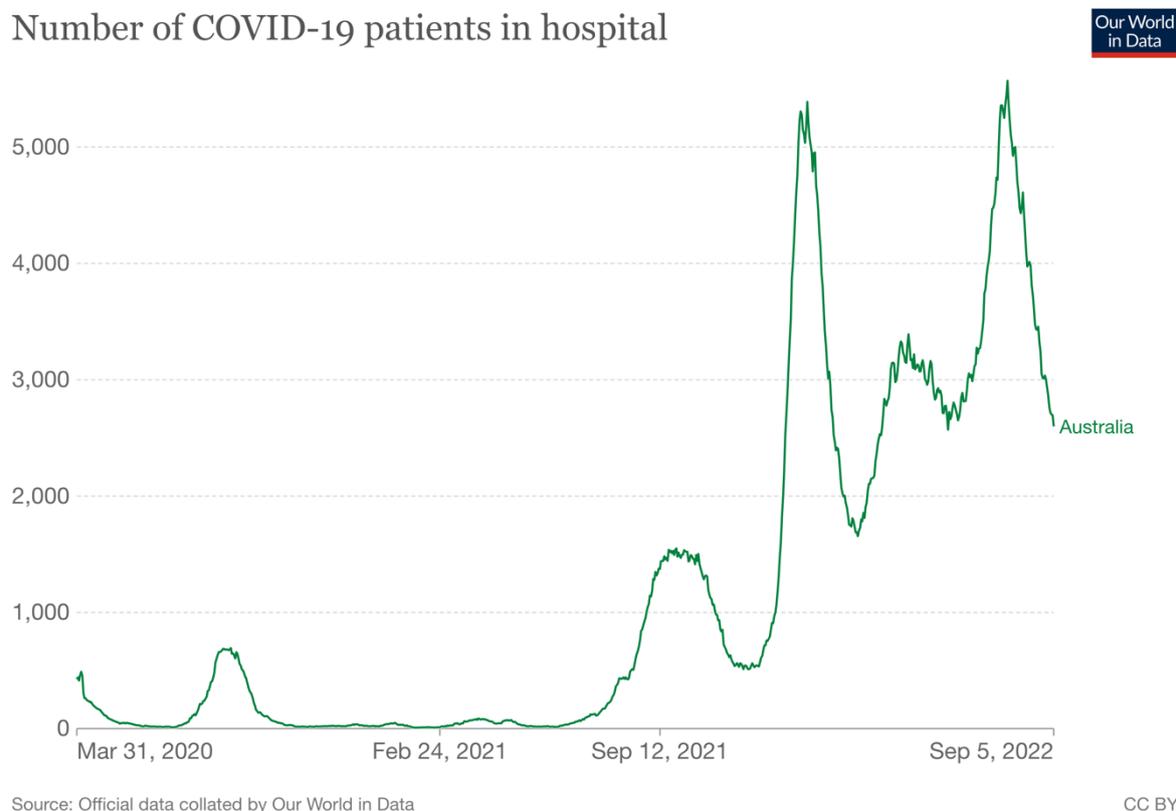


Source: Johns Hopkins University CSSE COVID-19 Data

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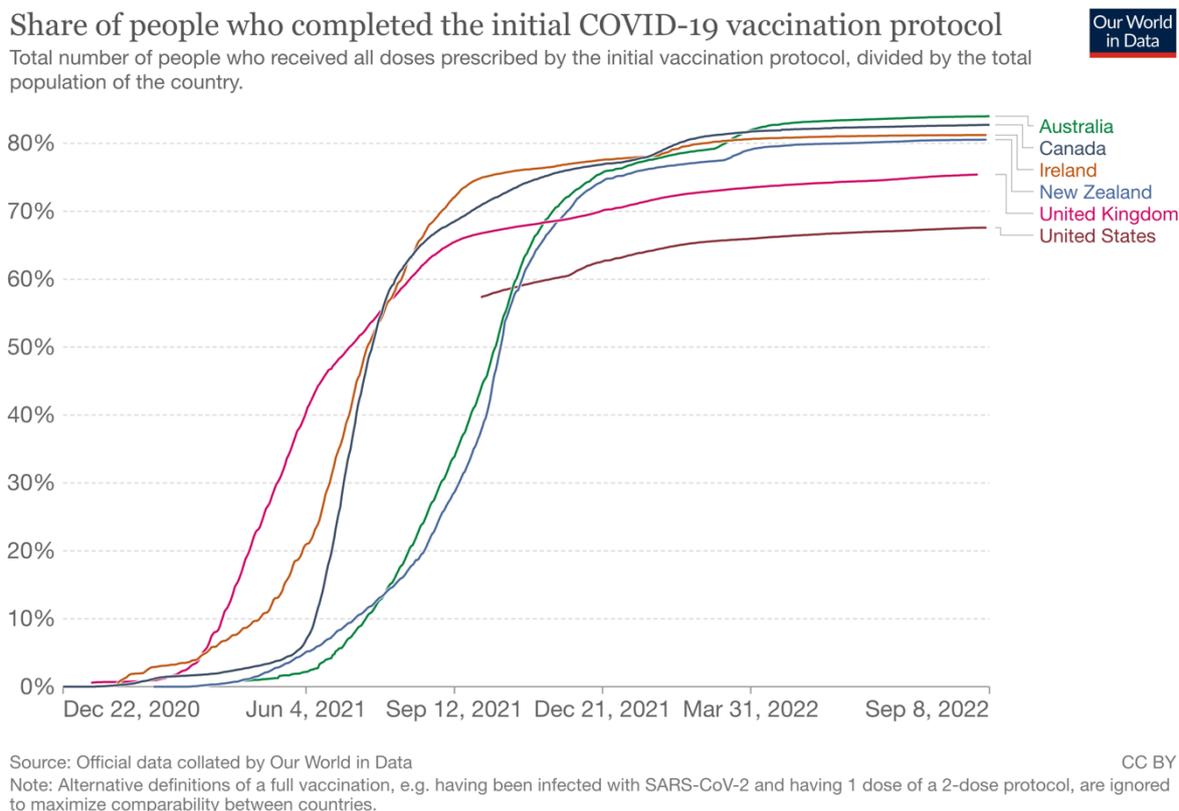
The experience of COVID-19 has therefore been very different in Australia (alongside New Zealand) compared to other countries that we usually compare ourselves against. For those who have been infected, this has occurred much later in the pandemic after everyone has had the opportunity to be vaccinated (including one or more booster-shots) and after hospital treatment for those with COVID-19 has improved. That is not to say that the experience of COVID-19 in Australia has not been traumatic for those who have been hospitalised or those who have had close family and friends hospitalised or die from the disease. The more than 14,000 deaths from COVID-19 in Australia and multiple thousands of COVID-19 patients in hospital on a given day (Figure 3) will have serious and long-lasting impacts for years to come. Rather, it is to say that other country experiences have in many ways been far worse.

Figure 3 COVID-19 patients in hospital on a given day; Australia – March 2020 to September 2022



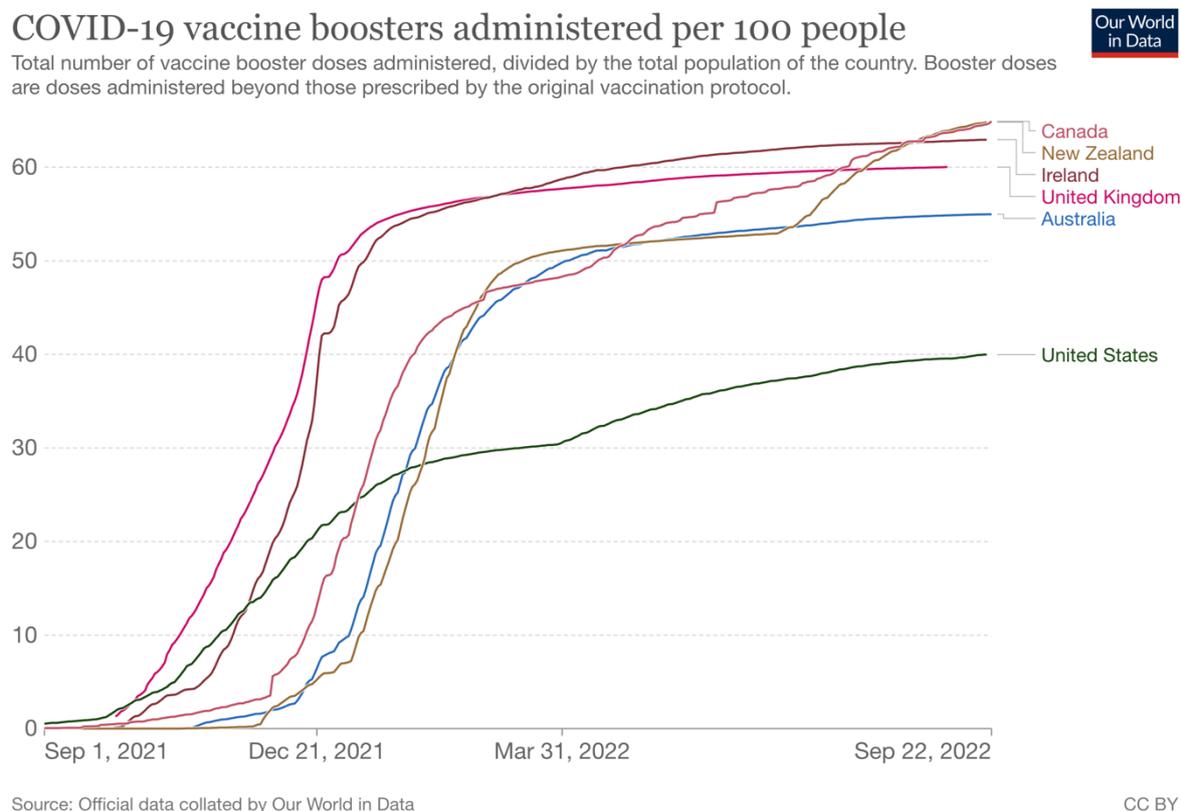
As both a cause and a consequence of this quite different infection, hospitalisation, and mortality experience, the trajectory of COVID-19 vaccines in these countries has also varied quite substantially. After an initially slow start, uptake of the various COVID-19 vaccines in Australia accelerated and now has the highest proportion of the population fully vaccinated amongst the high-income, English-speaking countries that we often compare Australia against. As shown in Figure 4 using comparable data, Australia overtook New Zealand in vaccine uptake at the end of July 2021, the US at the end of October 2021, The UK in mid-November 2021, Ireland in mid-March 2022, and Canada in late-March 2022.

Figure 4 Per cent of population that have been fully vaccinated; Australia, Canada, Ireland, New Zealand, UK, and US – December 2020 to September 2022



The uptake of COVID-19 boosters (that is, vaccinations after the first two scheduled doses) has not been as positive a story in Australia. Figure 5 gives the number of booster doses administered per 100 people in each country. Because of the relatively late start to the vaccination program, Australia (and New Zealand) had low rates of booster uptake up until the end of 2021. Doses then increased in early 2022, soon overtaking the US and beginning to converge with the UK, Ireland, and Canada. Since around April/May 2022, however, the trajectory of booster uptake appears to have flattened. This is at a lower level than the UK which also appears to have plateaued, but in comparison to Canada, Ireland, and New Zealand where booster doses have continued to increase.

Figure 5 Number of booster doses administered per 100 people; Australia, Canada, Ireland, New Zealand, UK, and US – December 2020 to September 2022



Since the start of the COVID-19 period, the ANU Centre for Social Research and Methods COVID-19 Impact Monitoring Surveys has been tracking wellbeing, attitudes, and behaviours of adult Australians. The first wave of the series was collected in the second half of April 2020 with data eventually collected on 3,155 Australians over a two-week period. On the 8th of August 2022, data collection began for the 12th wave the COVID-19 Impact Monitoring series, with a total of 3,510 responses collected between the 8th and 22nd of August.

Part of the focus of the data collection series has been on vaccine uptake, beginning in late 2020 with questions on hypothetical vaccine hesitancy, and then continuing through 2021 and 2022 with questions on actual booster uptake. The aim of this paper is to try to understand some of the reasons why booster uptake in Australia may have stalled, with a focus on the socioeconomic, demographic, and geographic determinants of third and fourth-dose booster uptake. A particular focus of this paper is the relationship between COVID-19 infection and booster uptake, the first time this appears to have been studied quantitatively in Australia.

The dataset is described in the next section of the paper, with the remainder of the paper structured as follows. In Section 3, I discuss the levels of COVID-19 vaccine uptake in Australia, making comparisons between estimates from administrative data and survey data. In Section 4 I look at how third and fourth dose uptake varies across demographic, socioeconomic, and geographic characteristics. This analysis is expanded in Section 5 by looking at broader attitudes and the relationship with third and fourth dose uptake, including a discussion of how vaccine uptake correlates with prior COVID-19 infections. In Section 6 I provide some concluding comments and discuss the implications of the findings.

2 Overview of the COVID-19 Impact Monitoring Survey

In April 2020, the Social Research Centre on behalf of the ANU Centre for Social Research and Methods collected the first wave of data as part of the centre's COVID-19 Impact Monitoring Series.¹ Since that first wave of data collection, surveys have been undertaken a further 11 times, with the most recent wave of data collection undertaken in August 2022.

Surveys have also been conducted with the same group of respondents in January and February 2020, just before the COVID-19 pandemic started in Australia, as part of the ANUpoll and Australian Social Survey International-ESS (AUSSI-ESS) surveys respectively.² This allows us to track outcomes for the same group of individuals from just prior to COVID-19 impacting Australia through to two-and-a-bit years since COVID-19 first reached Australia.

The August 2022 survey collected data from 3,510 Australians aged 18 years and over.³ Data collection for this most recent ANUpoll commenced on the 8th of August 2022 with a pilot test of telephone respondents. The main data collection commenced on the 9th and concluded on the 22nd of August. 57.6 per cent of the sample had completed the survey by the 11th of August and the average interview duration was 23.9 minutes.

The Social Research Centre collected data online and through Computer Assisted Telephone Interviewing (CATI) in order to ensure representation from the offline Australian population. Around 3.5 per cent of interviews were collected via CATI.⁴ A total of 4,294 panel members were invited to take part in the August 2022 survey, leading to a wave-specific completion rate of 81.7 per cent.⁵

Data in the paper is weighted to population benchmarks. For Life in Australia™, the approach for deriving weights generally consists of the following steps:

1. Compute a base weight for each respondent as the product of two weights:
 - a. Their enrolment weight, accounting for the initial chances of selection and subsequent post-stratification to key demographic benchmarks
 - b. Their response propensity weight, estimated from enrolment information available for both respondents and non-respondents to the present wave.
2. Adjust the base weights so that they satisfy the latest population benchmarks for several demographic characteristics.

3 Third and fourth-dose uptake in Australia

Severely immunocompromised adults were eligible for a third vaccine dose from 11th October⁶, and from 8th November, all individuals aged 18 and over who received their second dose six or more months prior were eligible for a third-dose vaccine⁷. The interval between a person's second and third dose was reduced to four months on 4th January⁸, and three months on 31st January⁹. Young people aged 16 and over were eligible for a third-dose three months after their second dose on 3rd February 2022¹⁰.

On the 11th of July 2022, those aged 50-64 years were recommended to take and those aged 30-49 years were made eligible for a fourth dose. As part of the announcement, the responsible Minister (Hon Mark Butler MP) made it clear that the Australian Technical Advisory Group on Immunisation (ATAGI) 'reiterated that people who had already been eligible for the fourth dose, including those aged 65 years and over, remain at higher risk of severe disease and death from COVID-19.'¹¹

Based on data from the Australian Immunisation Registry (AIR), there were 14.2 million people in Australia aged 16 years and over, who had received more than two doses (as of 9th September 2022).¹² This is slightly under three-quarters (71.6 per cent) of those who have received at least two doses, though it should be kept in mind that there are a small number of adults who still would not have been eligible for a third-dose as the time elapsed since their second dose was too short, or who have died/left the country since their second dose. There were 4.7 million people aged 16 years and over who have received four doses, a little over one-third of those who have received at least three doses.

While the data from the AIR provides a very useful population-level estimate of the number of people in Australia who have received a given number of COVID-19 vaccinations, it provides only a partial picture of the vaccination situation in Australia. First, without being linked to other databases, it does not have information on those who have not been immunised, making it difficult to convert the aggregate numbers into rates. Rates can be calculated by dividing by relevant population estimates, but these estimates come from very different sources and therefore it is unclear whether they are comparable. This challenge was demonstrated during the initial vaccine roll-outs when some jurisdictions like the ACT were reported to have greater than 100 per cent vaccine uptake.

A second limitation of the AIR data in terms of understanding the vaccine roll-out in Australia is that there is limited information to explain the vaccine decision. While there is some demographic and a significant amount of geographic information on AIR, there is no socioeconomic information on AIR and no information on attitudes/beliefs. Even with the currently available linked data, there is also no information on AIR regarding who has and who has not had COVID-19. So, while it may be possible with linked-data to calculate rates of vaccine uptake, understanding the factors associated with that decision would be difficult.

For this reason, in the August 2022 ANUpoll we asked respondents 'Have you received a COVID-19 vaccine?' Keeping in mind that ANUpoll is a survey of Australian adults and therefore the age distribution is slightly different to that used for the official reporting, estimates from ANUpoll suggest the following distribution of doses amongst adults in Australia:

- No COVID-19 vaccinations – 4.1 per cent;
- One COVID-19 vaccination – 0.7 per cent;

- Two COVID-19 vaccinations – 17.5 per cent;
- Three COVID-19 vaccinations – 49.0 per cent; and
- Four or more COVID-19 vaccinations – 28.7 per cent.

Taken together, while the vast majority of Australia adults have received at least two doses of a COVID-19 vaccine (95.2 per cent), there are still a sizable minority of Australians who do not have the protection of a third or fourth dose.

4 Demographic and socioeconomic differences in COVID-19 vaccination

Third and fourth dose uptake in Australia is not evenly spread across the population. A large part of this difference is due to age-based eligibility restrictions (particularly for fourth-dose uptake), but even when we examine within age groups, we find large differences that potentially prompt policy action.

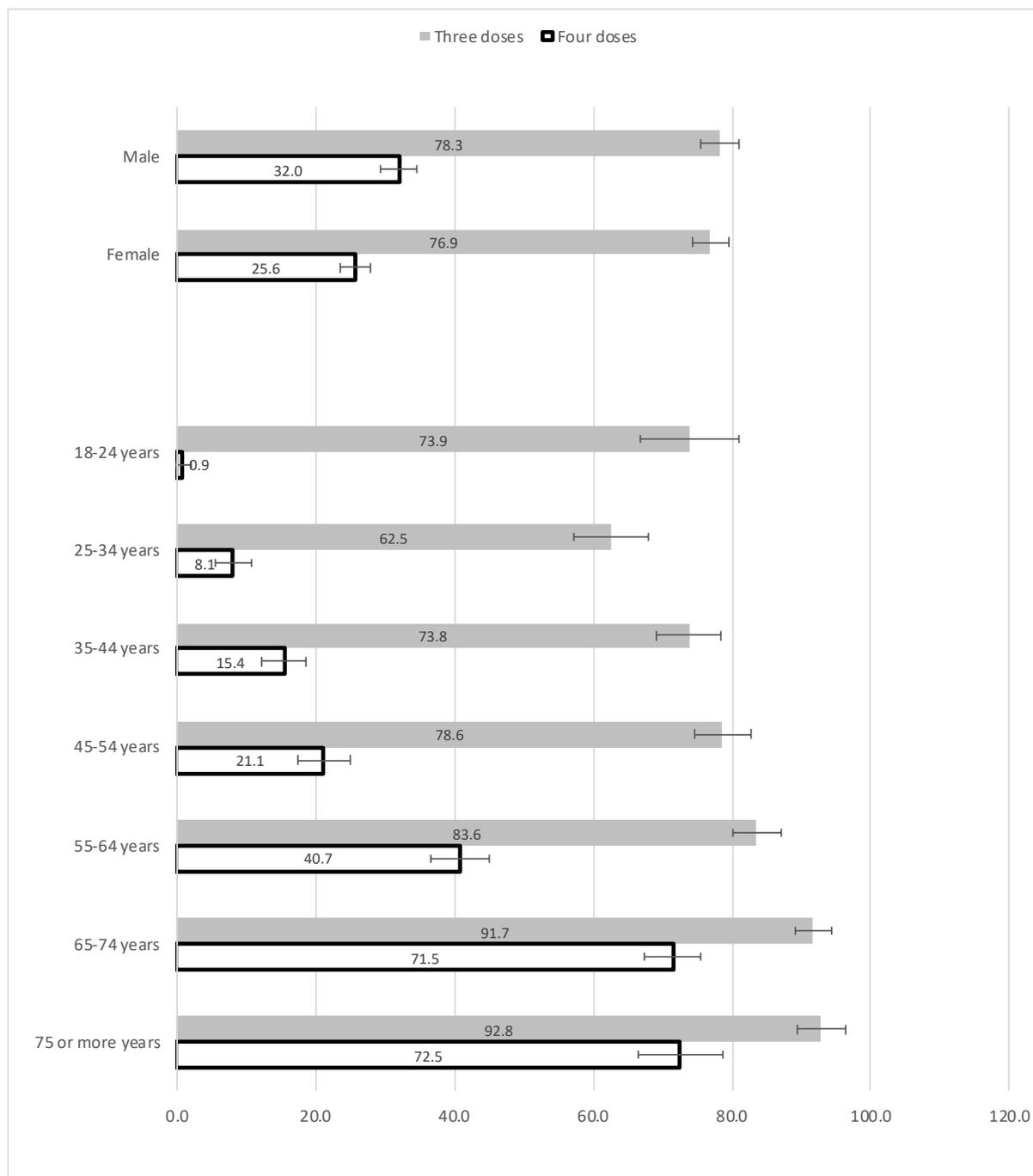
4.1 Third and fourth dose uptake by age and sex

Figure 6 presents differences in vaccine uptake across age and sex, focusing on the per cent of people who have had three or four doses. While there are not large differences in the per cent of males and females who have received three COVID-19 vaccinations, there are large differences in the per cent who have received four doses. Males (32.0 per cent) are estimated to be more likely to have received a fourth dose compared to females (25.6 per cent).

Despite all adults in Australia being eligible for a third COVID-19 vaccination in Australia (apart from the very small proportion of Australians who only recently had their second dose) there are quite large differences in third-dose uptake by age. The age group with the lowest uptake is those aged 25 to 34 years, with only 62.5 per cent of that age group having received a third dose. Younger Australians (aged 18 to 24) and those aged 35 to 44 years have similar levels of third-dose uptake to each other (73.9 and 73.8 per cent respectively), with third-dose uptake then increasing across the age distribution. For those most susceptible to the negative impacts of COVID-19 (those aged 65 years and over), third-dose uptake is quite high and above 90 per cent. However, there is still an important minority of those age groups without the protection of three COVID-19 vaccines.

The differences in fourth dose uptake by age are greater still. This is not surprising, given that in early to mid-August when the survey took place, those aged under 65 were only recently made eligible to receive a fourth dose and those aged under 50 were eligible, rather than recommended to have received one. Still, less than three quarters of those aged 65-74 years (71.5 per cent) and those aged 75 years and over (72.5 per cent) had received a fourth dose, with fourth dose uptake much less for those aged 55 to 64 years (40.7 per cent) and those aged 45 to 54 years (21.1 per cent).

Figure 6 Per cent of Australian adults who have received three and four COVID-19 vaccines, by age and sex, August 2022



Notes: The “whiskers” on the bars indicate the 95 per cent confidence intervals for the estimate.

Source: ANUpoll: August 2022.

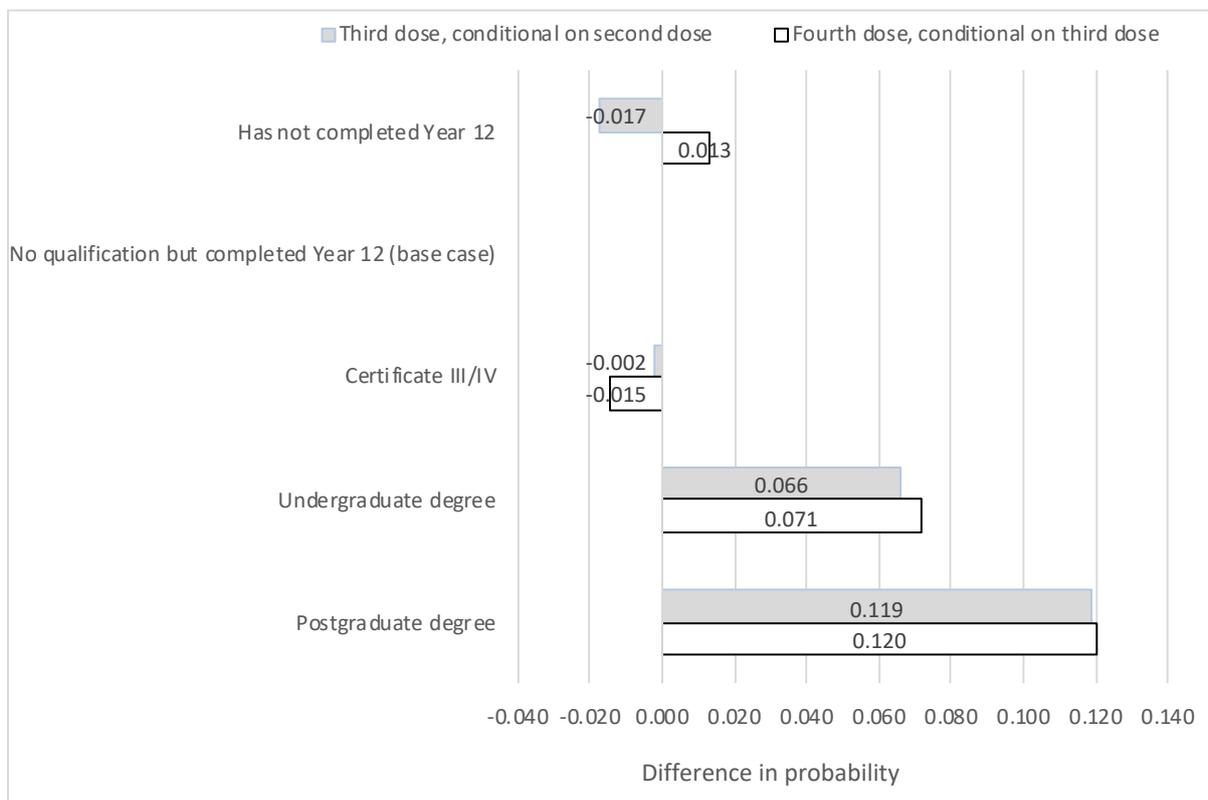
4.2 Modelling the factors associated with third and fourth dose uptake

Age and sex are not the only factors associated with third and fourth dose uptake. In Table 1 in the Appendix, I present detailed results looking at the factors associated with vaccine uptake. Because the dependent variable takes one of two values (vaccinated versus unvaccinated) a binary probit model is estimated. Results are presented in the table as marginal effects, or the difference in the predicted probability of being vaccinated for an individual with that characteristic compared to the baseline characteristics, holding all else

constant. In the first set of results, I look at the factors associated with third dose uptake, focusing on those who have had at least two doses. The second set of results is for the factors associated with fourth dose uptake, focusing on those who have had at least three doses and excluding those aged 18 to 24 years.

The largest differences in vaccine uptake are by education and income. Figure 7 summarises the relationship with education, presented as the difference in the probability of receiving a third or fourth dose compared to someone who has completed Year 12 but has no qualifications (the base case), but holding all other characteristics constant. There are small differences at the lower end of the education distribution, but these differences are not statistically significant. However, there are large and significant differences between those with a degree and those without a qualification, with those with a postgraduate degree having a probability that is 0.12 higher for a third dose vaccine (conditional on having a second) and as fourth dose (conditional on having a third).

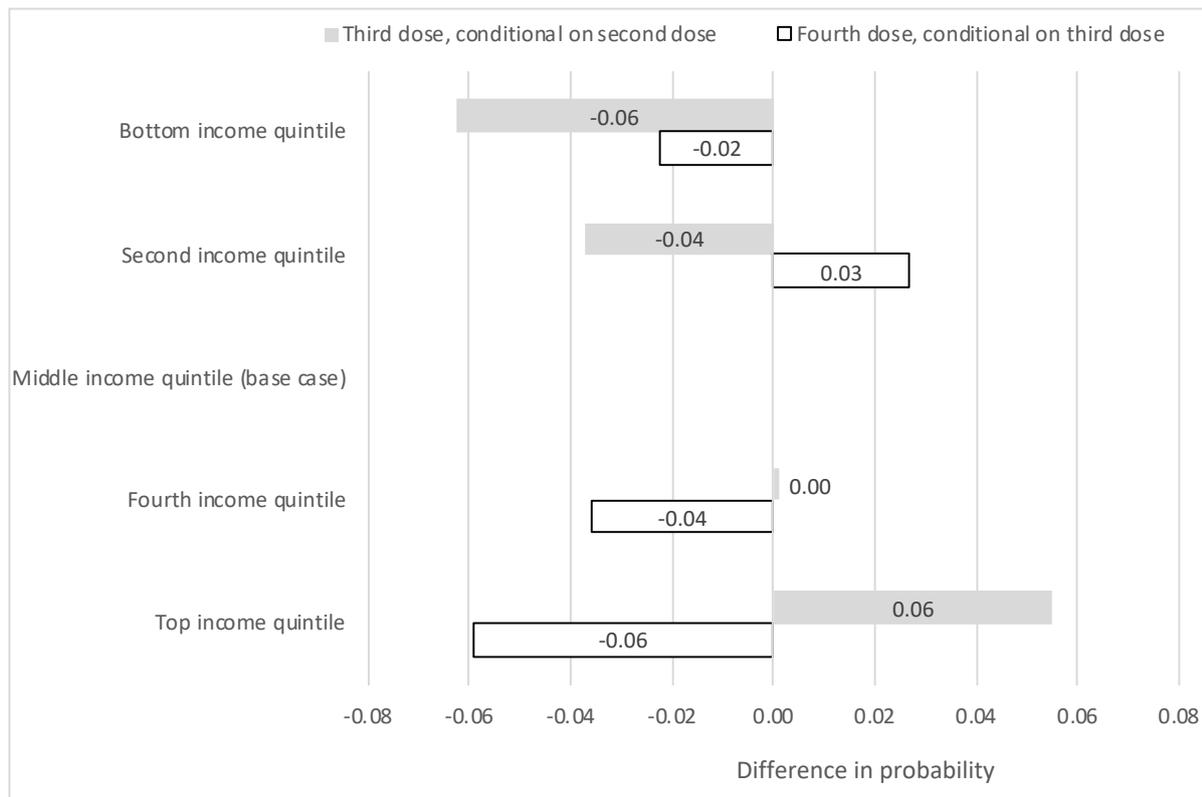
Figure 7 Estimated relationship between education and booster uptake, holding constant demographic, geographic and other socioeconomic factors, August 2022



Source: ANUpoll: August 2022, Appendix Table 1.

The relationship between income and booster uptake is slightly more complex (Figure 8). For third dose (conditional on second dose), there appears to be a reasonably consistent linear relationship, with those in the lowest income quintile having the lowest uptake and those in the highest income quintile having the highest uptake. Although the differences between these two extremes and the middle part of the income distribution are not statistically significant, the difference between the first and fifth quintile is significant. For fourth dose uptake, however, the highest estimated probability holding all other characteristics constant appears to be in the second and third quintile, with those in the lowest quintile having slightly lower uptake and those in the top quintile having much lower uptake.

Figure 8 Estimated relationship between household income and booster uptake, holding constant demographic, geographic and other socioeconomic factors, August 2022



Source: ANUpoll: August 2022, Appendix Table 1.

A final factor that appears to have a relationship with booster uptake is broad country of birth. Compared to those born in Australia those born in another English-speaking country do not appear to have a different probability (holding constant other characteristics) for either third or fourth dose. Furthermore, there does not appear to be any difference in third dose uptake for those born in a non-English speaking country compared to those other two groups. However, there is a large and statistically significant difference in fourth dose uptake (conditional on having had three doses) even once we control for other characteristics. With a marginal effect of -0.072, this difference is similar in magnitude to someone with an undergraduate degree compared to someone without any qualifications.

5 Attitudinal and other predictors of COVID-19 vaccination

The results presented in the previous section have identified a number of disparities in the probability of having had a third or fourth dose of a COVID-19 vaccine. In some ways, they replicate analysis of socioeconomic data linked to the AIR as part of the Multi-Agency Data Integration Project (MADIP) data asset, which includes Census, Tax, Social Security, and a range of other datasets. In a forthcoming paper (Biddle, Korda and Welsh 2022) we use this data to analyse some of these determinants. The benefit of the linked AIR-MADIP data is that information is available for close to the full population of Australians, with more than 10 million individuals able to be analysed. This not only allows for more precise estimates that are not prone to sampling error, but also allows for analysis of much smaller sub-populations.

The AIR-MADIP data is, however, limited in crucial ways compared to the survey data discussed in this paper. First, while linkage rates are quite high, they are far from 100 per cent. This form

of non-sampling error can impact on conclusions if those who aren't linked are different in some ways to those who are linked. A bigger issue with the linked AIR-MADIP data though is that despite its richness, it still does not include many of the key measures that explain why some people get vaccinated and others don't.

5.1 Attitudinal predictors

Appendix Table 2 includes results from a similar probit regression to that which was discussed in the previous section. In addition to the demographic, socioeconomic, and geographic factors used in the previous analysis, however, I also control for whether or not a person was confident in the state/territory government in which they live when asked in October 2021 prior to the widespread uptake of third and fourth dose. I also control for where on a scale of 0 to 10 a person places themselves according to the left/right political scale (when asked just after the May 2022 election) as well as where they obtained their information from during the election. Figure 9 summarises the main marginal effects.

Having confidence in the State/Territory government in the jurisdiction in which a person lives is strongly associated with whether or not a person has received a third COVID-19 vaccine (for those who have had at least two doses) and also associated with whether or not a person then goes on to have a fourth dose. As we use confidence from prior to the booster period, this is unlikely to be due to a reverse causal relationship and may instead reflect people not trusting that a booster dose is in their best interest, either because they think the benefits have been overstated, or the risks understated. This is an indication that long-term erosion in confidence in key institutions can hamper the ability of those institutions to achieve public policy aims, as has been shown in a number of other country contexts (Van Oost et al. 2022; Wynen et al. 2022).

In the model presented in Appendix Table 2, a single linear term is used to capture self-perceived position on the left-right spectrum, with the average value for this term being 4.89, only slightly to the left of the centre. In Figure 9, the predicted difference in booster uptake between someone who gives a value of 2 (moderately left wing) and 5 is given, as well as the predicted difference in booster uptake between someone who gives a value of 5 and 8 (moderately right wing). It can be seen from the figure that there are very large differences in third-dose uptake in particular between someone who is self-reportedly left wing and someone who is right wing. In Australia like in many other developed countries (Peng 2022), resistance to receiving a booster appears to be a decidedly right wing phenomenon, and something that those who are in political parties associated with the right have a particular opportunity to push back against.

The third and last set of additional variables included in Appendix Table 2 give differences in third and fourth dose uptake based on the source of information a person accessed during the May 2022 election campaign. Ideally, it would have been better to include the source of information someone used either more broadly outside of the election, or specifically with regards to COVID-19. However, that was not asked on any recent ANUpoll surveys. The specific question asked was 'During the recent election campaign, in a typical week, how many days did you...?' with six types of activities

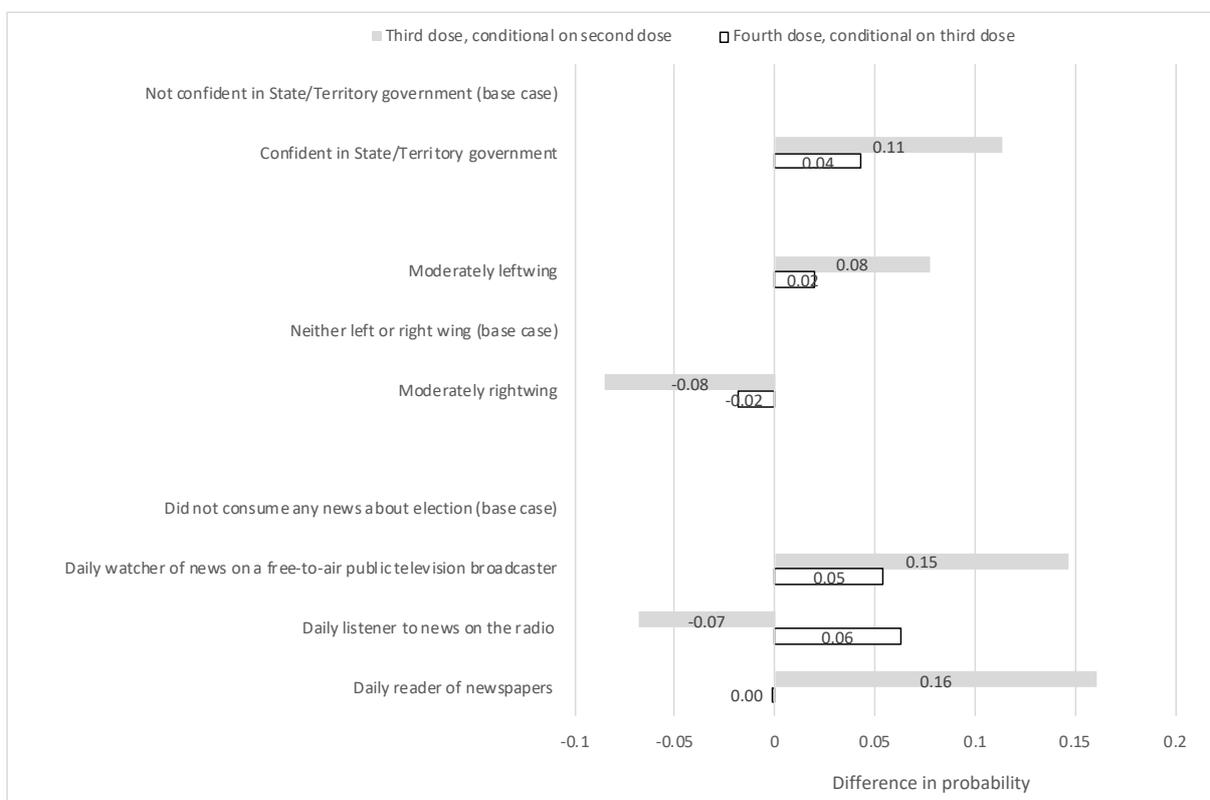
- Watch the news on a free-to-air public television broadcaster (e.g. ABC, SBS);
- Watch the news on a free-to-air commercial television broadcaster (e.g. Seven, Nine and Ten but not Sky News);

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- Listen to the news on the radio;
- Read newspapers;
- Visit Online News Sites; and
- Use social media such as Facebook, Twitter, or Whatsapp to follow news about parties and candidates

The base case for this variable is someone who did not consume any of the sources of news, with Figure 9 giving the difference in booster uptake for someone who consumes one of three types of news on a daily basis, holding constant all other characteristics. The sources of news chosen were those that had a statistically significant relationship for at least one of the two regressions at the five per cent level of significance. In terms of third dose uptake, the largest probability is for those who watch free-to-air public television broadcasters or read newspapers (on a daily basis). For fourth dose uptake, it is listeners to the radio that had the highest uptake. Taken together, we can see that where people get their news about a somewhat tangential topic (the election) had an association with booster uptake even controlling for other characteristics. From a public policy perspective, this reiterates the need to target the other potential sources of news (commercial television, online news sites, and social media) if the goal is to increase third and fourth COVID-19 vaccine uptake.

Figure 9 Estimated relationship between selected attitudinal and behaviour factors and booster uptake, holding constant demographic, geographic and other socioeconomic factors, August 2022



Source: ANUpoll: August 2022, Appendix Table 2.

5.2 Relationship between COVID-19 exposure/concerns and COVID-19 vaccination

In the introduction to this paper, I presented a series of charts that may at first glance appear

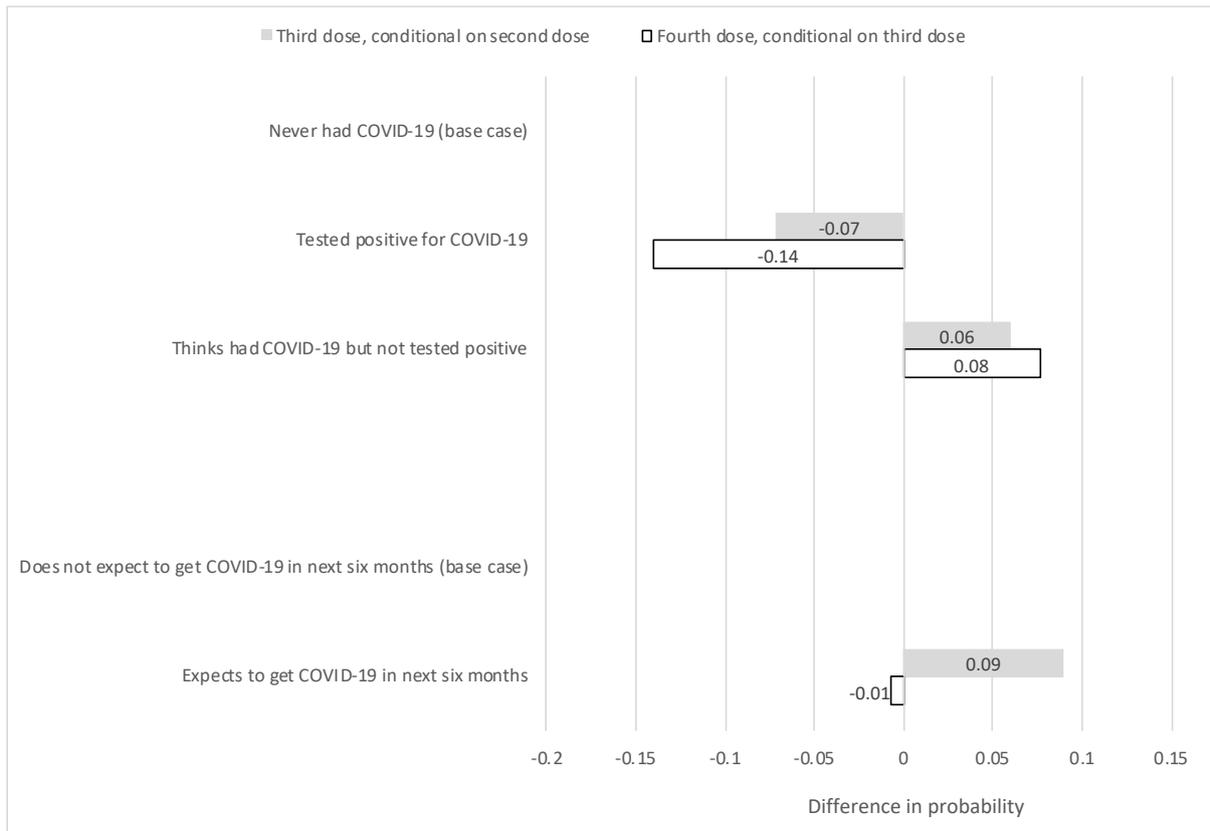
to be somewhat contradictory. On the one hand, COVID-19 infections, hospitalisation, and mortality increased substantially in 2022 as the level of COVID-19 restrictions were eased. It was during this time, however, that cumulative uptake of COVID-19 boosters levelled quite substantially, falling behind New Zealand and Canada, and failing to converge to the UK and Ireland. It would seem that booster uptake failed to increase at precisely the time that it would have been most helpful from a public health perspective. As shown in Figure 10, however, these trends aren't entirely contradictory as it would appear that one of the main reasons why people have not received a third or fourth dose is because they themselves have been exposed to COVID-19 and are therefore required to wait for a number of months to be vaccinated or perceive the benefit from that infection as being sufficient.

To test this, I present a third set of probit regression models in Appendix Table 3 with the same demographic, socioeconomic, and geographic measures as in Appendix Table 1, but this time controlling for whether or not the person has tested positive for COVID-19 or whether they think they have had COVID-19 but did not test positive (either because the test was negative or because they did not get tested). The base case is then someone who thinks they never have had COVID-19. An additional variable (also asked in the August 2022 ANUpoll) is whether or not the person thinks they are likely to get COVID-19 in the next six months. Both of these variables are analysed in a forthcoming paper as part of this series (Biddle and Korda 2022), but in this paper are used as explanatory variables. Figure 10 summarises the marginal effects.

Once again, the relationship with COVID-19 infection and fears are somewhat complicated. First, those who have tested positive for COVID-19 are significantly and substantially less likely to have received a third dose (conditional on second dose) and less likely to have received a fourth dose (conditional on third dose). It is interesting that the biggest difference is for fourth rather than third dose, indicating that people who have tested positive either are waiting to receive their fourth dose or do not see it as being necessary. If it is the former, then it would be beneficial if people who have tested positive (and presumably reported it to the public health system) receive an individual reminder once they do become eligible, as a third or fourth dose is still likely to be beneficial for this group once their natural immunity has waned.

The other two variables do imply, however, that perceived fear of infection is still a motivating factor for some to get vaccinated. Those who think they had COVID-19 but did not test positive are in fact more likely to have been vaccinated, implying that they still feel a third or fourth dose would be beneficial, and that because they haven't tested positive they are not constrained from receiving a vaccine. Furthermore, those who expect to get COVID-19 in the next six months are more likely to have received a third dose, despite their presumably being some countervailing effects in the opposite direction whereby those who have received a third dose may feel that this gives them some protection.

Figure 10 Estimated relationship between COVID-19 infection/fears and booster uptake, holding constant demographic, geographic and other socioeconomic factors, August 2022



Source: ANUpoll: August 2022, Appendix Table 3.

6 Concluding comments

Australia’s COVID-19 vaccine program is stalling. Despite there being a very high proportion of Australians that have had two COVID-19 vaccine doses (the initial schedule), the proportion of those with two doses who go on to receive third or fourth doses is low compared to many other countries, and has failed to continue to increase since early 2022. This matters, because third and fourth doses provide significant additional protection for those who have received two doses (Andrews et al. 2022), including for those who have been infected by COVID-19.¹³ Without high rates of booster uptake, it is more difficult for a country like Australia to continue to maintain minimal COVID-19 related restrictions without seeing high levels of hospitalisation and mortality.

Results presented in this paper highlight some concerning aspects of the current levels of third and fourth dose uptake in Australia. In particular, even when we control for a range of demographic and geographic factors, those Australians with relatively low levels of education and relatively low household income are significantly and substantially less likely to have received a third or fourth COVID-19 vaccine. Individuals with these characteristics were also shown to have lower levels of first-dose uptake early in the pandemic (Edwards et al. 2021) Those who were born overseas in a non-English speaking country are also less likely to have received a fourth vaccine dose. If these socioeconomic disparities continue, then these groups in Australia will be at heightened risk of the negative health impacts of contracting COVID-19, and also more likely to spread the virus to others in their community. Policy interventions need to be particularly focused on these groups wherever possible.

There are also other attitudes and behaviours revealed in the survey data that could help guide the overall policy response. Those who have less confidence in state/territory governments are less likely to have received a third or fourth dose. Furthermore, those who self-identify as being right wing in their political views are less likely to have received a booster dose compared to those who identify in the centre or on the left. Those leaders who are also identified as being on the right wing of politics and who are also supportive of broad vaccine uptake have a particular responsibility to encourage those who share their views to consider a third or fourth dose.

Where people receive their information also appears to have an association. Frequent consumers of public broadcasting, radio, and newspapers are more likely to have received a third or fourth dose. Those who are involved in the delivery of news through commercial television, online news sites, or social media have a potential role in equalising uptake across society.

A final finding from the paper provides some explanation for the stalled rate of third and fourth dose uptake, as well as a potential avenue for targeted messaging. Specifically, those Australians who have tested positive for COVID-19 are far less likely to have received a third or fourth dose. This may be because there are restrictions on receiving a booster soon after an infection. Or, it may be that people perceive there to be a lower risk if they have been infected. Those who do test positive for COVID-19 need to notify state/territory authorities of that infection, and evidence suggests that most do. There could be some benefit in targeting these groups once they have again become eligible to receive a third or fourth dose to remind them of that eligibility, and to remind them that vaccines still provide additional protection for those who have been infected.

Data from the ANU Centre for Social Research and Methods COVID-19 Impact Monitoring Survey series has shown that wellbeing in Australia increases as COVID-19 restrictions ease (Biddle, Edwards, and Rehill 2022). This is particularly the case for males, those who are young, and those who live in jurisdictions that were impacted by COVID-19 the hardest in 2020 and 2021. To maintain relatively light restrictions without an unacceptable level of hospitalisation and mortality, it is likely that people will continue to need to receive multiple vaccine doses. Survey data has a role to play in identifying who in the population is not getting vaccinated, what some of the reasons might be for those disparities, and ways in which interventions and messages can be targeted.

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Appendix tables

Appendix Table 1 Demographic, geographic, and socioeconomic factors associated with third and fourth COVID-19 vaccine, August 2022

Explanatory variables	Third dose (conditional on 2 doses)		Fourth dose (conditional on 3 doses)	
	Coeff.	Signif.	Coeff.	Signif.
Female	0.015		-0.009	
Aged 18 to 24 years	0.002			
Aged 25 to 34 years	-0.110	***	-0.110	***
Aged 45 to 54 years	0.089	**	0.041	
Aged 55 to 64 years	0.149	***	0.274	***
Aged 65 to 74 years	0.231	***	0.544	***
Aged 75 years plus	0.251	***	0.585	***
Indigenous	0.106		0.080	
Born overseas in a main English-speaking country	0.000		-0.027	
Born overseas in a non-English speaking country	-0.008		-0.072	**
Speaks a language other than English at home	-0.028		-0.041	
Has not completed Year 12 or post-school qualification	-0.017		0.013	
Has a post graduate degree	0.119	***	0.120	***
Has an undergraduate degree	0.066	*	0.071	*
Has a Certificate III/IV, Diploma or Associate Degree	-0.002		-0.015	
Lives in the most disadvantaged areas (1st quintile)	-0.068		-0.052	
Lives in next most disadvantaged areas (2nd quintile)	0.040		-0.030	
Lives in next most advantaged areas (4th quintile)	0.019		-0.049	
Lives in the most advantaged areas (5th quintile)	0.046		0.012	
Lives outside of a capital city	0.004		-0.006	
Lives in lowest income household (1st quintile)	-0.063		-0.022	
Lives in next lowest income household (2nd quintile)	-0.037		0.027	
Lives in next highest income household (4th quintile)	0.001		-0.036	
Lives in highest income household (5th quintile)	0.055		-0.059	*
Probability of base case	0.721		0.261	
Sample size	3,051		2,563	

Notes: Probit regression model. The base case individual is male; aged 35 to 44 years; non-Indigenous; born in Australia; does not speak a language other than English at home; has completed Year 12 but does not have a post-graduate degree; lives in neither an advantaged or disadvantaged suburb (third quintile); lives in a capital city; lives in neither a high-income or low-income household (third quintile).

Coefficients that are statistically significant at the 1 per cent level of significance are labelled ***; those significant at the 5 per cent level of significance are labelled **, and those significant at the 10 per cent level of significance are labelled *

Appendix Table 2 Attitudinal and behavioural factors associated with third and fourth COVID-19 vaccine, August 2022

Explanatory variables	Third dose (conditional on 2 doses)		Fourth dose (conditional on 3 doses)	
	Coeff.	Signif.	Coeff.	Signif.
Confident in state/territory government	0.097	***	0.045	**
Self identified point on left-right political distribution	-0.025	***	-0.007	
Free-to-air public television broadcaster	0.021	***	0.007	**
Free-to-air commercial television broadcaster	0.008		0.001	
Radio	-0.008		0.009	**
Newspapers	0.023	**	0.000	
Online News Sites	-0.003		0.007	*
Social media	0.005		-0.002	
Female	0.022		0.020	
Aged 18 to 24 years	-0.006			
Aged 25 to 34 years	-0.148	***	-0.021	
Aged 45 to 54 years	0.072		0.026	
Aged 55 to 64 years	0.117	***	0.274	***
Aged 65 to 74 years	0.196	***	0.579	***
Aged 75 years plus	0.226	***	0.634	***
Indigenous	0.020		0.117	
Born overseas in a main English-speaking country	0.011		-0.005	
Born overseas in a non-English speaking country	-0.053		-0.050	
Speaks a language other than English at home	-0.060		-0.034	
Has not completed Year 12 or post-school qualification	-0.036		-0.030	
Has a post graduate degree	0.126	**	0.048	
Has an undergraduate degree	0.034		0.000	
Has a Certificate III/IV, Diploma or Associate Degree	-0.032		-0.021	
Lives in the most disadvantaged areas (1st quintile)	-0.032		-0.033	
Lives in next most disadvantaged areas (2nd quintile)	0.030		-0.027	
Lives in next most advantaged areas (4th quintile)	0.026		-0.022	
Lives in the most advantaged areas (5th quintile)	0.084	*	0.037	
Lives outside of a capital city	-0.025		-0.019	
Lives in lowest income household (1st quintile)	-0.127	**	-0.005	
Lives in next lowest income household (2nd quintile)	-0.015		-0.001	
Lives in next highest income household (4th quintile)	0.017		-0.013	
Lives in highest income household (5th quintile)	0.073		-0.019	
Probability of base case	0.740		0.159	
Sample size	1,936		1,658	

Notes: Probit regression model. The base case individual is male; aged 35 to 44 years; non-Indigenous; born in Australia; does not speak a language other than English at home; has completed Year 12 but does not have a post-graduate degree; lives in neither an advantaged or disadvantaged suburb (third quintile); lives in a capital city; lives in neither a high-income or low-income household (third quintile).

Coefficients that are statistically significant at the 1 per cent level of significance are labelled ***; those significant at the 5 per cent level of significance are labelled **, and those significant at the 10 per cent level of significance are labelled *

Appendix Table 3 COVID-19 related factors associated with third and fourth COVID-19 vaccine, August 2022

Explanatory variables	Third dose (conditional on 2 doses)		Fourth dose (conditional on 3 doses)	
	Coeff.	Signif.	Coeff.	Signif.
Tested positive for COVID-19	-0.072	**	-0.140	***
Thinks had COVID-19 but not tested positive	0.060		0.076	*
Expects to get COVID-19 in next six months	0.090	***	-0.007	
Female	0.020		-0.004	
Aged 18 to 24 years	0.004			
Aged 25 to 34 years	-0.119	***	-0.112	***
Aged 45 to 54 years	0.102	**	0.033	
Aged 55 to 64 years	0.178	***	0.266	***
Aged 65 to 74 years	0.295	***	0.532	***
Aged 75 years plus	0.330	***	0.576	***
Indigenous	0.114		0.099	
Born overseas in a main English-speaking country	-0.004		-0.024	
Born overseas in a non-English speaking country	0.003		-0.074	**
Speaks a language other than English at home	-0.033		-0.051	
Has not completed Year 12 or post-school qualification	-0.023		0.000	
Has a post graduate degree	0.137	***	0.125	***
Has an undergraduate degree	0.083	*	0.081	*
Has a Certificate III/IV, Diploma or Associate Degree	0.006		-0.011	
Lives in the most disadvantaged areas (1st quintile)	-0.071		-0.050	
Lives in next most disadvantaged areas (2nd quintile)	0.043		-0.031	
Lives in next most advantaged areas (4th quintile)	0.025		-0.053	
Lives in the most advantaged areas (5th quintile)	0.052		0.019	
Lives outside of a capital city	0.001		-0.005	
Lives in lowest income household (1st quintile)	-0.057		-0.049	
Lives in next lowest income household (2nd quintile)	-0.033		0.012	
Lives in next highest income household (4th quintile)	0.004		-0.035	
Lives in highest income household (5th quintile)	0.066		-0.050	
Probability of base case	0.626		0.273	
Sample size	3,037		2,552	

Notes: Probit regression model. The base case individual is male; aged 35 to 44 years; non-Indigenous; born in Australia; does not speak a language other than English at home; has completed Year 12 but does not have a post-graduate degree; lives in neither an advantaged or disadvantaged suburb (third quintile); lives in a capital city; lives in neither a high-income or low-income household (third quintile). Coefficients that are statistically significant at the 1 per cent level of significance are labelled ***; those significant at the 5 per cent level of significance are labelled **, and those significant at the 10 per cent level of significance are labelled *

Endnotes

- 1 <https://csrcm.cass.anu.edu.au/research/publications/covid-19>
- 2 The ANUpoll series of surveys is collected on a probability-based, longitudinal panel (Life in Australia™). By using probability-based recruiting (predominantly telephone-based) the unknown and unquantifiable biases inherent in opt-in (non-probability) panels are minimised and it is also possible to quantify the uncertainty around the estimates due to sampling error using standard statistical techniques. This is not possible with non-probability surveys.
- 3 The unit record survey data is available for download through the Australian Data Archive.
- 4 The contact methodology adopted for the online Life in Australia™ members is an initial survey invitation via email and SMS (where available), followed by multiple email reminders and a reminder SMS. Telephone follow up of panel members who have not yet completed the survey commenced in the second week of fieldwork and consisted of reminder calls encouraging completion of the online survey. The contact methodology for offline Life in Australia™ members was an initial SMS (where available), followed by an extended call-cycle over a two-week period. A reminder SMS was also sent in the second week of fieldwork.
- 5 Taking into account recruitment to the panel, the cumulative response rate for this survey is around 6.8 per cent.
- 6 <https://www.health.gov.au/ministers/the-hon-greg-hunt-mp/media/booster-shot-for-severely-immunocompromised-australians>
- 7 <https://www.health.gov.au/ministers/the-hon-greg-hunt-mp/media/start-of-covid-19-booster-vaccination-program>
- 8 <https://www.health.gov.au/ministers/the-hon-greg-hunt-mp/media/interval-between-primary-course-of-covid-19-vaccination-and-booster-dose-further-reduced>
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- 11 <https://www.health.gov.au/ministers/the-hon-mark-butler-mp/media/expanded-eligibility-for-fourth-covid-19-vaccine-dose>
- 12 <https://www.health.gov.au/sites/default/files/documents/2022/09/covid-19-vaccine-rollout-update-9-september-2022.pdf>
- 13 <https://www.ncirs.org.au/covid-19/covid-19-vaccines-frequently-asked-questions>