Health literacy among adults in (Victoria), Australia after the COVID-19 pandemic: a cross-sectional survey

Osman, Abdi D, Bhowmik, Jahar, Yasan, Caglayan, Philip, Susan and Kruger, Gina (2026) Health literacy among adults in (Victoria), Australia after the COVID-19 pandemic: a cross-sectional survey. Critical Public Health, 36 (1). ISSN 0958-1596

Critical Public Health

ISSN: 0958-1596 (Print) 1469-3682 (Online) Journal homepage: www.tandfonline.com/journals/ccph20

Health literacy among adults in (Victoria), Australia after the COVID-19 pandemic: a cross-sectional survey

Abdi Osman, Jahar Bhowmik , Caglayan Yasan , Susan Philip & Gina Kruger

To cite this article: Abdi Osman, Jahar Bhowmik , Caglayan Yasan , Susan Philip & Gina Kruger (2026) Health literacy among adults in (Victoria), Australia after the COVID-19 pandemic: a cross-sectional survey, Critical Public Health, 36:1, 2666450, DOI: 10.1080/09581596.2026.2666450

To link to this article: https://doi.org/10.1080/09581596.2026.2666450

CRITICAL PUBLIC HEALTH
2026, VOL. 36, NO. 1, 2666450
https://doi.org/10.1080/09581596.2026.2666450

RESEARCH ARTICLE

OPEN ACCESS Check for updates

Health literacy among adults in (Victoria), Australia after the COVID-19 pandemic: a cross-sectional survey

Abdi Osman[a], Jahar Bhowmik[b], Caglayan Yasan[a], Susan Philip[a] and Gina Kruger[a]

[a]College of Sports, Health, and Engineering. Nursing and Midwifery Discipline, Victoria University, Melbourne, Australia; [b]Swinburne University of Technology, Department of Biomedical, Health and Exercise Sciences, School of Health Sciences, Melbourne, Australia

ABSTRACT

Introduction: Health literacy is known to be deficient in diverse populations. This study aims to evaluate the health literacy of a segment of Australia's adult population following the COVID-19 pandemic.

Method: Using quantitative cross-sectional method utilising validated survey guided by STROBE checklist, we used student-led process convenience-based sampling technique for a segment of Australia's adult population. We collected Sociodemographic and other health literacy questions using a validated HLS-EU-Q16 questionnaire.

Results: Among 758 participants, almost one-third (220) had low level of HLS-EU-Q16 scores. Results from multiple linear regression model, after adjusting for covariates, indicate that HLS-EU-Q16 scores are significantly higher among participants with regular GP visits (β = 2.01, 95% CI 0.65–3.36), good or excellent self-rated health (β = 1.85, 95% CI 0.52–3.18), education above secondary level (β = 2.21, 95% CI 0.98–3.43), and employment in healthcare (β = 2.70, 95% CI 0.75–4.64). Lower health literacy scores are observed among participants born outside Australia/New Zealand (β = −1.66, 95% CI −3.07 to −0.26).

Conclusion: The reported health literacy level and the proportion of participants not having a regular GP are concerning. For meaningful gains to be made, demographics such as country of birth and cultural background requires targeted approach.

ARTICLE HISTORY
Received 18 July 2025
Accepted 24 April 2026

KEYWORDS
Health literacy; HLS-EU-Q16 tool; health status; health seeking behaviour; cultural background

Introduction

Many individuals with chronic health issues, such as cardiovascular disease, recently had limited access to healthcare due to fear or anxiety related to potential COVID-19 exposure (Kim & Yu, 2023) and this necessitated the need to evaluate community Health Literacy (HL). The COVID-19 pandemic has had a negative effect on public health in Australia and worldwide, above and beyond the immediate danger of illness and death. Effects included a surge in mental health conditions (Botha et al., 2023; Kleanthous et al., 2023; Zhao et al., 2023), limited early access to health care due to lock downs and other restrictions and loss of general health screening opportunities led to the quick adoption of telehealth of which the uptake was enhanced by Medicare Benefit Scheme subsidisation (Reay et al., 2021; Zhou et al., 2020).

To enhance HL at a state, national and international level, it is necessary to have a comprehensive tool to measure the population's HL (Pelikan et al., 2022). The European Health Literacy Survey (HLS-EU) Consortium, developed the European Health Literacy Survey Questionnaire (HLS-EU-Q) (Sørensen et al., 2013) to investigate the correlation between health literacy and health outcomes (Nutbeam & Lloyd, 2021) within the general population and from a broad public health perspective. Health literacy encompasses the ability of individuals to read and understand health related materials. Broader definitions (Mitsutake et al., 2020) include the requirement to know, understand and decipher health information and health messages (Sørensen et al., 2012). The focus of this paper is on conceptual models of HL

CONTACT Abdi D. Osman abdosma@gmail.com
Supplemental data for this article can be accessed online at https://doi.org/10.1080/09581596.2026.2666450.

(Sørensen et al., 2012) evaluating functional, interactive, and critical HL (Nutbeam, 2000) and the ability to rely on literacy and numeracy skills when required to solve problems in the access and use of healthcare (von Wagner et al., 2009).

The aim was to equip the individual to make health related decisions, such as attending the GP for check-ups, monitoring their health status risks and adhering to regular screening programs (Sørensen et al., 2012). Health literacy is already viewed as a means of improving help seeking behaviours (Nutbeam, 2017; Paakkari & Okan, 2020). However, disparities in health literacy remains in terms of knowledge, attitudes, socioeconomic inequities and disadvantage and generational gaps (Leung et al., 2022; McCaffery et al., 2020), Factors such as employment status and income, which are social determinants can influence an individual's ability to effectively access health services (Nutbeam & Lloyd, 2021).

During the COVID-19 pandemic period, the use of digital health technologies as an alternative emerged (Golinelli et al., 2020) with an uptake of approximately 36% of all GP medical appointments reported in Australia in the early phase of the COVID-19 (Fisher et al., 2022). This move was a consequential one as clinicians were to rapidly adopt the change terming it as a '*forced adoption*' (Taylor et al., 2021) even though patients reported to be as good or even better than the traditional face-to-face appointments (Isautier et al., 2020). Interestingly, although the recommended mode of telehealth in Australia was video conferencing primarily, during the early phase of the COVID-19, only 4% of telehealth appointments were reported to have involved video conferencing (Fisher et al., 2022; White et al., 2022). This new mode of health care delivery, had the likelihood of the physician or healthcare provider missing visual cues (White et al., 2022) while at the same time, the requirement for individuals to proactively assess and monitor their own health has increased considerably, hence the gap necessitating the need for a greater level of HL or understanding of health issues (Paakkari & Okan, 2020).

This study aims to evaluate the health literacy of a segment of the state of Victoria, Australia's adult population following the COVID-19 pandemic. The study objectives are to determine participants' self-reported perceptions of their health status, to assess participants care seeking behaviour in relation to registering with a GP for continuity of care, and to evaluate whether any correlations exist between participants' country of birth and cultural background to their reported HL.

Methods

Study design

This study used a cross-sectional survey consisting of a mix of generic socio-demographic questions and HLS-EU-Q16 questionnaire (Coman et al., 2022) to assess participants HL in the domains of healthcare, disease prevention and health promotion guided by Strengthening the Reporting of Observational studies in Epidemiology (STROBE).

Questionnaire tool

HLS-EU-Q16 (in English) is a validated short version of HLS-EU-Q47 (Pelikan & Ganahl, 2017). The HLS-EU-Q16 is a validated short-form instrument derived from the HLS-EU-Q47 for measuring health literacy. It has shown good internal consistency (Cronbach's α generally exceeding 0.80) and acceptable construct validity across different settings. Its strong correlation with the full-scale instrument supports its reliability and suitability for use in large-scale surveys. The tool has been validated for local context using this same data reported here with two-factor solution and resulted a Cronbach's alpha of 0.86 and 0.85 respectively for the two factors (Osman et al., 2026). There are a total of 16 items, and each are scored on a four-point Likert scale- ranging from very difficult to very easy. Each question of HLS-EU-Q16 was answered by choosing one response of the available choices: 'very difficult = 1', 'fairly difficult = 2', 'fairly easy = 3' and 'very easy = 4' (Pelikan et al., 2014). Although a range of tools were considered, the HLS-EU-Q16 was selected for its ease of use, the simplicity and non-ambiguous nature of the questions and the brevity of the questionnaire (Appendix 1) (Coman et al., 2022).

Ethics approval

Human Research Ethics Committee approval was obtained from Victoria University Ethics Committee (Reference HRE23-009). Written informed consent was obtained from the participants after providing them with a detailed participant information form informing and explaining to them that, participation was voluntary, the data will always be anonymous as there were no personal identifiers collected, and they had the right to withdraw from the study at any time.

Sample and recruitment

Using student-led process, where the students were trained for data collection, expectations on adherence to ethical principles and preservation of data quality as part of the research unit content where collected data were submitted to the unit's LMS portal and were reviewed by the unit teaching staff who are part of the study team, convenience-based sampling was used targeting a population of 1600 potential participants based on number of students (n = 320) who were to recruit five participants each as part of learning research data collection for the unit. Using a convenient sampling technique, 758 (47%) adult participants attended the survey from greater Victoria state. The true response rate is 47%. Inclusion criteria were adults aged 18–65 years, able to converse in English, and had the capacity to complete the questionnaires. Participant recruitment occurred as part of student learning activities on research data collection in an undergraduate Nursing and Midwifery research unit in the 2nd and 3rd year of the Bachelor of Nursing and Bachelor of Midwifery/Nursing double degree in 2023.

Measures

Validated quantitative measure for the 16 items HLS-EU-Q16 was administered. The 16-item HLS-EU-Q16 scale is a tool that was developed and validated by the European Health Literacy Survey (HLS-EU) Consortium with the aim of measuring health literacy of Europeans in the domains of healthcare, disease prevention and health promotion (Coman et al., 2022). The scale produces a total score ranging from 16 to 64. Each of the 16 items were rated on a 4-point Likert scale ranging from 1 ('*very difficult*') to 4 ('*very easy*') and summed to calculate total scores. For interpretation of the final score, all items of the scale are summed, giving a score ranging between 16 (no health literacy) to 64 (high health literacy). Total summated scores were classified into three categories (low HL, middle HL and High HL) based on (Mekhail et al., 2022). Reliability and validity of the HLS-EU-Q16 measure was demonstrated through reliability measures and principal component analysis (Bergman et al., 2023; Coman et al., 2022). The reliability of the HLS-EU-Q16 questionnaire was evaluated using Cronbach's Alpha. The resulting Cronbach's alpha coefficient was 0.91, indicating excellent internal consistency among the items. Besides general wellbeing for health status and GP for continuity of care and the HLS-EU-Q16 questions, other non-identifiable socio-demographic covariates were also collected including age (in years), gender (male, female and other), height (in centimeters), weight (in kilograms), general status of health (poor, average, good, excellent), level of education, employment status (yes, no), area of employment (health care, other), smoking status (yes, no), regular GP visit (yes, no), and country of birth (Australia, elsewhere). Participants' BMI was calculated using their height and weight, and this was used as a covariate in the statistical analysis (BMI = kg/m^2, where kg is the individual's weight in kilograms and m^2 is their height in meters squared) (Rahimi et al., 2025). To define the variable 'area of employment', we created two dummy variables: 'employed_health' and 'employed_other'. The variable 'employed_health' is coded as 1 if the participant is employed in the healthcare sector and 0 otherwise. Similarly, 'employed_other' is coded as 1 if the participant is employed in sectors other than healthcare and 0 otherwise. Hence, the 'not employed' category in the 'area of employment' variable serves as a reference category.

Statistical analysis

After cleaning the data, the final sample size was 758. To address missing data in the HLS-EU-Q16 questionnaire responses, Little's Missing Completely at Random (MCAR) test (Little, 1988) was performed on

the 16 items. Little's MCAR test was not statistically significant (χ^2 (59) = 51.65, $p = 0.741$), indicating that the missing data were MCAR. Moreover, the overall amount of missing data was minimal (<5% across all variables). Therefore, list-wise deletion was applied to handle the missing values (Bhowmik et al., 2020; Gamage et al., 2022).

Multiple linear regression analysis was then conducted to evaluate the association between the HLS-EU-Q16 score and covariates, identifying the significant factors. Additionally, analysis of variance (ANOVA) and independent samples t-tests with Bonferroni correction for multiple comparisons test were used to assess the impact of individual sociodemographic factors on the HLS-EU-Q16 score. A power analysis, based on a general linear model with 13 covariates, was performed to determine the required sample size. Assuming 20% attrition (Barnett et al., 2021) and 80% power to detect a medium effect size ($f^2 = 0.15$) at a 0.05 significance level, 126 samples were deemed necessary. With 758 participants, the sample was sufficient to conduct multiple regression analysis using 13 covariates. For the multiple linear regression analysis in this study, the raw summated scale scores (ranging from 16 to 64) were used.

Assumptions related to all statistical methods deployed were validated using model fitting statistics including residual plots, variance inflation factors (VIF) and Durbin-Watson statistics (See supporting document: Figures S1–S2 and Tables S1–S2). All analyses were conducted using IBM SPSS Version 29 and R 4.0.2, with a significance level of 0.05 applied to all tests.

Results

Of the 758 participants, 59.9% (n = 454) were female. More than half of the respondents reported having good or excellent general health, while 27.2% (n = 206) reported poor or average general health. A significant majority (83.1%) were non-smokers. Around 60% of participants had completed secondary education or higher, and 86.3% were employed. Among the employed, 24.7% worked in the healthcare sector, while the majority (61.64%) were employed in other sectors. Only 20.8% of participants had the Australia and New Zealand cultural background, and over 50% were born outside Australia. The majority (77%) regularly visited their GP. Those without a regular GP were younger (median age 27 years (IQR = 10), evenly split by country of birth, and more likely to have education above secondary level. Participants ranged in age from 18 to 65 years, with a median age of 30 years (IQR = 21 years). Their BMI ranged from 15 to 49 kg/m^2, with median BMI of nearly 25 kg/m^2 (IQR = 6.0 kg/m^2). The HLS-EU-Q16 scores ranged from 16 to 64, with a mean score of 49.77 (SD = 7.98). Notably, 29% of the participants (n = 220) had scores of 45 or below which is defined as low or inadequate HL and almost 27% of the participants had middle HL score (Mekhail et al., 2022; Okan et al., 2020). A detailed breakdown of the participants' sociodemographic characteristics is provided in Table 1.

A multiple linear regression model was used to predict the HLS-EU-Q16 score, considering predictors such as gender, smoking status, cultural background, country of birth, regular GP visits, general state of health, highest level of education, area of employment, age, and BMI. The results show that country of birth, cultural background, regular GP visits, general state of health, highest level of education, and area of employment are significantly ($p < 0.05$) associated with HLS-EU-Q16 scores (see Table 2).

After controlling for all other variables, several notable significant associations with the HLS-EU-Q16 score were identified. Specifically, individuals born outside Australia have on average, a score that is 1.66 units lower, suggesting that being born in another country is linked to lower health literacy. Conversely, those employed in the healthcare sector have on average, a score that is 2.70 units higher compared to those not employed in healthcare, indicating that healthcare professionals generally have better health literacy.

Additionally, individuals who regularly visit a GP have, on average, a HLS-EU-Q16 score that is 2.00 units higher compared to those who do not have regular GP visits, indicating that frequent interaction with healthcare providers is associated with higher health literacy. Similarly, individuals with good or excellent general health have an average HLS-EU-Q16 score that is 1.88 units higher than those with poor or average health, underscoring the positive impact of better health on health literacy. Furthermore, individuals with education beyond the secondary level have an average HLS-EU-Q16 score that is 2.21 units higher than those with secondary or lower education, strongly suggesting that higher educational attainment is linked to better health literacy.

Table 1. Sociodemographic characteristics of the participants in the survey (N = 758).

Variable	N/mean/median	Percentage/SD/IQR
Gender		
Female	454	59.9
Male	304	40.1
General state of health		
Poor or average	206	27.2
Good or excellent	552	72.8
Smoking status		
No	630	83.1
Yes	128	16.9
Highest level of education		
Secondary or lower	300	39.6
Above secondary	458	60.4
Employment status		
No	104	13.7
Yes	654	86.3
Area of employment		
Health care	187	24.7
Other	467	61.6
Not employed	104	13.7
Cultural background		
Australian/New Zealand	158	20.8
Other	600	79.2
Country of birth		
Australian/New Zealand	348	45.9
Other	410	54.1
Regular GP visits		
No	174	23.0
Yes	584	77.0
Regular GP visits		
No	174	23.0
Age (in years)**	27.0	10.0
Country of birth		
Australian/New Zealand	87	50.0
Other	87	50.0
Highest level of education		
Secondary or lower	65	37.4
Above secondary	109	62.6
Yes	584	77.0
Age (in years)*	33.81	12.85
Age (in years)**	30.00	21.00
BMI (kg/m^2)*	26.11	5.21
BMI (kg/m^2)**	25.39	6.00
HLS-EU-Q16*	49.77	7.98

*Mean and SD for symmetric metric variables.
**Median and IQR for non-normally distributed metric variables.

Table 2. Regression coefficient for the association between the HLS-EU-Q16 score and selected predictors (N = 758).

PREDICTORS	UNSTANDARDIZED REGRESSION COEFFICIENT (95% CI)	STANDARD ERROR	STANDARDIZATION REGRESSION COEFFICIENT	*T* VALUE	*P*-VALUE
CONSTANT	36.982 (30.76 to 43.21)	3.171		11.663	<0.001
GENDER	0.389 (−0.81 to 1.59)	0.611	0.024	0.637	0.524
SMOKING STATUS	−0.662 (−2.2 to 0.87)	0.782	−0.031	−0.847	0.397
CULTURAL BACKGROUND	1.058 (−0.59 to 2.7)	0.838	0.054	1.262	0.207
COUNTRY OF BIRTH	−1.663 (−3.07 to −0.26)	0.717	−0.104	−2.321	0.021*
REGULAR GP VISITS	2.005 (0.65 to 3.36)	0.692	0.106	2.898	0.004**
GENERAL STATE OF HEALTH	1.85 (0.52 to 3.18)	0.678	0.103	2.731	0.006**
HIGHEST LEVEL OF EDUCATION	2.206 (0.98 to 3.43)	0.624	0.135	3.536	<0.001**
AREA OF EMPLOYMENT*					
EMPLOYMENT_HEALTH	2.696 (0.75 to 4.64)	0.992	0.147	2.718	0.007**
EMPLOYMENT_OTHER	0.866 (−0.87 to 2.6)	0.885	0.053	0.978	0.328
AGE (IN YEARS)	0.032 (−0.02 to 0.08)	0.024	0.052	1.326	0.185
BMI (KG/M^2)	0.042 (−0.07 to 0.16)	0.059	0.027	0.711	0.477

*Significant at 5% level.
**Significant at 1% level.

The multiple R^2 value of 0.066 indicates that the combined independent variables account for 6.7% of the variance in the HLS-EU-Q16 score. This includes factors such as gender, smoking status, cultural background, country of birth, regular GP visits, general health status, highest level of education, area of employment, age, and BMI. The overall explanatory power of the regression model is modest ($R^2 = 6.7\%$) which is common is social science, health and human behavioural studies (Lee et al., 2026).

Before finalizing the model, it underwent a validation process involving normal probability plots and tests for homoscedasticity. The normality of residuals was assessed using Normal probability (P-P) plots of standardised residuals. Visual inspection of the P-P plots indicated that most of the residuals roughly follow a straight line, supporting the assumption of normality (See supporting document: Figure S2). Multicollinearity was assessed using variance inflation factors (VIF), and no evidence of problematic multicollinearity was observed (See supporting document: Table S1). The Durbin-Watson (DW) test was conducted to assess autocorrelation, with an acceptable range of 1.5 to 2.5. The DW value for this study was 2.04, indicating that the residuals exhibit relative independence and there is no serial correlation. Homoscedasticity was evaluated using residuals versus fitted values plots, and the random dispersion of residuals across the range of fitted values supported the assumption of constant variance (See supporting document: Figure S1).

An independent ANOVA conducted on the HLS-EU-Q16 scores by area of employment revealed a significant difference in mean scores among participants ($p < 0.001$). Post-hoc testing with Bonferroni correction showed that participants working in the healthcare sector had a significantly higher ($p < 0.001$) average score (51.77) compared to those employed in other sectors (49.37) or those who were not employed 47.99).

Discussion

This study explored the level of health literacy of adults living in Victoria state, Australia. The study results demonstrate significant implications for adult in the Victoria state's level of health literacy related to a person's country of birth, their capacity to access GPs for health care, and levels of education. Of concern, is how participants born overseas can access primary healthcare with deficits potentially influencing the level of health this population may experience.

Measuring health literacy is essential given the benefits it provides to communities and policymakers in planning, yet it is complex considering the challenges in finding or developing easy to administer comprehensive tools (Choudhry et al., 2019). Health literacy was given the relevance it deserved in Australia as evidenced by the government's initiative in targeting schools a decade ago (Macdonald & Enright, 2013; Peralta & Rowling, 2018) but this was challenged by the recent COVID-19 pandemic where the need for health literacy was equated with social vaccine in curbing the spread (Okan et al., 2023). While the gains of HL rollout in school is unknown, positive gains have been reported in the rollout of HL program in adult education setting (McCaffery et al., 2019).

The strong association between inadequate health and factors such as socio-economic status, poor health status, inactivity and overweight has previously been reported (Svendsen et al., 2020) and our study results has shown a significant association between health literacy and country of birth, highest level of education with education beyond secondary level showing an average HLS-EU-Q16 score of which all these variables are determinants of socio-economic status (Darin-Mattsson et al., 2017).

Access to health services in Australia, is challenging, especially related to levels of health literacy for people born overseas who are of Culturally and Linguistically Diverse (CALD) backgrounds (Khatri & Assefa, 2022; Zachariah et al., 2022). Being from a CALD background creates barriers related to poor health literacy influenced by a myriad of factors associated with language and communication issues in finding and understanding language-appropriate information, impacting on patients' seeking time-appropriate healthcare from GP's (Javanparast et al., 2020; Parmar et al., 2025). This highlights some potential reasons for the current findings and why adults born in countries other than Australia may not regularly seek the primary health care provided by GP clinics.

Levels of employment across a broad spectrum of people is generally known to have an impact on the degree of health literacy people have (Svendsen et al., 2021). In the opposite spectrum, employment in healthcare related fields will always benefit individuals more than their community counterparts. Our

study results indicate that those employed in the healthcare have a better HL than those who do not work in the healthcare sector.

The prevailing low HL reported here is further complicated by the shift to online and electronic health platforms (Hasannejadasl et al., 2022), which necessitates evaluating digital HL given its complexity (Kim et al., 2024) as this can be more pronounced among certain socioeconomic groups.

The significant associations between health literacy and factors such as country of birth, cultural background, GP visits, general health status, education, and employment highlight that health literacy is shaped by social, cultural, and structural determinants rather than being evenly distributed. These findings are important for policy because they help identify vulnerable groups and modifiable pathways, supporting targeted and equity-focused interventions such as culturally appropriate communication, improved access to primary care, and education and workplace-based programs, rather than one-size-fits-all approaches.

Limitations

This study had several limitations. First, the survey data was based on self-reported information, which may be subject to recall bias. Second, since the surveys are cross-sectional, causal associations cannot be established. Third, since the data was collected from Victoria state's population, the results should be interpreted with caution when extrapolating to other populations. Fourth as the surveys were administered by students within community settings, there is a potential risk that some individuals may have completed the survey more than once, either unintentionally or due to participation at multiple recruitment points or voluntary participation may have been compromised due to student participant relationship. While students were instructed to screen for prior participation and to remind respondents to complete the survey only once, and ensure participation was voluntary, it was not possible to independently verify unique participation. Consequently, the presence of duplicate responses or voluntarily participation cannot be entirely excluded and may have introduced minor bias into the findings. Fifth, given the modest explanatory power of the regression model due to low explained variance (R^2) including for CALD populations, the findings should be interpreted cautiously to avoid overstating their practical significance. The low explained variance suggests that the current set of variables does not fully capture the complexity of health literacy (HL); future studies may benefit from including additional relevant predictors such as country of birth, cultural background, and related factors (Beyene et al., 2009). Sixth, while the sample size in our study is representative and large for Victoria state's population, a larger sample that includes all states and territories would enable us to extend the analysis to a national level for Australian population. Finally, given the use of a convenience sample and a survey design, non-response bias is possible, as respondents may not fully represent the target population, which may limit the generalisability of the findings.

Conclusion

This study has reported on the health literacy levels, as identified by a diverse group of adults in Victoria state. The results indicate there are issues with peoples' levels of health literacy and how this influences personal choices around health seeking behaviours. Of significance is the study result's demonstration that people may not access a GP for primary health concerns which in the short to longer term may have implications for that person's health and the burden of health on public with the incidence of chronic illness.

Acknowledgements

We acknowledge Professor Karen-leigh Edward (posthumous) and Professor Mary Carolan-Olah's contribution in the study concept, design and the initial data collection phase. Conceptualization: AO, CY and GK. Data curation: AO, JB, CY, SP and GK. Formal analysis: AO and JB. Investigation: AO, CY, SP and GK. Methodology: AO, CY and GK. Project administration: AO and GK. Supervision: GK. Validation: AO and JB. Visualization: AO, JB and GK. Writing—original draft: AO. Writing—review and editing: AO, JB, CY, SP and GK.

Author contributions

CRediT: **Abdi Osman**: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing; **Jahar Bhowmik**: Data curation, Formal analysis, Software, Validation, Writing – review & editing; **Caglayan Yasan**: Conceptualization, Data curation, Investigation, Methodology, Writing – review & editing; **Susan Philip**: Data curation, Investigation, Methodology, Writing – review & editing; **Gina Kruger**: Conceptualization, Investigation, Methodology, Resources, Supervision, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics approval

This study obtained ethics approval from the University Human Research Ethics Committee (Reference HRE23-009) in line with the National Statement and Helsinki Declaration. Written informed consent was obtained from the participants after providing them with a detailed participant information form informing them about risks, benefits, and the plan for publishing aggregate findings.

Funding

No funding received at any stage of this study.

ORCID

Abdi Osman http://orcid.org/0000-0002-8104-8019

Data availability statement

Data will be availed where reasonable request is made to the authors.

References

Barnett, W., Halligan, S. L., Wedderburn, C., MacGinty, R., Hoffman, N., Zar, H. J., Stein, D., & Donald, K. (2021). Maternal emotional and physical intimate partner violence and early child development: Investigating mediators in a cross-sectional study in a South African birth cohort. *BMJ Open*, *11*(10), e046829. https://doi.org/10.1136/bmjopen-2020-046829

Bergman, L., Nilsson, U., Dahlberg, K., Jaensson, M., & Wångdahl, J. (2023). Validity and reliability of the arabic version of the HLS-EU-Q16 and HLS-EU-Q6 questionnaires. *BMC Public Health*, *23*(1), 304. https://doi.org/10.1186/s12889-023-15226-5

Beyene, J., Atenafu, E. G., Hamid, J. S., To, T., & Sung, L. (2009). Determining relative importance of variables in developing and validating predictive models. *BMC Medical Research Methodology*, *9*(1), 64. https://doi.org/10.1186/1471-2288-9-64

Bhowmik, J., Biswas, R. K., & Ananna, N. (2020). Women's education and coverage of skilled birth attendance: An assessment of Sustainable Development Goal 3.1 in the South and Southeast Asian Region. *PLoS One*, *15*(4), e0231489. https://doi.org/10.1371/journal.pone.0231489

Botha, F., Morris, R. W., Butterworth, P., & Glozier, N. (2023). Trajectories of psychological distress over multiple COVID-19 lockdowns in Australia. *SSM - Population Health*, *21*, 101315. https://doi.org/10.1016/j.ssmph.2022.101315

Choudhry, F. R., Ming, L. C., Munawar, K., Zaidi, S. T. R., Patel, R. P., Khan, T. M., & Elmer, S. (2019). Health literacy studies conducted in Australia: A scoping review. *International Journal of Environmental Research and Public Health*, *16*(7), 1112. https://doi.org/10.3390/ijerph16071112

Coman, M. A., Forray, A. I., Van den Broucke, S., & Chereches, R. M. (2022). Measuring health literacy in Romania: Validation of the HLS-EU-Q16 survey questionnaire. *International Journal of Public Health*, *67*, 1604272. https://doi.org/10.3389/ijph.2022.1604272

Darin-Mattsson, A., Fors, S., & Kåreholt, I. (2017). Different indicators of socioeconomic status and their relative importance as determinants of health in old age. *International Journal for Equity in Health*, *16*(1), 173. https://doi.org/10.1186/s12939-017-0670-3

Fisher, K., Davey, A. R., & Magin, P. (2022). Telehealth for Australian general practice: The present and the future. *Australian Journal of General Practice*, *51*(8), 626–629. https://doi.org/10.31128/ajgp-11-21-6229

Gamage, S., Biswas, R. K., & Bhowmik, J. (2022). Health awareness and skilled birth attendance: An assessment of sustainable development goal 3.1 in south and south-east Asia. *Midwifery*, *115*, 103480. https://doi.org/10.1016/j.midw.2022.103480

Golinelli, D., Boetto, E., Carullo, G., Nuzzolese, A. G., Landini, M. P., & Fantini, M. P. (2020). Adoption of digital technologies in health care during the COVID-19 pandemic: Systematic review of early scientific literature. *Journal of Medical Internet Research*, *22*(11), e22280. https://doi.org/10.2196/22280

Hasannejadasl, H., Roumen, C., Smit, Y., Dekker, A., & Fijten, R. (2022). Health literacy and eHealth: Challenges and strategies. *JCO Clinical Cancer Informatics*, *6*, e2200005. https://doi.org/10.1200/cci.22.00005

Isautier, J. M., Copp, T., Ayre, J., Cvejic, E., Meyerowitz-Katz, G., Batcup, C., Bonner, C., Dodd, R., Nickel, B., Pickles, K., Cornell, S., Dakin, T., & McCaffery, K. J. (2020). People's experiences and satisfaction with telehealth during the COVID-19 pandemic in Australia: Cross-sectional survey study. *Journal of Medical Internet Research*, *22*(12), e24531. https://doi.org/10.2196/24531

Javanparast, S., Naqvi, S. K. A., & Mwanri, L. (2020). Health service access and utilisation amongst culturally and linguistically diverse populations in regional South Australia: A qualitative study. *Rural and Remote Health*, *20*(4), 5694. https://doi.org/10.22605/rrh5694

Khatri, R. B., & Assefa, Y. (2022). Access to health services among culturally and linguistically diverse populations in the Australian universal health care system: Issues and challenges. *BMC Public Health*, *22*(1), 880. https://doi.org/10.1186/s12889-022-13256-z

Kim, J., Livingston, M. A., Jin, B., Watts, M., & Hwang, J. (2024). Fundamentals of digital health literacy: A scoping review of identifying core competencies to use in practice. *Adult Learning*, *35*(3), 131–142. https://doi.org/10.1177/10451595231178298

Kim, K., & Yu, J. (2023). Fear of COVID-19 and social distancing on the health behavior of coronary heart disease patients. *Applied Nursing Research: ANR*, *69*, 151664. https://doi.org/10.1016/j.apnr.2022.151664

Kleanthous, E., Evangelou, E., Georgiadou, A., Galanis, P., Andreadaki, E., Tzavara, C., Kaitelidou, D., & Kallergis, G. (2023). Stress and coping strategies in the general population of Greece and Cyprus in response to the COVID-19 pandemic: A cross-sectional study. *European Journal of Trauma & Dissociation = Revue europeenne du trauma et de la dissociation*, *7*(1), 100306. https://doi.org/10.1016/j.ejtd.2022.100306

Lee, I. G., Jeong, J., Kim, J. W., & Jeon, Y-h (2026). The effects of citizens' risk perceptions on voluntary compliance with government policies: Protective action decision model. *Public Performance & Management Review*, *49*(2), 448–476. https://doi.org/10.1080/15309576.2025.2563365

Leung, A. Y. M., Parial, L. L., Tolabing, M. C., Sim, T., Mo, P., Okan, O., & Dadaczynski, K. (2022). Sense of coherence mediates the relationship between digital health literacy and anxiety about the future in aging population during the COVID-19 pandemic: A path analysis. *Aging & Mental Health*, *26*(3), 544–553. https://doi.org/10.1080/13607863.2020.1870206

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, *83*(404), 1198–1202. https://doi.org/10.1080/01621459.1988.10478722

Macdonald, D., & Enright, E. (2013). Physical literacy and the Australian health and physical education curriculum. *ICSSPE: Bulletin of the International Council of Sport Science and Physical Education*, *65*, 351–359.

McCaffery, K. J., Dodd, R. H., Cvejic, E., Ayrek, J., Batcup, C., Isautier, J. M., Copp, T., Bonner, C., Pickles, K., Nickel, B., Dakin, T., Cornell, S., & Wolf, M. S. (2020). Health literacy and disparities in COVID-19-related knowledge, attitudes, beliefs and behaviours in Australia. *Public Health Research & Practice*, *30*(4) https://doi.org/10.17061/phrp30342012

McCaffery, K. J., Morony, S., Muscat, D. M., Hayen, A., Shepherd, H. L., Dhillon, H. M., Smith, S. K., Cvejic, E., Meshreky, W., Luxford, K., & Nutbeam, D. (2019). Evaluation of an Australian health literacy program delivered in adult education settings. *Health Literacy Research and Practice*, *3*(3 Suppl), S42–S57. https://doi.org/10.3928/24748307-20190402-01

Mekhail, K. T., Burström, B., Marttila, A., Wångdahl, J., & Lindberg, L. (2022). Psychometric qualities of the HLS-EU-Q16 instrument for parental health literacy in Swedish multicultural settings. *BMC Public Health*, *22*(1), 293. https://doi.org/10.1186/s12889-021-12346-8

Mitsutake, S., Shibata, A., Ishii, K., Miyawaki, R., & Oka, K. (2020). Associations of eHealth literacy with obtaining knowledge about colorectal cancer among internet users accessing a reputable cancer website: Internet-based survey study. *International Journal of Environmental Research and Public Health*, *17*(9), 3302. https://doi.org/10.3390/ijerph17093302

Nutbeam, D. (2000). Health literacy as a public health goal: A challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, *15*(3), 259–267. https://doi.org/10.1093/heapro/15.3.259

Nutbeam, D. (2017). World Health Organisation Discussion Paper: Promoting, measuring and implementing health literacy – Implications for policy and practice in non-communicable disease prevention and control (pp. 1–29).

Nutbeam, D., & Lloyd, J. E. (2021). Understanding and responding to health literacy as a social determinant of health. *Annual Review of Public Health*, *42*(1), 159–173. https://doi.org/10.1146/annurev-publhealth-090419-102529

Okan, O., Bollweg, T. M., Berens, E. M., Hurrelmann, K., Bauer, U., & Schaeffer, D. (2020). Coronavirus-related health literacy: A cross-sectional study in adults during the COVID-19 infodemic in Germany. *International Journal of Environmental Research and Public Health*, *17*(15), 5503. https://doi.org/10.3390/ijerph17155503

Okan, O., Messer, M., Levin-Zamir, D., Paakkari, L., & Sørensen, K. (2023). Health literacy as a social vaccine in the COVID-19 pandemic. *Health Promotion International*, *38*(4), edaab197. https://doi.org/10.1093/heapro/daab197

Osman, A. D., Kruger, G., Yasan, C., Philip, S., & Bhowmik, J. (2026). Validation of the HLS-EU-Q16 questionnaire for a regional setting. *Advances in Public Health*, *2026*(1), 5944226. https://doi.org/10.1155/adph/5944226

Paakkari, L., & Okan, O. (2020). COVID-19: Health literacy is an underestimated problem. *The Lancet. Public Health*, *5*(5), e249–e250. https://doi.org/10.1016/s2468-2667(20)30086-4

Parmar, J., El Masri, A., MacMillan, F., McCaffery, K., & Arora, A. (2025). Health literacy and medication adherence in adults from ethnic minority backgrounds with type 2 diabetes mellitus: A systematic review. *BMC Public Health*, *25*(1), 222. https://doi.org/10.1186/s12889-024-20734-z

Pelikan, J. M., & Ganahl, K. (2017). Measuring health literacy in general populations: Primary findings from the HLS-EU Consortium's health literacy assessment effort. *Studies in Health Technology and Informatics*, *240*, 34–59.

Pelikan, J. M., Link, T., Straßmayr, C., Waldherr, K., Alfers, T., Bøggild, H., Griebler, R., Lopatina, M., Mikšová, D., Nielsen, M. G., Peer, S., & Vrdelja, M. (2022). Measuring comprehensive, general health literacy in the general adult population: The development and validation of the HLS(19)-Q12 instrument in seventeen countries. *International Journal of Environmental Research and Public Health*, *19*(21), 14129. https://doi.org/10.3390/ijerph192114129

Pelikan, J. M., Röthlin, F., Ganahl, K., Boltzmann, L. (2014). *Measuring comprehensive health literacy in general populations: Validation of instrument, indices and scales of the HLS-EU study*. Proceedings of the 6th Annual Health Literacy Research Conference.

Peralta, L. R., & Rowling, L. (2018). Implementation of school health literacy in Australia: A systematic review. *Health Education Journal*, *77*(3), 363–376. https://doi.org/10.1177/0017896917746431

Rahimi, T., Barunizadeh, M., Aune, D., & Rezaei, F. (2025). Association between health literacy and body mass index among Iranian high school students. *Scientific Reports*, *15*(1), 19198. https://doi.org/10.1038/s41598-025-04386-6

Reay, R., Kisely, S. R., & Looi, J. C. (2021). Better Access: Substantial shift to telehealth for allied mental health services during COVID-19 in Australia. *Australian Health Review*, *45*(6), 675–682. https://doi.org/10.1071/AH21162

Sørensen, K., Van den Broucke, S., Fullam, J., Doyle, G., Pelikan, J., Slonska, Z., & Brand, H. (2012). Health literacy and public health: A systematic review and integration of definitions and models. *BMC Public Health*, *12*(1), 80. https://doi.org/10.1186/1471-2458-12-80

Sørensen, K., Van den Broucke, S., Pelikan, J. M., Fullam, J., Doyle, G., Slonska, Z., Kondilis, B., Stoffels, V., Osborne, R. H., & Brand, H. (2013). Measuring health literacy in populations: Illuminating the design and development process of the European Health Literacy Survey Questionnaire (HLS-EU-Q). *BMC Public Health*, *13*(1), 948. https://doi.org/10.1186/1471-2458-13-948

Svendsen, I. W., Damgaard, M. B., Bak, C. K., Bøggild, H., Torp-Pedersen, C., Svendsen, M. T., & Berg-Beckhoff, G. (2021). Employment status and health literacy in Denmark: A population-based study. *International Journal of Public Health*, *66*, 598083. https://doi.org/10.3389/ijph.2021.598083

Svendsen, M. T., Bak, C. K., Sørensen, K., Pelikan, J., Riddersholm, S. J., Skals, R. K., Mortensen, R. N., Maindal, H. T., Bøggild, H., Nielsen, G., & Torp-Pedersen, C. (2020). Associations of health literacy with socioeconomic position, health risk behavior, and health status: A large national population-based survey among Danish adults. *BMC Public Health*, *20*(1), 565. https://doi.org/10.1186/s12889-020-08498-8

Taylor, A., Caffery, L. J., Gesesew, H. A., King, A., Bassal, A-r., Ford, K., Kealey, J., Maeder, A., McGuirk, M., Parkes, D., & Ward, P. R. (2021). How Australian health care services adapted to telehealth during the COVID-19 pandemic: A survey of telehealth professionals. *Frontiers in Public Health*, *9*, 648009. https://doi.org/10.3389/fpubh.2021.648009

von Wagner, C., Steptoe, A., Wolf, M. S., & Wardle, J. (2009). Health literacy and health actions: A review and a framework from health psychology. *Health Education & Behavior*, *36*(5), 860–877. https://doi.org/10.1177/1090198108322819

White, J., Byles, J., & Walley, T. (2022). The qualitative experience of telehealth access and clinical encounters in Australian healthcare during COVID-19: Implications for policy. *Health Research Policy and Systems*, *20*(1), 9. https://doi.org/10.1186/s12961-021-00812-z

Zachariah, D., Mouwad, D., Muscat, D. M., Ayre, J., Nutbeam, D., & McCaffery, K. J. (2022). Addressing the health literacy needs and experiences of culturally and linguistically diverse populations in Australia during COVID-19: A research embedded participatory approach. *Journal of Health Communication*, *27*(7), 439–449. https://doi.org/10.1080/10810730.2022.2118910

Zhao, X., Lukito, S., Huang, X., Qiu, C., & Tang, W. (2023). Longitudinal associations between pandemic post-traumatic stress symptoms and subsequent non-suicidal self-injury in adolescents: A multiple mediation model. *Journal of Affective Disorders*, *323*, 707–715. https://doi.org/10.1016/j.jad.2022.12.040

Zhou, X., Snoswell, C. L., Harding, L. E., Bambling, M., Edirippulige, S., Bai, X., & Smith, A. C. (2020). The role of telehealth in reducing the mental health burden from COVID-19. *Telemedicine Journal and e-Health*, *26*(4), 377–379. https://doi.org/10.1089/tmj.2020.0068

Appendix 1. Questionnaire tool

Section 1: Demographic questions

Please fill in the following details to help us with our understanding of Health Literacy in the community.

1. Age: _____
2. Gender: _____
3. Height in cm: _____
4. Weight in kg: _____
5. General state of health: (Select applicable one):

   ☐Poor ☐Average ☐Good ☐Excellent
6. Are you a smoker? (Select applicable one):

   ☐Yes ☐No
7. Highest level of education obtained (Select applicable one):

   ☐None ☐Primary school ☐Secondary school ☐Undergraduate degree ☐Postgraduate degree
8. Are you employed? (Select applicable one):

   ☐Yes ☐No
9. If yes, Area of employment: _____
10. Cultural background: _____
11. Country of birth: _____
12. Do you have a regular GP? (Select applicable one):

    ☐Yes ☐No

Section 2: HLS-EU-Q16 survey questions

Questions	Very difficult	Fairly difficult	Fairly easy	Very easy
1. Find information on treatments of illnesses that concern you?				
2. Find out where to get professional help when you are ill?				
3. Understand what your doctor says to you?				
4. Understand your doctor's or pharmacist's instruction on how to take a prescribed medicine?				
5. Judge when you may need to get a second opinion from another doctor?				
6. Use information the doctor gives you to make decisions about your illness?				
7. Follow instructions from your doctor or pharmacist?				
8. Find information on how to manage mental health problems like stress or depression?				
9. Understand health warnings about behavior such as smoking, low physical activity and drinking too much?				
10. Understand why you need health screenings?				
11. Judge if the information on health risks in the media is reliable?				
12. Decide how you can protect yourself from illness based on information in the media?				
13. Find out about activities that are good for your mental well-being?				
14. Understand advice on health from family members or friends?				
15. Understand information in the media on how to get healthier?				
16. Judge which everyday behavior is related to your health?				

From Coman et al. (2022).