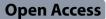# The relationship between health literacy and COVID-19 prevention behaviors among people living with HIV

Iman Navidi[1] and Raheleh Soltani[2,3*]

Abstract

Background Health literacy (HL)has been identified as one of the important determinants of healthy behaviors and the health of individuals and communities. The global attempts to control the HIV disease were emphasized, in the midst the new coronavirus disease (COVID-19) emerged as a pandemic. This study aimed to determine HL level and its relationship with COVID-19-prevention behaviors among people living with HIV(PLWH).

Methods This cross-sectional study was conducted on 112 PLWH referred to behavioral disorders consulting center in Arak, Iran from May to December 2022. The data collection tool was a questionnaire including COVID-19 prevention behaviors (5 items) and a health literacy instrument (14 items). The data were analyzed using SPSS software version 18 and for all tests, the significance level of α was considered as 0.05.

Results The average (SD)age of the participants was 42.9 (10.6) and the education level of 11.6% of the participants were university. The mean score of HL was 3.5 (0.73) out of 5 and 36.6% of them had higher HL. The mean of behaviors was 17.2 (3.4) out of 25 and 53.6 had higher behaviors. The HL had a significant relationship with behaviors ($r = 0.48$; $p < 0.001$). Multiple linear regression indicated that HL had a significant association with age ($P = 0.002$), education ($P = 0.046$), and economic status ($p < 0.001$) and explained 32% of the variance of HL.

Conclusion According to the findings, HL affected COVID-19-prevention behaviors. Effective educational interventions intended for PLWH based on health literacy can be useful to this extent.

Keywords COVID-19 preventive behaviors, Health literacy, COVID-19, HIV/AIDS

*Correspondence:
Raheleh Soltani
shadi8685@gmail.com
[1]Department of Health Education and Promotion, Tehran University of Medical Sciences, Tehran, Iran
[2]Department of Health Education and Health Promotion, School of Health, Arak University of Medical Sciences, Arak, Iran
[3]Department of Health Education and Health Promotion, Faculty of Health, Arak University of Medical Sciences, Arak, Iran

Introduction

Novel coronavirus disease (COVID-19) is a global challenge and one of the main public health emergencies and concerns [1]. In the last 28-day period report by WHO on 1 September 2023, about 770 million confirmed cases of COVID-19 and 6.9 million deaths were reported globally. The number of new COVID-19 cases was reported over 1.4 million and new deaths over 1800 during the last 28-day period (31 July to 27 August 2023) [2]. Human immunodeficiency virus (HIV) is a major worldwide public health concern [3]and it is estimated that it will be the third cause of death and the primary cause of lost

years of life in low-income and middle-income countries by 2030. The number of HIV cases in Iran is increasing [4]. According to the WHO's report, it is estimated there were 39.9 million (range, 36.1–44.6 million) people living with HIV with 1.3 million new cases, and 630,000 individuals died of HIV-related causes worldwide at the end of 2023 [3]. Between the global and local efforts to control HIV a new infectious disease called COVID-19 appeared [5]. However, people who are older or have underlying diseases and immunodeficiency are at risk of severe disease or death [6]. The concern about the increased risk of severe disease of COVID-19 in people living with HIV, especially patients has become low-income countries [7]. A study by Weiser et al. showed that in the United States, African–American people living with HIV were more likely to have severe COVID-19 infection and difficulties following COVID-19 infection [8]. Health literacy (HL) is viewed as a global challenge [9] and one of the main health concerns [10]. HL refers to a set of socio-cognitive skills that determine the ability and incentive individuals have to access, understand, and utilize information to maintain and promote good health [9]. The WHO defines "HL as the degree to which individuals possess the capacity to acquire, process, and understand basic health information and receive healthcare services. It includes reading, listening, analysis, decision-making, and the application of these skills in health-affecting conditions. All these skills are required to make appropriate health decisions [11]. Several studies have identified limited HL as one of the risk factors for poor HIV medication adherence [12, 13]. Also, studies reported low HL was associated with poor medication adherence, clinical and health outcomes in people living with HIV on the HIV care continuum [12, 14, 15]. A scoping review on this issue shows that HL is linked to social stigma among people living with HIV [16]. In a study conducted in Indonesia, 38.5% of participants exhibited low health literacy, which is associated with reduced medication adherence and poorer clinical outcomes (viral loads) and increased hospitalizations [14]. Walker et al. (2018) in a study titled "Health literacy and CD4 cell count among people with HIV in the United States" showed that insufficient HL has a significant relationship with CD4 cell count, thus individuals with inadequate HL have lower CD4 cell counts [17]. A study by Stonbraker et al. (2018) revealed that 69.2% of individuals living with HIV (PLWH) in the Dominican Republic had low HL [18].Studies reported the positive effect of HL on the prevention of COVID-19 transmission [19, 20]. A study in Iran by Nawrozi et al. demonstrated that HL plays a vital role in enhancing COVID-19 preventative behaviors in adults 30 to 50 years old (r = 0.52) [21]. HL plays not only an important role in healthy behaviors, health outcomes, and treatment adherence among PLWH [13, 17, 22] but also affects the preventive behaviors of COVID-19 [20, 22, 23]. However, there are relatively few studies on PLWH's health literacy and COVID-19 preventative behaviors. Therefore, this study aimed to determine HL level and its relationship with COVID-19-prevention behaviors among people living with HIV(PLWH).

Methods

Study design and participants

This cross-sectional study was conducted on 112 individuals living with HIV infection referred to behavioral disorders consulting centers (Free HIV testing and treatment are governmental clinics) in Arak, Iran from May 15 to December 30, 2022. Arak, the center of Markazi province is located in central Iran. Behavioral disorders consulting centers provide surveillance, care, prevention, and treatment services in the field of AIDS control [24, 25]. "The behavioral disorders consulting centers are the governmental centers offering free consultation, testing, ART, and other services to HIV-positive individuals, and the high-risk groups in Iran" [26]. Convenience sampling was used to select eligible participants due to limited access to the study population. The eligibility criteria of the participants were willingness to participate in the study and not suffering from mental and cognitive disorders. The eligible participants were completed through self-administered questionnaires. To avoid any data collection bias, a trained public health worker had the responsibility for data collection. In this study, a total number of 112 questionnaires were analyzed, and the participation rate was 83% (112 out of 135).

Measuring tools

Data were collected through a questionnaire (demographic characteristics, COVID-19 preventive behaviors, and health literacy). Section one: demographic characteristics including gender, age, duration of HIV infection, education (primary, secondary/high school, diploma, and academic), occupation status, marital status, self-rated economic status (poor, average, good), and number of residents at home.

Section two: COVID-19 prevention behaviors of the participants were measured with five items (physical distancing, stay at home, mask use, and hand washing) [27, 28]. The questions were on a 5-point Likert (1 = never to 5 = always) and scoring was from 1 to 5. The possible score range was 5–25 and the higher score indicated the higher COVID-19 prevention behaviors.

Section three: we used the 14-item health literacy instrument (HLS-14) developed by Ishikawa and colleagues [29]. The HLS consists of 14 items and three parts including functional (5 items), communicative (5 items), and critical (4 items). All the items scored a five-point Likert scale (never = 1 to always = 5). The total

Table 1 Demographic characteristics of the participant and association between health literacy and all the variables ($n = 112$)

Variables	Category	N (%)	Health literacy Mean (SD)	P-value
Education	Primary	45(40.2)	3.2(0.67)	< 0.001*
	Middle and High	34(30.4)	3.5(0.69)	
	Diploma	20(17.9)	3.7(0.74)	
	University	13(11.6)	4.2(0.41)	
Marital status	Single/ divorced	41(36.6)	3.6(0.83)	0.28**
	Married	71(63.4)	3.5(0.67)	
Gender	Female	39(34.8)	3.7(0.77)	0.17**
	Male	73(65.2)	3.5(0.70)	
Economic status	Weak	45(40.2)	3.1(0.58)	< 0.001*
	Average	36(32.1)	3.6(0.7)	
	Good	31(27.7)	4.0(0.62)	
COVID-19 preventive behaviors	Inadequate (Higher than Mean)	60(53.6)	3.2(0.62)	< 0.001**
	Adequate (Lower than Mean)	52(46.4)	3.9 (0.67)	
Variables	Mean (SD)	Lower-Upper	Range of score	
Total COVID-19 preventive behaviors	17.2(3.4)	9–24	5–25	
Total health literacy	3.5(0.73)	1.9–4.8	1–5	
Duration of antiretroviral therapy	5.3(3.8)	28days-18 in y		
Age	42.9(10.6)	14–69		

**The test applied: t-test, *one-way ANOVA. SD: Standard deviation

scores ranged from 1 (lowest) to 5 (highest). The HLS-14 scores were divided into two categories: higher HL group, ≥ 4, and lower HL group, < 4) [30]. The Persian version of HLS-14 cultural adaptation by Reisi et al. [31] reported an alpha reliability coefficient of 0.82 for the total scale

[32]. In this study, the reliability (Cronbach's alpha) for the scale was 79%.

Statistical analysis

Data were analyzed through SPSS software version 18. Descriptive statistics (frequency and mean) were performed to examine the distribution of the demographic characteristics and health literacy scores. The one-way ANOVA test and independent samples t-test were used to associate health literacy scores in groups of categorical variables. Pearson's correlation coefficient was used to explore the relationship between Health literacy and COVID-19 preventive behaviors. The multiple linear regression was performed to assess the predictors of health literacy while controlling for confounding variables. The significance level of α was considered as 0.05 for all data.

Results

The description of the demographics is listed in Table 1. The average (SD)age of the participants was 42.9 (10.6) and the education level of 11.6% of the participants were university. The mean of the COVID-19 preventive behaviors was 17.2 (3.4) out of 25. The mean score of HL was 3.5(0.73) out of 5. Nearly 36.6% of them had higher HL (score ≤ 4) and 63.6 lower HL (score ˃ 4). The HL had a significant relationship with economic status ($P < 0.001$), and education ($P < 0.001$). Results of Turkey's post hoc Table 2 tests show that individuals with university education and better economic status had a significantly higher health literacy score compared to other participants. According to Pearson's correlation coefficient, HL had significant positive correlations with the total score of COVID-19 preventive behaviors ($P < 0.001$, $r = 0.48$) (Table 3). According to the multiple linear regression analysis, HL had a significant association with

Table 2 Results of Tukey post hoc tests to compare means of variables in various categories

Variables	Category I	Category J	Mean Difference (I-J)	S E	p	95% Confidence Interval	
						Lower Bound	Upper Bound
Economic Status	Weak	Average	0.5	0.14	0.001	0.8	0.2
		Good	0.9	0.145	0.001	1.2	0.5
Education	University	Primary	1	0.2	0.001	0.4	1.5
		Middle and High	0.7	0.2	0.006	0.1	1.2

S E: SE: Standard error

Table 3 Pearson's correlation coefficients between Health literacy with total COVID-19 preventive behaviors and each of the items COVID-19 preventive behaviors

Variables		Total COVID-19 preventive behaviors	Wearing face masks	Avoiding crowded places	Staying at home	Washing hands	Keeping a distance
Health literacy	r	0.482**	0.399**	0.266**	0.280**	0.548**	0.402**
	P	0.001	0.001	0.005	0.003	0.001	0.001

** Correlation is significant at the 0.01 level (2-tailed)

Table 4 Multiple linear regression for health literacy and associated factors

Variable	Unstandardized coefficients		P-value	95% Confidence Interval for B		VIF	Adjusted R^2
	B	SE		Lower Bound	Upper Bound		
Age	−0.019	0.006	0.002	0.313	0.072	1.320	0.329
Education	0.131	0.065	0.046	1.324	3.819	1.361	
Economic	0.275	0.060	0.001	0.300	2.897	1.465	

Note: $R = 0.589$, $R^2 = 0.32$, $F = 19.1$, $P < 0.001$, df = (3,108), SE: Standard error

age, education, and economic status ($P < 0.001$, $f = 19.1$, R2 = 0.32) (Table 4)*.*

Discussion

To our knowledge, this is the first study to investigate HL among people living with HIV toward COVID-19 preventive behaviors. According to our results, the HL had significant positive correlations with COVID-19 preventive behaviors ($r = 0.48$). This finding confirms the results of other similar studies that report the relationship between COVID-19 preventive behaviors and HL [20, 21, 33]. In a study by Nakayama et al. [19] .HL was associated with COVID-19 preventive behaviors ($r = 0.23$). In a study by Orkan et al., the confusion about COVID-19 information was significantly associated with coronavirus-related HL levels in adults in Germany [23]. Other studies also reported the importance of HL in infectious diseases, as well as HIV. Walker et al. (2018) in a study titled "Health literacy and CD4 cell count among people with HIV in the United States" showed that insufficient HL level has a significant relationship with CD4 cell count, so individuals with inadequate HL have lower CD4 cell counts [17].

The study by Castro-Sanches et al. on the topic of "the importance of health literacy in infectious diseases" showed that limited or insufficient HL reduces the acceptance of protective behaviors such as immunization, adherence to treatment medicines, and the use of antibiotics are associated with individuals suffering from infectious diseases, and it emphasizes the role of HL in infectious diseases [34].

Our findings showed that 46.4% of participants had adequate COVID-19 preventive behaviors. The most preventive behaviors were hand washing, wearing a mask, and avoiding crowded places. This finding confirms several previous studies in this field. In line, a population-based study in Iran by Honarvar et al. [35] showed that "Always" wearing a mask was 29.8% and hand washing was 50.8% among adults. Similarly, another study among people living with HIV/AIDS in Kigali, Rwanda, that reported 90% of participants had high preventive behavior scores toward COVID-19 [5]. Also, a cross-sectional study by Khumsaen et al., in Thailand reported high practice toward COVID-19 and 86% of PLWH had favorable COVID-19 preventive behaviors [36].

Matsumoto et al. in a multicenter observational survey in Vietnam involving 7,808 PLWH revealed that 99.2% practiced preventive measures against COVID-19, such as wearing masks and handwashing [37]. As well as Christodoulou et al. examined COVID-19 prevention behaviors among 83 young people at risk of HIV infection in a study. Findings showed that a significant majority of participants engaged in preventive behaviors, with 90% reporting consistent mask use, 84% hand washing, and 70% practicing social distancing [38].

Based on the findings of this study, the rate of COVID-19 preventive behaviors wasn't desirable hence using appropriate programmers to promote healthy behavior regarding COVID-19 for specific at-risk groups, such as PLWH seems necessary.

This study showed that HL was associated with economic status, education level, and age. This finding indicated the positive effect of socio-demographic factors on HL, it can be participants with higher education levels and economic status had obtained higher HL scores. This finding confirms the previous studies conducted by Wang et al. [39], Moussa et al. [40], and Rebeiro et al. [15], who reported that HL was associated with socio-demographic factors. This finding confirms the findings of other studies in the field of COVID-19 and HL [15, 41].

There were some limitations in this study. The questionnaire was self-reported which could be subject to recall and response bias. Also, this was a cross-sectional study, hence might not lead to causal inferences about HL and COVID-19 preventive behaviors. The convenience sampling method limits the generalizability of the findings, as the sample may not be representative of all people living with HIV (PLWH). The relatively small sample size and the specific regional focus (Arak, Iran) further restrict the ability to generalize the results to broader populations.

Conclusion

According to the findings of this study, HL had a positive effect on COVID-19 preventive behaviors in people living with HIV. Hence, based on this prediction, health promotion interventions seem necessary to improve HL and COVID-19 preventive behaviors. Also, health professionals need to assess the HL of clients referring to health centers and provide appropriate educational programs through HL strategies (simply understood materials) to promote health behaviors. Also, improving HL in PLWH is a priority.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethical approval
The study protocol was approved by the ethics committee of Arak University of Medical Sciences, Iran, approved the study protocol (ID number-IR.ARAKMU.REC.1400.172).

Competing interests
The authors declare no competing interests.

References
1. Shigemura J, Ursano RJ, Morganstein JC, Kurosawa M, Benedek DM. Public responses to the novel 2019 coronavirus (2019-nCoV) in Japan: Mental health consequences and target populations. J Neuropsychiatry Clin Neurosci. 2020;74(4):281.
2. Organization WH. COVID-19 weekly epidemiological update, edition82,8 March 2022. 2021.
3. World Health Organization. The Global Health Observatory. Explore a world of health data. Summary of the global HIV epidemic, 2023. Available from: https://www.who.int/data/gho/data/themes/hiv-aids. Accessed 24 January 2025.
4. Joulaei H, Lankarani KB, Kazerooni PA, Marzban M. Number of HIV-infected cases in Iran: true or just an iceberg. Indian J Sexually Transmitted Dis AIDS. 2017;38(2):157–62.
5. Iradukunda PG, Pierre G, Muhozi V, Denhere K, Dzinamarira T. Knowledge, attitude, and practice towards COVID-19 among people living with HIV/AIDS in Kigali, Rwanda. J Commun Health. 2021;46:1–6.
6. Chenneville T, Gabbidon K, Hanson P, Holyfield C. The impact of COVID-19 on HIV treatment and research: a call to action. Int J Environ Res Public Health. 2020;17(12):4548.
7. Adadi P, Kanwugu ON. Living with HIV in the time of COVID-19: a glimpse of hope. J Med Virol. 2020.
8. Weiser JK, Tie Y, Beer L, Neblett Fanfair R, Shouse RL. Racial/Ethnic and income disparities in the prevalence of comorbidities that are Associated with risk for severe COVID-19 among adults receiving HIV Care, United States, 2014–2019. J Acquir Immune Defic Syndr. 2021;86(3):297–304.
9. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. Health Promot Int. 2000;15(3):259–67.
10. von Wagner C, Knight K, Steptoe A, Wardle J. Functional health literacy and health-promoting behaviour in a national sample of British adults. J Epidemiol Community Health. 2007;61(12):1086–90.
11. Fransen MP, Van Schaik TM, Twickler TB, Essink-Bot ML. Applicability of internationally available health literacy measures in the Netherlands. J Health Commun. 2011;3:134–49.
12. Rodkjaer LØ, Storgaard M, Sørensen NT, Schougaard LMV. Levels of health literacy among people living with HIV in outpatient care: a cross-sectional study from Denmark. AIDS Res Therapy. 2023;20(1):59.
13. Reynolds R, Smoller S, Allen A, Nicholas PK. Health literacy and health outcomes in persons living with HIV disease: a systematic review. AIDS Behav. 2019;23(11):3024–43.
14. Sianturi EI, Perwitasari DA, Soltief SN, Atiqul Islam M, Geboers B, Taxis K. Health literacy of people living with HIV in a rural area in Indonesia: a cross-sectional study. Health Soc Care Community. 2021;29(1):127–34.
15. Rebeiro PF, McPherson TD, Goggins KM, Turner M, Bebawy SS, Rogers WB, et al. Health Literacy and Demographic Disparities in HIV Care Continuum outcomes. AIDS Behav. 2018;22(8):2604–14.
16. Wilandika A, Yusuf A, Kurniawati ND, Yusof S, Widianti AT. Factors that Enhance Health Literacy in dealing with HIV Stigma: a scoping review. J Health Lit. 2024;8(4):62–76.
17. Walker RL, Hong JH, Talavera DC, Verduzco M, Woods SP. Health literacy and current CD4 cell count in a multiethnic US sample of adults living with HIV infection. Int J STD AIDS. 2018;29(5):498–504.
18. Stonbraker S, Smaldone A, Luft H, Cushman LF, Lerebours Nadal L, Halpern M, Larson E. Associations between health literacy, HIV-related knowledge, and information behavior among persons living with HIV in the Dominican Republic. Public Health Nurs. 2018;35(3):166–75.
19. Nakayama K, Yonekura Y, Danya H, Hagiwara K. COVID-19 preventive behaviors and health literacy, information evaluation, and decision-making skills in Japanese adults: cross-sectional survey study. JMIR Form Res. 2022;6(1):e34966.
20. Rosano A, Lorini C, Unim B, Griebler R, Cadeddu C, Regazzi L, et al. Coronavirus-related health literacy: a cross-sectional study during the COVID-19 pandemic in Italy. Int J Environ Res Public Health. 2022;19(7):3807.
21. Nawrozi W, Talebi B, Asadi Sharif F, Mansoori K, Abasiraki F. Prediction of preventive behaviors against Covid-19 among patients aged 30 to 50 admitted to Ardabil Health Centers Based on Health Literacy. J Health Res Community. 2023;8(4):1–12.
22. Naveed MA, Shaukat R. Health literacy predicts Covid-19 awareness and protective behaviours of university students. Health Inform Libr J. 2022;39(1):46–58.
23. Okan O, Bollweg TM, Berens E-M, Hurrelmann K, Bauer U, Schaeffer D. Coronavirus-related health literacy: a cross-sectional study in adults during the COVID-19 infodemic in Germany. Int J Environ Res Publ health. 2020;17(15):5503.
24. Yaghoobi H, Ahmadiniya H, Shabani Z, Vazirinejad R, Zolfizadeh F, Rezaeian M. The Epidemiological Investigation of Patients with HIV/AIDS in Bandar Abbas behavioral disorders Counseling Center during 2005–2015. J Rafsanjan Univ Med Sci. 2018;16(10):969–82.
25. SeyedAlinaghi S, Amiri T, Alizadeh S, Kazerooni PA, Sargolzaei Moghaddam M, Farrokh Ashtiani M, et al. A protocol for diagnosis, Care and Treatment of HIV, Hepatitis C and Tuberculosis in Residential centers of Tehran, Iran. J Iran Med Council. 2020;3(1):9–22.
26. Nedjat S, Moazen B, Rezaei F, Hajizadeh S, Majdzadeh R, Setayesh HR, et al. Sexual and reproductive health needs of HIV-positive people in Tehran, Iran: a mixed-method descriptive study. Int J Health Policy Manag. 2015;4(9):591–8.
27. Soltani R, Shamsi M, Moradi A. Determine the factors that affected COVID-19 prevention behaviors based on constructs of social cognition theory. BMC Public Health. 2023;23(1):2312.
28. Rader B, White LF, Burns MR, Chen J, Brilliant J, Cohen J et al. Mask Wearing and Control of SARS-CoV-2 Transmission in the United States. medRxiv: the preprint server for health sciences. 2020.
29. Ishikawa H, Takeuchi T, Yano E. Measuring functional, communicative, and critical health literacy among diabetic patients. Diabetes Care. 2008;31:6.
30. Ishikawa H, Nomura K, Sato M, Yano E. Developing a measure of communicative and critical health literacy: a pilot study of Japanese office workers. Health Promot Int. 2008;23(3):269–74.
31. Reisi M, Mostafavi F, Javadzede H, Mahaki B, Sharifirad G, Tavassoli E. The functional, communicative, and critical health literacy (FCCHL) scales: cross-cultural adaptation and the psychometric properties of the Iranian version. Iran Red Crescent Med J. 2017;19(1).
32. Javadzade H, Mahmoodi M, Hajivandi A, Ghaedi S, Reisi M. The relationship between health literacy and health promoting behaviors among adults in Bushehr. J Health Lit. 2019;4(2):49–60.
33. Saffari M, Sanaeinasab H, Rashidi-jahan H, Rahmati F, Pakpour A. Factors related to health literacy on prevention and control of COVID-19: a cross-sectional study. J Milit Health Promot. 2021;2(1):256–66.
34. Castro-Sánchez E, Chang PWS, Vila-Candel R, Escobedo AA, Holmes AH. Health literacy and infectious diseases: why does it matter? Int J Infect Diseases: IJID : Official Publication Int Soc Infect Dis. 2016;43:103–10.

35. Honarvar B, Lankarani KB, Kharmandar A, Shaygani F, Zahedroozgar M, Rahmanian Haghighi MR, et al. Knowledge, attitudes, risk perceptions, and practices of adults toward COVID-19: a population and field-based study from Iran. Int J Public Health. 2020;65(6):731–9.

36. Khumsaen N, Peawnalaw S, Sripituk S, Chantorn A, Knowledge. Attitude, and preventive practice towards COVID-19 among Thai people Living with HIV/AIDS: an online survey. HIV Nurs. 2021;21(02):54–60.

37. Matsumoto S, Nagai M, Tran LK, Yamaoka K, Nguyen HDT, Dinh Van T, et al. Multicenter observational survey on psychosocial and behavioral impacts of COVID-19 in people living with HIV in Northern Vietnam. Sci Rep. 2023;13(1):20321.

38. Christodoulou J, Fehrenbacher AE, Shaw EH, Vincent EM, Saleska JL. COVID-19 prevention behaviors, trust, and intent to vaccinate among youth at risk for HIV. PLoS ONE. 2022;17(3):e0266321.

39. Wang H, Cheong PL, Wu J, Van IK. Health literacy regarding infectious disease predicts covid-19 preventive behaviors: a pathway analysis. Asia Pac J Public Health. 2021;33(5):523–9.

40. Moussa ML, Moussa FL, Alharbi HA, Omer T, Sofiany HA, Almuzaini TM et al. Association of Fear of COVID-19 and Health Literacy among the General Public in Saudi Arabia: a cross-sectional Assessment. Front Public Health. 2021;9.

41. Baghernezhad Hesary F, Tavassoli E, Mohammadian-Hafshejani A. Health literacy regarding Prevention and Control of COVID-19 in Iran. J Health Lit. 2022;7(3):73–81.