Estimating the proportion of Victorians infected with COVID-19 during the Omicron BA.1 epidemic wave of January 2022 in Australia

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Submitted: 16 September 2022; Revision requested: 20 October 2022; Accepted: 30 October 2022

Abstract

Objective: To estimate the proportion of Victorians infected with COVID-19 in January 2022.

Methods: Between 11–19 February 2022 we conducted a nested cross-sectional survey on experiences of COVID-19 testing, symptoms, test outcome and barriers to testing during January 2022 in Victoria, Australia. Respondents were participants of the Optimise Study, a prospective cohort of adults considered at increased risk of COVID-19 or the unintended consequences of COVID-19-related interventions.

Results: Of the 577 participants, 78 (14%) reported testing positive to COVID-19, 240 (42%) did not test in January 2022 and 91 of those who did not test (38%) reported COVID-19-like symptoms. Using two different definitions of symptoms, we calculated symptomatic (27% and 39%) and asymptomatic (4% and 11%) test positivity. We extrapolated these positivity rates to participants who did not test and estimated 19–22% of respondents may have had COVID-19 infection in January 2022.

Conclusion: The proportion of Victorians infected with COVID-19 in January 2022 was likely considerably higher than officially reported numbers.

Implications for public health: Our estimate is approximately double the COVID-19 case numbers obtained from official case reporting. This highlights a major limitation of diagnosis data that must be considered when preparing for future waves of infection.

Keywords: COVID-19, omicron, epidemiology, test positivity, community exposure

Introduction

For much of 2020 and 2021, Victoria, Australia's second most populous state, experienced low cases of COVID-19[1] relative to the rest of the world. Alongside high vaccine coverage, a test, trace, isolate and quarantine (TTIQ) approach was central to Victoria's COVID-19 response, with health promotion messaging encouraging frequent polymerase chain reaction (PCR) testing for COVID-19. A QR check-in system was in place to assist the Government and individuals to identify if they had been potentially exposed to COVID-19 in public places, prompting quarantine and testing. Both symptomatic and asymptomatic testing were promoted and laboratory (PCR) positive results were a notifiable condition, reported to the Government.

Ready access to PCR testing and low case numbers during 2020 and 2021, resulted in low COVID-19 test positivity. Between January and August 2021 in Victoria, there were 5,723,314 PCR tests performed with an overall test positivity of 0.3%.[2] It is therefore reasonable to assume a high proportion of people infected with COVID-19 were being diagnosed.

In January 2022, Victoria experienced its largest wave of COVID-19 to date[1] with over 660,000 infections[3] and 470 deaths[4] recorded in January alone. Surging cases, TTIQ system alerts recommending testing for close contacts, and opening interstate travel which required a negative COVID-19 test[5] further strained testing capacity. Daily testing numbers in Victoria for January peaked at 89,000 tests on 8 January (compared to an average 54,800 daily tests between 1 July

Abbreviations
PCR, Polymerase Chain Reaction; RAT, Rapid Antigen Test.

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Aust NZ J Public Health. 2023; Online; https://doi.org/10.1016/j.anzjph.2022.100007

and 31 December 2021)[6] and were accompanied by long wait times,[7] reduced opening hours at testing centres,[8] delayed processing of tests and many people not receiving timely results. To alleviate PCR testing capacity constraints, the Victorian Government encouraged the use of Rapid Antigen Tests (RATs),[9] which at the time were in short supply and when available, were expensive.[10] While the Victorian Government established an online system to notify positive RAT results, limited access to RATs meant people were unable to test or delayed testing, even when nominated as a close contact or in the presence of symptoms. Reporting of positive RATs was voluntary; it is unknown how may positive RATs were not reported by the community.[11]

The absence of a universal and accessible testing regime meant the number of notifications of positive test results underestimated the number of people infected with COVID-19. Accurate estimates of the proportion of people with COVID-19 are important for informing public health interventions, modelling and response planning,[12] including in the context of population-level exposure-acquired immunity, a key factor influencing future disease spread.[13] This is important in the context of ongoing emerging subvariants of Omicron.[14] However, the limited access to testing and the likely under-reporting of positive RAT results meant the proportion of people with diagnosed COVID-19 infection was likely to be a substantial underestimate of the total number of COVID-19 cases.

To estimate the proportion of Victorians infected with COVID-19 during the Omicron BA.1 variant wave, we surveyed participants of the Optimise Study[15] about COVID-19 testing, test outcomes and barriers to testing in January 2022. We aim to estimate the proportion of respondents infected with COVID-19 during January 2022.

Methods

The Optimise Study (Optimise) is a longitudinal cohort of participants and their social networks conducted in Victoria, Australia between September 2020 and August 2022. Detailed descriptions of Optimise participants and methods are published elsewhere.[15,16] However, briefly, Optimise participants were aged ≥18 years old, able to provide informed consent and able to complete surveys online or over the phone. Participants were recruited through social media, flyers circulated to community and industry groups, community-based organisations and professional networks. Optimise aimed to recruit participants from groups considered at risk of: (i) contracting COVID-19; (ii) developing severe COVID-19; or (iii) experiencing unintended consequences of COVID-19 restrictions. These groups included employees in aged/health care, older and younger adults, people with chronic disease and people from culturally and linguistically diverse backgrounds.

In February 2022, Optimise participants were invited to complete a standalone cross-sectional survey (see Supplementary file 1) about their experiences during January 2022. Surveys were self-completed online in English or phone-administered in first language for participants completing Optimise surveys in Mandarin, Arabic, or Dinka. Participants were not reimbursed for this standalone survey.

Data collection

Sociodemographic data were from participants' baseline and follow-up surveys. In the standalone survey, participants were asked to select all their reasons for taking a COVID-19 test during January 2022, including: experiencing COVID-19 symptoms; being identified as a household-like contact of a COVID-19 case; being an 'other' contact (social or workplace); or surveillance testing, such as adhering to work, travel, or healthcare appointment requirements. We classified participants as having tested based on whether they responded 'yes' to any reason for testing (classified as testers) or selected 'I did not test' (classified as non-testers). Participants were asked how many times they tested negative via RAT and via PCR (numeric response between 0 and 50), and how often (always, most of the time, sometimes, never, not applicable, prefer not to say) in January 2022: (i) they had access to RATs when they needed them; (ii) RATs were too expensive for them when needed; and (iii) they tested when they experienced COVID-19-like symptoms. For this analysis, we assumed participants did not experience symptoms if they responded 'not applicable' and did experience symptoms if they selected another response option.

Analysis

To determine the proportion of participants who may have been infected with COVID-19, we summed the diagnosed (reporting testing positive for COVID-19) and the estimated undiagnosed people and divided by the total number of participants. To make use of all available data, we estimated undiagnosed COVID-19 infections using two different sets of survey questions to define symptomatic and asymptomatic testing. For each definition, we obtained a test positivity, which was then extrapolated to the untested populations. The two methods were based on: 1) presence of symptoms; and 2) reason for testing.

Estimation of proportion infected – presence of symptoms method

We classified participants as experiencing symptoms (yes/no/prefer not to say) based on their answer to, 'how often did you test when symptoms occurred?'. Participants selecting 'always', 'most of the time', 'sometimes', or 'never' were classified as yes, and participants selecting 'not applicable' were classified as no (participants selecting 'prefer not to say' were classified as such). COVID-19 test positivity for the three groups (yes, no, prefer not to say) was calculated among testers, and test positivity was extrapolated to corresponding non-testers to estimate the number of people with undiagnosed COVID-19 in each group (**Figure 1**).

Estimation of proportion infected – reason for testing method

We classified participants who tested in January because they had symptoms versus for reasons other than having symptoms (being a close or 'other' contact, or for surveillance such as work, travel or healthcare appointment requirements, or peace of mind). Because participants could select more than one option, we established a hierarchy whereby testing due to symptoms took precedence over other reasons. COVID-19 test positivity for the three groups (symptoms, close or other contact, surveillance) was calculated among testers and test positivity was extrapolated to corresponding non-testers to estimate the number of people with undiagnosed COVID-19 in each group (**Figure 2**).

Estimated numbers of people with possible undiagnosed COVID-19, based on these two methods, were added to the number of people

Figure 1: Reported and derived COVID-19 infection in the cohort – presence of symptoms method. The 577 participants were classified into symptomatic groups based on whether they reported symptoms. These symptomatic classification groups were divided into testers and non-testers, and test positivity was calculated for testers (red boxes). Test positivity was then extrapolated to corresponding non-testers to estimate undiagnosed infections (grey boxes).

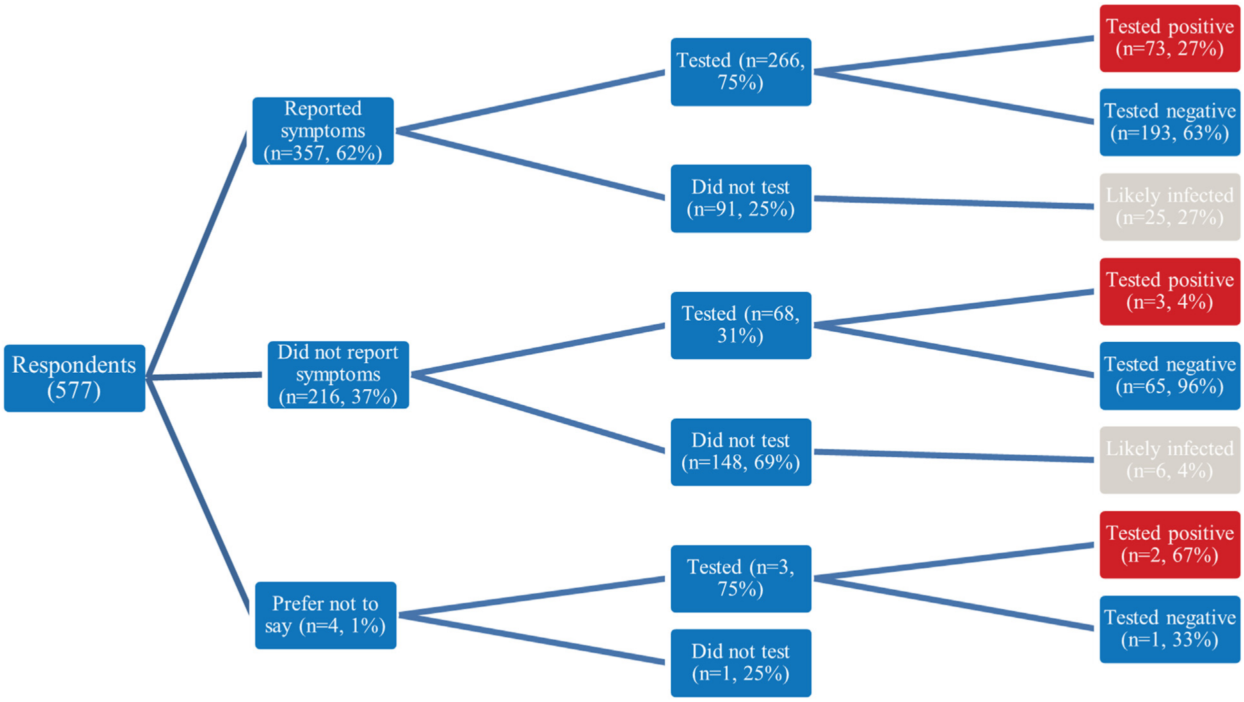

Figure 2: Reported and derived COVID-19 infection in the cohort – reason for testing method. The 577 participants were classified into testing groups based on whether they tested in January 2022. Testers were further classified based on their reason for testing, and test positivity was calculated for the different testing classification groups (red boxes). Test positivity was then extrapolated to corresponding non-testers to estimate undiagnosed infections (grey boxes). There were zero participants who did not test, reported symptoms and were close contacts. One participant who did not test and replied "prefer not to say" about symptoms has been excluded from the figure.

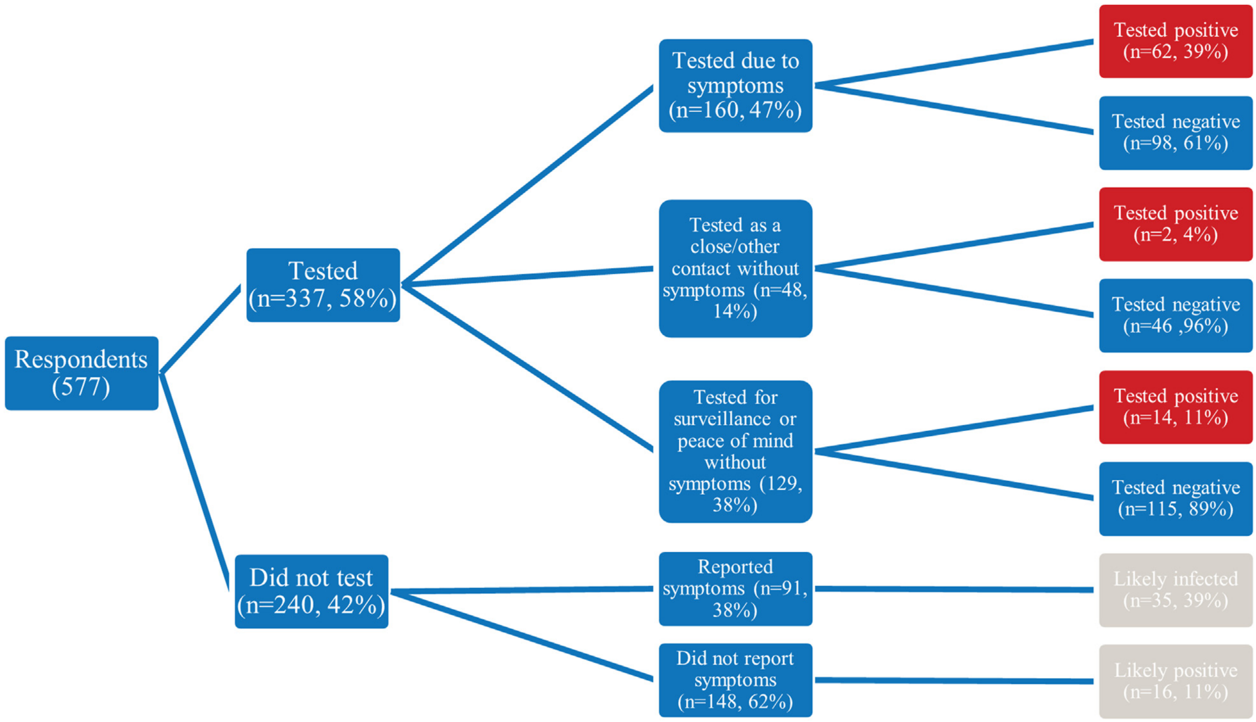

Table 1: Sociodemographic characteristics of participants, Victoria, Australia, February 2022. N=577.

Characteristic	N = 577[a]
Age category, years	
18 – 24	66 (11%)
25 – 34	108 (19%)
35 – 44	99 (17%)
45 – 54	98 (17%)
55 – 64	99 (17%)
65 – 74	83 (14%)
75+	22 (4%)
Missing	2
Healthcare worker	132 (23%)
Country of birth	
Australia	382 (66%)
Other	195 (34%)
Language spoken at home	
English	486 (84%)
Language other than English	91 (16%)
Gender	
Woman	432 (75%)
Man	139 (24%)
Non-binary, other, prefer not to say	6 (1%)
Area of Victoria	
Metropolitan Melbourne	464 (81%)
Regional Victoria	107 (19%)
Missing	6
Chronic disease	
No	350 (61%)
Yes	214 (37%)
Don't know or prefer not to say	12 (2%)
Missing	1
Received at least two doses of COVID-19 vaccine	570 (99%)

[a]n (%).

who were diagnosed (self-reported a positive COVID-19 test) to estimate the total number and proportion of participants who may have been infected with COVID-19 in January 2022.

Data were analysed using summary statistics in R version 3.6.3.

Results

A total of 577 of the 697 (83%) Optimise participants completed the cross-sectional survey and were included in analyses. All further results are based on the 577 participants who responded.

Participants were aged 18–85 years (median age 47, IQR: 32–61). Most were born in Australia (66%), spoke English at home (84%), were female (75%) and lived in Metropolitan Melbourne (81%) (Table 1).

Of the 357 participants who experienced COVID-19-like symptoms, 111 (31%) reported 'never' testing when they had symptoms. Three hundred and nineteen out of 421 respondents (76%) were unable to access a RAT at some point in January 2022 when they needed one. One hundred and seventy-nine out of 342 (52%) reported that RATs were always, mostly or sometimes too expensive for them to afford when needed (Table 2).

Symptoms and testing are summarised in Figure 1 and Supplementary file 2. Of the 577 participants, 357 (62%) reported experiencing COVID-19-like symptoms in January 2022 (Figure 1) and 337 (58%) tested for COVID-19, of whom 78 (23%) tested positive. The proportion of all participants diagnosed with COVID-19 was 14% (78/577).

Twelve out of 34 (35%) participants who tested positive via RAT only reported their positive result to the Government. Combining these twelve with the 44 who tested positive via PCR (26 via PCR only and 18 via RAT and PCR), whose positive results were reported to the government via PCR lab notifications, a total of 56 out of 78 (72%) participants who tested positive had their positive result reported to the government (Table 3). This corresponded to 10% (56/577) of all participants.

For participants who tested for COVID-19 in January, the mean number of negative RATs was 2.7 (standard deviation: 3.7) and the mean number of negative PCR tests was 1.3 (standard deviation: 3.5).

Estimation of proportion infected – presence of symptoms method

Twenty-seven per cent of participants with symptoms who tested (73/266), and 4% (3/68) of participants who did not report symptoms and tested, tested positive. Extrapolating the 27% symptomatic test positivity, we calculated 25 of the 91 symptomatic non-testers in January could have been infected with COVID-19. Similarly, extrapolating the 4% asymptomatic test positivity, we calculated six of the 148 asymptomatic non-testers in January could have been infected with COVID-19. Summing the 25 plus six potentially undiagnosed participants and the 78 participants who were

Table 2: Accessibility of COVID-19 tests in January 2022, February 2022, Victoria, Australia, N=577.

	Always	Mostly	Sometimes	Never
Tested with a PCR and/or a RAT when COVID-19-like symptoms occurred	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Symptoms[a] (n=357)	139 (39%)	50 (14%)	57 (16%)	111 (31%)
Had access to a RAT when I needed to test				
Symptoms (n=330)	72 (22%)	49 (15%)	122 (37%)	87 (26%)
No symptoms (n=89)	30 (34%)	16 (18%)	28 (31%)	15 (17%)
RATs were too expensive for me to buy when I needed them including for family members				
Symptoms (n=270)	40 (15%)	36 (13%)	66 (24%)	128 (47%)
No symptoms (n=71)	12 (17%)	6 (8%)	19 (27%)	34 (48%)

[a]Definition of symptoms was derived from this variable, where answers of 'not applicable' were classified as 'no' to symptoms. Responses for participants who replied 'prefer not to say' to symptoms excluded due to small sample size (i.e., <5 participants). Denominators for percentages are from column 1, i.e., the number of people with/without symptoms.

Table 3: Number and proportions of test type on which participants tested positive in January 2022, February 2022, Victoria, Australia, N=577.

Test type	Number tested positive (n=78) n (%)	Number whose positive test result was reported to the Victorian Government n (%)[a]
RAT only	34 (44%)	12 (35%)
PCR only	26 (33%)	26 (100%)
Both RAT and PCR	18 (23%)	18 (100%)

We assumed that all participants who tested positive via PCR had their positive test result reported to the government via PCR lab notifications.

[a]The denominator in this column is the number of people who received a positive result via each test type.

diagnosed, results in 109 of 577 participants (19%) who may have been infected with COVID-19 in January 2022 (Figure 1).

Estimation of proportion infected– reason for testing method

Thirty-nine per cent (62/160) of participants who tested due to experiencing symptoms, and 11% (14/129) of participants who did not experience symptoms at the time of testing, tested positive. Extrapolating the 39% symptomatic test positivity, we calculated 35 of the 91 symptomatic non-testers may have been infected with COVID-19. Similarly, extrapolating the 11% asymptomatic positivity, we calculated 16 of the 148 asymptomatic non-testers could have been infected with COVID-19. Summing the 35 plus 16 potentially undiagnosed participants and the 78 (14%) participants who were diagnosed, results in 129 of 577 participants (22%) who may have been infected with COVID-19 in January 2022 (Figure 2).

Discussion

Fourteen per cent of participants tested positive for COVID-19 in January 2022 and 10% reported a positive test to the government. However, after extrapolating the test positivity observed to non-testers, accounting for the presence or not of symptoms, between 19% and 22% may have had COVID-19 infection in this time. In January 2022, the 664,729 reported infections in Victoria represented 10% of the Victorian population, which corresponds to the 10% of our cohort who reported their positive COVID-19 test result to the Victorian government. Whilst the study cohort was not a representative sample, if the estimated proportion infected in our adult cohort was extrapolated to both children and adults across the Victorian population, there could have been as many as 1.27 to 1.47 million cases of COVID-19 in Victoria in January 2022. This estimate is around double the officially reported number of people with a positive test in the month of January. Conversely, it suggests there were 604,000–805,000 undiagnosed cases in Victoria during this period. Our estimate is consistent with a seroprevalence survey conducted in February–March 2022,[17] which estimated that 23% of Victorians may have been infected with COVID-19 during the first Omicron wave.

Australia is now at a crucial point of the pandemic where we have an opportunity to review the past to prepare for the future response. Whilst, at the time of writing, there is a current decline in Victorian cases, between 31 January and 1 September 2022 there have been 7.6 million COVID-19 cases[18] Australia-wide, with over 10,000 deaths.[19] Despite the recent National Cabinet decision[20] to end mandatory isolation measures, this remains a public health emergency. As such, we must reflect on refining the public health response by reviewing epidemiological measures of the burden of infection. Our findings suggest that test positivity, reported by the Victorian government,[2] is no longer an accurate indicator of burden of COVID-19 infection. This is due to reduced access to PCR tests, the number of RATs taken being unknown and therefore not included in the denominator for test positivity and the voluntary nature of reporting a positive RAT in Victoria, which means the numerator of positive tests is an underestimate to an unknown degree. Alternative indicators and their integration into existing reporting systems are therefore needed. Serial cross-sectional bio-behavioural surveys that include the questions asked in this study could be conducted. These could be implemented through cross-sectional serial sampling[21] or geographical or risk-based sentinel surveillance, as is in place for influenza[22] and could involve testing at high-risk workplaces or randomly chosen general practices. Encouraging the community to report their positive RAT, through incentivisation or simplified reporting systems is also important to ensure a timely understanding of the dynamics of COVID-19 epidemiology. This will be crucial in light of the recent removal of pandemic orders, which will see infected people moving freely in the community. Distributing RATs with QR codes printed onto the test cassettes[23] could allow simple reporting of both positive and negative results through scanning the code and being taken to the Government's reporting website. Lessons learnt (both positive and negative) and the development of innovative strategies for COVID-19 testing and surveillance, if incorporated into the influenza response could also lead to a harmonised, cohesive response to both diseases, with an aim to have accurate monitoring and timely surveillance. Leveraging knowledge gained about normalisation of testing, self-reporting of positive results, self-isolation and quarantining, annual vaccination, social distancing, mask wearing and hand hygiene could also improve our response to annual waves of influenza infection.

Limitations

Our estimate of the proportion of people infected with COVID-19 in January 2022 has several limitations. First, the Optimise cohort is not a representative sample of the Victorian population. Optimise used a social network approach to recruit participants and their networks, as opposed to probabilistic sampling. However, participants were from a range of key groups in the community, with coverage across ages, genders, occupations, and geographical areas; the purpose of over-sampling groups was to increase the power to detect differences between groups. The Optimise sample may have different COVID-19 risk and engagement in testing than the general population. Further, cohort participants may be more cautious than the general population because of long-term study participation (cohort effect), making them less likely to be exposed to COVID-19 and more likely to test. The sample also does not include children who may have experienced different rates of infection and testing patterns to adults. The higher level of education and employment in the cohort may also increase their likelihood of testing and decrease their likelihood of exposure to COVID-19. Alternatively, participants may have experienced a higher incidence of infection given the potential for increased exposure to COVID-19 through occupational settings such as health and aged care.

However, given the Omicron outbreak was community-wide, this is unlikely to be a major factor. These characteristics of our study cohort may mean that we have under- or over-estimated COVID-19 infection and extrapolated a non-representative sample to the whole population. However, in the absence of a probabilistic sample, evidence from the Optimise study remains robust and useful for planning the next phase of Australia's response to pandemics. Second, in the reasons for testing method, symptomatic distribution was calculated differently for testers and non-testers, because non-testers were not asked the reason they tested; participants may have been misclassified. However, we mitigated this by making use of all relevant data and using two different definitions of symptoms (i.e. presence of symptoms and reasons for testing). Third, our COVID-19 infection estimate is likely to be conservative as we did not account for RAT sensitivity. RATs have been found to be less sensitive to the Omicron variant than other variants[24] and RAT sensitivity varies with viral load, so the timing of the test can influence detection. Fourth, because we aim to use a simplified extrapolation to estimate an overall proportion of people likely infected with COVID-19 in the sample, we did not utilise standard statistical inference methods or report confidence intervals for the estimates. Finally, our data are self-reported; participants may report in a direction that reflects favourably on them[25] or have recall bias.

Conclusion

Our results suggest that the proportion of Victorians infected with COVID-19 in Victoria in January 2022 was considerably higher than the officially reported numbers, due to both under-diagnosis and non-reporting of positive RAT results. This is important when trying to understand what lessons can be learnt from the significant rise in infections experienced in January 2022, the limited control interventions in place at the time, the shortage of affordable tests and substantial community disruption experienced. Our adjusted COVID-19 infection estimates help inform future responses and are crucial to account for when calculating projections for what lies ahead with Omicron and future variants. Finally, given test reporting is an increasingly inaccurate indicator of the number of infections in the community, our study helps guide future mechanisms to accurately measure COVID-19 infections.

Conflict of interest

NS has received funding from the Victorian Department of Health (DoH), NSW DoH and the Federal Government for modelling related to COVID-19. MH receives funding support from a National Health and Medical Research Council Investigator grant.

Funding

The study is funded by the Victorian Government Department of Jobs, Precincts and Regions, the Macquarie Group Foundation, and Burnet Institute donors.

Ethics

The study was approved by the Alfred Health Ethics Committee (approval number: 333/20).

Acknowledgements

Optimise is a partnership between the Burnet Institute and Peter Doherty Institute. The authors gratefully acknowledge the generosity of the community members who participated in the study.

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Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anzjph.2022.100007.