

# Health literacy and disparities in COVID-19–related knowledge, attitudes, beliefs and behaviours in Australia

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## Abstract

**Objectives:** To explore the variation in understanding of, attitudes towards, and uptake of, health advice on coronavirus disease 2019 (COVID-19) during the 2020 pandemic stage 3 restrictions ('lockdown') by health literacy in the Australian population.

**Study design:** National cross-sectional community survey.

**Setting:** Australian general public.

**Participants:** Adults aged over 18 years ( $N = 4362$ ).

**Main outcome measures:** Knowledge, attitudes and behaviours related to COVID-19; health literacy and sociodemographic factors.

**Results:** People with inadequate health literacy had poorer understanding of COVID-19 symptoms (49% vs 68%;  $p < 0.001$ ), were less able to identify behaviours to prevent infection (59% vs 72%;  $p < 0.001$ ), and experienced more difficulty finding information and understanding government messaging about COVID-19 than people with adequate health literacy. People with inadequate health literacy were less likely to rate social distancing as important (6.1 vs 6.5;  $p < 0.001$ ) and reported more difficulty with remembering and accessing medicines since lockdown (3.6 vs 2.7;  $p < 0.001$ ). People with lower health literacy were also more likely to endorse misinformed beliefs about COVID-19 and vaccinations (in general) than those with adequate health literacy. The same pattern of results was observed among people who primarily speak a language other than English at home.

## Key points

- People with chronic disease are more susceptible to severe illness and death from COVID-19, and the same group frequently has lower health literacy
- This paper presents the first Australian data on variations in COVID-19 knowledge, attitudes and uptake of public health messages by health literacy. Data show important disparities, with poorer outcomes among groups with lower health literacy and those who speak a primary language other than English at home
- Inadequate understanding and uptake of behavioural advice may undermine public health efforts to reduce viral transmission
- Health messages must be tailored to meet the needs of diverse populations; otherwise, they may put already vulnerable populations at greater risk

**Conclusion:** Our findings show that there are important disparities in COVID-19–related knowledge, attitudes and behaviours according to people's health literacy and language. These have the potential to undermine efforts to reduce viral transmission and may lead to social inequalities in health outcomes in Australia. People with the greatest burden of chronic disease are most disadvantaged, and are also most likely to experience severe disease and die from COVID-19. Addressing the health literacy, language and cultural needs of the community in public health messaging about COVID-19 must now be a priority in Australia.

## Introduction

The coronavirus pandemic is the biggest public health challenge Australia and the world have faced in living memory. Because coronavirus disease 2019 (COVID-19) spreads so rapidly, the pandemic has placed unprecedented strain on health systems globally. People at greater risk of a severe response to COVID-19 include those aged over 60 years, those living in aged care facilities, those with compromised immune systems (e.g. cancer) and those with chronic medical conditions.<sup>1</sup> Although data are still emerging, the available data suggest that people with chronic disease and multimorbidity are particularly susceptible to COVID-19.<sup>2</sup> There are well-known social inequalities in chronic disease, with higher rates in more disadvantaged populations. Perhaps predictably, evidence of large disparities in COVID-19 deaths by ethnicity and socio-economic group has emerged in the US and the UK<sup>2,3</sup>; rates among these subgroups in Australia are currently unavailable.

Currently, there are no proven antiviral treatments and no vaccines for COVID-19. This means that, to control the spread of the virus, we are largely reliant on individual behaviour – that is, complying with restrictions, and following recommended advice on behaviours such as physical distancing, voluntary testing, self-isolation and hand hygiene. Restriction measures can enforce some of these behaviours – for example, by restricting travel, requiring returning travellers to self-isolate, closing public recreational spaces, dramatically limiting individual contacts, and requiring work or schooling to be undertaken remotely. These combined efforts to slow the spread of COVID-19 have had notable success in

Australia. However, different levels of engagement with restriction measures within our community may lead to hotspots or additional waves of infection, and certain groups may be more severely affected by COVID-19.

Since an effective response to the virus requires individuals to modify their behaviour, their engagement with public health information is a pivotal element. This means that people must be able to process and understand rapidly evolving public health messages, and then act on them. It is well known that people vary in their ability to understand, access and act on health advice and make informed health decisions – a set of skills commonly called 'health literacy'.<sup>4</sup> Health literacy has emerged as one of the strongest psychosocial determinants of health outcomes, and explains a range of health inequalities by age, ethnicity and socio-economic position.<sup>5</sup>

Stage 3 restrictions started in Australia in late March 2020, which included the requirement for all non-essential workers to work from home, no guests permitted to enter another household, indoor and outdoor gatherings limited to two adults (unless from the same household) and non-essential services closed, with small state/territory differences. Early on, concerns were raised about the quality and appropriateness of communication for people with lower health literacy and for other vulnerable population subgroups.<sup>6</sup> This was alongside widespread concern about inconsistent messaging (e.g. on sending children to school) and lack of clarity in key preventive behavioural advice (on physical distancing).<sup>7</sup>

We set out to explore the understanding, uptake and impact of COVID-19 health advice 4 weeks into the initial Australian lockdown (stage 3 restrictions) among a

diverse national sample. Our aim was to understand how health messages had been understood and interpreted at a key time point, when adherence to health advice was critical to ensure individual and community safety from the virus. We investigated whether vulnerable populations might be further disadvantaged in their understanding, attitudes and intended behaviours regarding COVID-19 prevention measures. We examined variation in knowledge, attitudes, behaviours and psychosocial outcomes by health literacy and primary language spoken at home, as well as other key sociodemographic factors.

## Methods

### Study design

A cross-sectional online survey was conducted using the web-based platform Qualtrics (Provo, UT: Qualtrics; Version XM). This study was approved by the University of Sydney Human Research Ethics Committee (2020/212).

### Setting

The survey was carried out in collaboration with a sister survey conducted in the US in March 2020.<sup>8</sup> The adapted Australian version of the survey (available from: [ses.library.usyd.edu.au/handle/2123/23707](https://ses.library.usyd.edu.au/handle/2123/23707)) was conducted on 17–22 April 2020, when stage 3 restrictions (colloquially referred to as ‘lockdown’ at that time) had been in place for 3 weeks.

### Participants

Participants were aged 18 years and older, able to read and understand English, and currently residing in Australia. Participants were recruited via social media (Facebook and Instagram) and Dynata, a large market research company with more than 600 000 online Australian panel members aged older than 18 years. For social media recruitment, adults aged 18 years and older living in Australia were targeted using paid advertisements, which were accompanied by text and a hyperlink that directed participants to the web-based COVID-19 survey. Participants recruited via social media were given the opportunity to enter a prize draw for the chance to win one of 10 \$20 gift cards upon completion of the survey. Panel members recruited via Dynata were sent an email invitation to participate in the study and received points for completing the survey, which they could redeem for gift vouchers, donations to charities or money. Recruitment of all participants occurred within 6 days.

### Measurements

Sociodemographic variables collected included age, gender, educational status, employment status, country of birth, area of residence, number in household, primary

language spoken at home, and self-identification as Aboriginal or Torres Strait Islander. In addition, information was obtained on health insurance status, self-reported chronic diseases and self-reported overall health. Changes in consumption of unhealthy snacks and alcohol intake were assessed.<sup>9</sup> We assessed health literacy using the Single Item Literacy Screener (SILS)<sup>10</sup>, and numeracy using the Subjective Numeracy Scale.<sup>11</sup> The Consumer Health Activation Index (CHAI) was used to determine patient activation.<sup>12</sup> Anxiety and depression were measured using self-reported history of anxiety, depression and the State–Trait Anxiety Inventory (STAI).<sup>13</sup> Participants were asked to indicate their awareness and concerns<sup>8</sup>, perceived financial impact<sup>14</sup>, knowledge, sources of information, personal preparedness<sup>15</sup>, behaviour change, daily impact and support for misinformation relating to COVID-19.<sup>16</sup> (Box 1 in the Appendix lists the items and scoring scales, available from: [ses.library.usyd.edu.au/handle/2123/23706](https://ses.library.usyd.edu.au/handle/2123/23706)).

### Statistical analysis

Descriptive statistics were calculated for all participant characteristics (Table 1) and study outcome measures (Supplementary Table S1, available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)). Associations between key participant characteristics and outcomes were examined in univariable analyses using  $\chi^2$  tests, t-tests or analysis of variance (as appropriate; see Supplementary Table S2, available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)). To explore variation in outcomes by health literacy, multivariable linear regression models were used to estimate marginal means (with 95% confidence intervals [CIs]) for continuous outcomes, and generalised linear models with a modified Poisson approach<sup>17</sup> were used to estimate relative risks (with 95% CIs) for dichotomous outcomes. All multivariable models controlled for age group, gender, number of chronic health conditions, language spoken at home, private health insurance status and employment status. Statistical analyses were conducted in Stata/IC (College Station, Texas: StataCorp; Version 16.1).

This survey was the first of a series of monthly surveys to map changes over time for up to 6 months. As such the sample size was calculated to achieve a specified level of precision in estimates (i.e., confidence intervals no wider than  $\pm 3\%$  for proportions, and no wider than  $\pm 0.3$  standard deviations for means) at a 6-month assessment in the prospective cohort, accounting for potential loss to follow-up of up to 20% with each assessment wave.

## Results

We had a total of 4362 respondents (2006 recruited by social media, 2356 from the online panel). Sample characteristics are summarised in Table 1.

**Table 1.** Descriptive characteristics of analysis sample ( $N = 4362$ ). Data are shown as  $n$  (%) unless otherwise specified

Variable	Summary value
Mean age (SD), years	42.6 (17.4)
Age group, years	
18–25	964 (22%)
26–40	1215 (28%)
41–55	962 (22%)
56–90	1221 (28%)
Gender	
Male	1698 (39%)
Female	2615 (60%)
Other/prefer not to say	49 (1%)
Highest level of educational attainment	
Less than high school	148 (3%)
High school graduate	786 (18%)
Trade certificate (I–IV)	617 (14%)
Diploma or bachelor degree, or equivalent	2026 (46%)
Masters or doctoral degree, or equivalent	785 (18%)
Born in Australia	3260 (75%)
Primary language spoken at home is English	4088 (94%)
Aboriginal or Torres Strait Islander	
Yes	88 (2%)
No	4231 (97%)
Not stated	43 (1%)
Health literacy SILS <sup>a</sup>	
Adequate health literacy	3813 (87%)
Inadequate health literacy	549 (13%)
Private health insurance	
Yes	2763 (63%)
No	1555 (36%)
Not stated	44 (1%)
Number of self-reported chronic health conditions <sup>b</sup>	
None	2251 (52%)
One only	1237 (28%)
Two or more	874 (20%)

Variable	Summary value
<b>Self-reported lifetime mental health history</b>	
Depression	1434 (33%)
Anxiety	1635 (37%)
Take any prescription medicines	2400 (55%)
Median number of alcoholic drinks consumed each week (IQR)	2 (0, 6)
Mean State–Trait Anxiety Inventory (STAI) score (SD) range 20–80 <sup>c</sup>	43.55 (15.20)
Do you know, or think, that you (currently) have COVID-19?	92 (2%)
<b>Self-reported general health</b>	
Poor	148 (3%)
Fair	632 (14%)
Good	1521 (35%)
Very good	1541 (35%)
Excellent	520 (12%)

QR = interquartile range; SD = standard deviation; STAI = State–Trait Anxiety Inventory

<sup>a</sup> Based on Single Item Literacy Screener (SILS): *How confident are you with filling out medical forms by yourself: not at all, a little bit, somewhat, quite a bit, extremely.* “Not at all” response categorised as inadequate health literacy.

<sup>b</sup> Chronic conditions were respiratory disease, asthma, chronic obstructive pulmonary disease, hypertension, cancer, heart disease, stroke and diabetes.

<sup>c</sup> STAI scores of 40 or above indicate clinical levels of anxiety, although some studies suggest a higher cut off for older populations of 55 or above.

The mean age was 42.6 years (standard deviation [SD] 17.4; range 18–90 years), and 60% of respondents were female. Most participants (75%) were born in Australia; 94% spoke English as their primary language at home; 35% had no tertiary qualifications; and 36% did not have private health insurance. The presence of at least one chronic health condition was reported by 48% of the sample. Inadequate health literacy (assessed using the SILS) was identified for 13% of the sample.

### COVID-19 awareness and concern

Awareness and concern about COVID-19 across sample demographics are shown in Supplementary Table 2 (available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)). Notably, older participants (aged 56–90 years) rated the seriousness of the threat of COVID-19 as higher than younger participants, but also reported being less nervous and having lower anxiety, and a greater proportion believed that they were not likely



to get sick than in younger age groups. The perceived seriousness of the threat also increased with number of chronic health conditions reported. Participants who reported speaking a language other than English (LOTE) at home rated the threat of COVID-19 as lower, with a greater proportion indicating that they were not likely to get sick compared with those who primarily spoke English at home.

Multivariable analyses examining differences in outcomes by health literacy (as assessed using the SILS) after adjusting for other sociodemographic variables are shown in Table 2 (full model estimates are provided in Supplementary Tables S3–S6, available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)). Compared with participants with adequate health literacy, individuals with inadequate health literacy rated the seriousness of the threat posed by COVID-19 as significantly lower ( $p < 0.001$ ), had higher anxiety ( $p < 0.001$ ), and reported that COVID-19 had a greater impact on their financial situation ( $p < 0.001$ ). Participants with inadequate health literacy were more likely than participants with adequate health literacy ( $p = 0.018$ ) to think that they would not get sick from COVID-19.

## COVID-19 knowledge and information

On average, participants estimated that 61.3% of people who are infected with COVID-19 will have only mild symptoms, and that approximately 6.5% of people who are infected with COVID-19 in Australia will die as a result (Supplementary Table S1, available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)). Most participants (60%) were able to provide at least three key symptoms of COVID-19, and more than two-thirds of the sample (71%) could describe three government-recommended prevention methods. Differences in knowledge of symptoms and preventive measures by sociodemographic factors are shown in Supplementary Table S2 (available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)). After controlling for other sociodemographic factors, participants with inadequate health literacy were significantly less likely ( $p < 0.001$ ) to be able to name three key symptoms of COVID-19, and less likely to be able to report three preventive methods ( $p < 0.001$ ).

Participants reported spending on average 1.3 hours (SD 1.3) per day getting news or learning about COVID-19. The three most frequently endorsed sources of information were public television (67.6%), social media (64.4%) and government websites (63.9%). Sociodemographic disparities in understanding government messaging were evident (Supplementary Table S2); younger participants, females, people with inadequate health literacy, people with poorer general health, primary English speakers, and people without private health insurance reported greater difficulty understanding government messaging. After adjusting for other sociodemographic factors, individuals with inadequate health literacy reported significantly more

difficulty ( $p < 0.001$ ) understanding messaging in relation to COVID-19 than those with adequate health literacy.

## COVID-19 behaviour change and impact

The vast majority of respondents (92%) reported changes in plans due to COVID-19, with 84% agreeing that COVID-19 had impacted their daily routine. Only 9% of the total sample felt “not at all” personally prepared for a widespread outbreak of COVID-19. Compared with before the introduction of COVID-19 restrictions, 26% reported drinking more alcohol, and 37% reported eating more unhealthy snacks. Variations in behaviour change and impact as a function of sociodemographic factors are shown in Supplementary Table S2 (available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)).

After controlling for other sociodemographic factors (Table 2), individuals with inadequate health literacy were less likely ( $p = 0.014$ ) to have made changes to their plans, and less likely to report social distancing as important ( $p < 0.001$ ), but much more likely to feel personally unprepared for a widespread outbreak ( $p < 0.001$ ) than those with adequate health literacy. Individuals with inadequate health literacy were less likely to have increased their alcohol intake ( $p = 0.013$ ); there was no difference in reports of unhealthy snacking ( $p = 0.20$ ) compared with those with adequate health literacy. Of those taking regular prescription medicines, individuals with inadequate health literacy reported that it was more difficult to remember and access medicines during lockdown ( $p = 0.013$ ).

## Belief in misinformation about COVID-19

Across the sample, support for misinformation about COVID-19 was generally more prominent in younger age groups, males, those with inadequate health literacy, those with fewer chronic health conditions, and those who spoke a LOTE at home (Supplementary Table S2). After controlling for other sociodemographic factors (Table 2), compared with individuals with adequate health literacy, those with inadequate health literacy were significantly more likely to agree with the following statements: “Data about the effectiveness of vaccines is often made up” ( $p < 0.001$ ); “The threat of COVID-19 is greatly exaggerated” ( $p = 0.029$ ); “Herd immunity would be beneficial for COVID-19 and this fact is covered up” ( $p = 0.022$ ); and “The government restrictions are stronger than what is needed” ( $p = 0.003$ ).

## Discussion

Our findings show important disparities in knowledge, attitudes, beliefs and behaviours related to COVID-19 that have the potential to undermine efforts to reduce viral transmission, and could lead to social inequalities in health outcomes in Australia. People with lower health literacy and people who spoke a LOTE at home had

**Table 2.** Descriptive statistics and multivariable regression models exploring variation in outcomes by health literacy

Outcome	Sample statistics (unadjusted)		Adjusted risk ratio <sup>a</sup> (95% confidence interval)	Test statistics
	Inadequate health literacy <i>n</i> (%)	Adequate health literacy <i>n</i> (%)		
<b>COVID-19 awareness and concern</b>				
Perceived seriousness of threat <sup>b</sup>	7.1 (2.3)	7.7 (2.1) <sup>d</sup>	−0.42 (−0.61, −0.22)	<i>t</i> (4248) = 4.09, <i>p</i> < 0.001
Not nervous/stressed	90 (16.4)	732 (19.2)	0.85 (0.70, 1.03)	$\chi^2(1) = 2.47$ , <i>p</i> = 0.12
Not likely to get sick	169 (30.8)	942 (24.7) <sup>e</sup>	1.19 (1.03, 1.37)	$\chi^2(1) = 5.62$ , <i>p</i> = 0.018
Anxiety (STAI) <sup>b</sup>	48.8 (14.3)	42.8 (15.2) <sup>d</sup>	4.19 (2.85, 5.52)	<i>t</i> (4256) = 6.14, <i>p</i> < 0.001
Perceived financial impact <sup>b</sup>	3.3 (0.9)	2.9 (1.0) <sup>d</sup>	0.26 (0.13, 0.32)	<i>t</i> (4302) = 4.85, <i>p</i> < 0.001
<b>COVID-19 knowledge and information</b>				
Knowledge of 3 key symptoms	271 (49.4)	2358 (61.8) <sup>d</sup>	0.82 (0.75, 0.90)	$\chi^2(1) = 16.92$ , <i>p</i> < 0.001
Knowledge of 3 prevention methods	323 (58.8)	2759 (72.4) <sup>d</sup>	0.86 (0.80, 0.93)	$\chi^2(1) = 14.56$ , <i>p</i> < 0.001
Difficulty understanding government messaging <sup>b</sup>	5.0 (2.7)	4.3 (2.8) <sup>d</sup>	0.61 (0.35, 0.86)	<i>t</i> (4302) = 4.66, <i>p</i> < 0.001
<b>COVID-19 behaviours and impact</b>				
Not personally prepared	80 (14.6)	319 (8.4) <sup>d</sup>	1.56 (1.22, 1.99)	$\chi^2(1) = 12.51$ , <i>p</i> < 0.001
Changed plans	490 (89.3)	3542 (92.9) <sup>e</sup>	0.96 (0.93, 0.99)	$\chi^2(1) = 6.07$ , <i>p</i> = 0.014
Social distancing score <sup>b</sup>	6.1 (1.0)	6.5 (0.7) <sup>d</sup>	−0.35 (−0.42, −0.28)	<i>t</i> (4170) = 9.75, <i>p</i> < 0.001
Difficulty remembering/accessing medicines <sup>b,c</sup>	3.6 (2.8)	2.7 (2.5) <sup>d</sup>	0.44 (0.10, 0.79)	<i>t</i> (2353) = 2.50, <i>p</i> = 0.013
Drinking more alcohol than before COVID-19 restrictions	112 (20.4)	1023 (26.8) <sup>e</sup>	0.80 (0.67, 0.96)	$\chi^2(1) = 6.01$ , <i>p</i> = 0.014
Eating unhealthy snacks more often than before COVID-19 restrictions	208 (37.9)	1409 (37.0)	0.93 (0.82, 1.04)	$\chi^2(1) = 1.61$ , <i>p</i> = 0.20
<b>Beliefs in COVID-19/vaccination misinformation</b>				
Data on vaccine effectiveness is often made up	143 (26.0)	610 (16.0) <sup>d</sup>	1.45 (1.22 to 1.72)	$\chi^2(1) = 17.75$ , <i>p</i> < 0.001
COVID-19 threat is greatly exaggerated	118 (21.5)	485 (12.7) <sup>d</sup>	1.24 (1.02 to 1.50)	$\chi^2(1) = 4.75$ , <i>p</i> = 0.029
Herd immunity for COVID-19 is beneficial, and this fact is being covered up	116 (21.1)	536 (14.1) <sup>d</sup>	1.25 (1.03 to 1.51)	$\chi^2(1) = 5.29$ , <i>p</i> = 0.022
Government restrictions are stronger than needed	105 (19.1)	490 (12.9) <sup>d</sup>	1.35 (1.11 to 1.65)	$\chi^2(1) = 8.70$ , <i>p</i> = 0.003

STAI = State–Trait Anxiety Inventory

<sup>a</sup> Estimates are presented as adjusted risk ratios or marginal mean differences (95% confidence intervals) for individuals with inadequate health literacy relative to individuals with adequate health literacy. All models adjusted for age group, gender, chronic health conditions, language spoken at home, private health insurance and employment status. Degrees of freedom differ across test statistics as a result of occasional instances of missing data (not imputed). Full models are provided in Supplementary Tables S3–S6, available from: [ses.library.usyd.edu.au/handle/2123/23705](https://ses.library.usyd.edu.au/handle/2123/23705)

<sup>b</sup> Descriptive statistics are displayed as mean (standard deviation), and multivariable estimates provided are marginal mean differences.

<sup>c</sup> Includes *n* = 2364 respondents who reported taking regular prescription medicines with complete covariate data.

<sup>d</sup> *p* < 0.001 for unadjusted pairwise comparisons.

<sup>e</sup> *p* < 0.01 for unadjusted pairwise comparisons.

poorer understanding of COVID-19 symptoms and were less able to identify behaviours to prevent infection than those with adequate health literacy and those who spoke English at home. They were also less likely

to rate physical distancing as important, and reported more difficulty remembering and accessing prescription medicines since lockdown. They felt less prepared and more anxious about COVID-19, and reported

experiencing greater financial impact, but also perceived that they were less likely to get sick from COVID-19. People with lower health literacy also experienced more difficulty finding information and understanding government messaging about COVID-19 than those with adequate health literacy. Notably, there was markedly higher endorsement of some common misinformation statements about COVID-19 in people with lower health literacy and LOTE backgrounds. This is a concern because these beliefs relate to ongoing efforts to prevent viral transmission and increase trust in vaccinations (in general) – the major hope for mitigating COVID-19 worldwide.

The findings support our earlier concerns about the low level of attention paid to health literacy, and cultural and linguistic diversity in COVID-19 public health messaging.<sup>6</sup> In our preliminary analysis of health information presented on government websites, we found readability scores to be higher than the level suitable for the average Australian (reading Grade 8), and far higher than the grade required for low-literacy communities (Grade 5), including those with English as a second language. Similar findings have now been reported elsewhere<sup>18</sup>, and echo results reported in the sister survey conducted in March in the US city of Chicago<sup>8</sup>, where even larger social disparities in key knowledge, attitude and prevention behaviours were reported.<sup>8</sup>

Although Australia is in a much more favourable position in relation to COVID-19 than the US for many reasons, the need for ongoing attention to social variation in community uptake of public health messages remains. Until an effective vaccine is available, our primary defence against the spread of COVID-19 is behaviour change. Effective behaviour change relies on diverse communities and patient groups being able to understand, trust and act on evolving health advice.<sup>19,20</sup> Our comprehensive survey of more than 4000 Australians suggests that, 1 month into stage 3 restrictions and widespread public health messaging, there were important knowledge and attitude gaps that could undermine efforts to reduce viral transmission in Australia.

A systematic review of communication during the H1N1 (swine flu) pandemic in 118 studies<sup>19</sup> reported a consistent association between social inequalities in communication and emergency preparedness outcomes. Trust in sources of information, worry about the disease, levels of knowledge about the disease, routine media exposure and information-seeking behaviours were all related to greater likelihood of adoption of recommended viral infection prevention behaviours. The review suggested that the effectiveness of the pandemic response can be increased when inequalities are considered in communication.

Although we highlight gaps in the understanding of public communications and messaging, there are local examples of good practice. One example of effective management of diverse community needs can be found in Western Sydney. Here, the Western Sydney Local

Health District Health Literacy Hub<sup>21</sup> has been working in partnership with key stakeholder groups to guide communications to meet the health literacy, and culturally and linguistically diverse (CALD) needs of its population. Structured working groups have been created to prioritise communications to vulnerable youth, CALD groups, the elderly, itinerate workers, asylum seekers and refugees. The aims are to test messaging and build trust with priority populations, to ensure effective communication of the need to sustain physical distancing measures in the absence of a vaccine. Similar efforts are now needed nationally and should start at the time of disease outbreaks in the future, alongside planned mass media and health communication campaigns.

## Limitations of study

There are several limitations to our study. Although our recruited sample was large and diverse, it was not statistically representative of the Australian population. The proportion of Australians from non-English speaking backgrounds was small (6%) since the survey was not translated and required sufficient English skills to complete the questionnaire in English. We also had few Aboriginal and Torres Strait Islander participants in our sample (2%), although the latter is similar to the national estimate of 3.5%. Women and people with higher education were also overrepresented in our sample. Further, nationally representative surveys are urgently needed, and surveys targeting CALD, and Aboriginal and Torres Strait Islander populations are necessary to better understand the knowledge, attitudes and behaviours in these subgroups.

The proportion of adults with low health literacy in our sample is similar to other studies we have conducted (~15%).<sup>22</sup> The single item measure of health literacy (SILS) used for assessment is simple and non-stigmatising to administer; however, it under-reports problems with health literacy, identifying only those with very low health literacy levels.<sup>23</sup> It was correlated with our additional related measure of numeracy, e-health literacy and graphical literacy (all *p* values <0.001). Future studies should use more comprehensive literacy measures to understand the associations with key knowledge, attitude and behaviour outcomes related to COVID-19.

## Conclusion

COVID-19 places a disproportionate burden on people with chronic disease, who are also more likely to have poorer health literacy and speak a LOTE at home. Health messages must be tailored to meet the needs of these groups, as our study shows important disparities in understanding, beliefs and behaviours related to COVID-19 that may put already vulnerable people at greater risk. Those with the greatest burden of chronic disease are most disadvantaged, and most likely to experience severe disease and die from COVID-19. It is

imperative that health advice reaches them in a way they understand and can implement. Addressing the health literacy, language and cultural needs of the community in public health messaging about COVID-19 must now be a priority in Australia.

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## Peer review and provenance

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## Competing interests

None declared.

## Author contributions

KM and MW conceived the study, all authors contributed to the study and questionnaire design and survey delivery. EC carried out the data analysis. All authors contributed to the interpretation of the findings. KM wrote the first draft of the manuscript. All authors edited subsequent drafts and all approved the final version of the manuscript.

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