eHealth literacy of patients attending a primary care clinic in Malaysia and its associated factors: A cross-sectional study

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Abstract

Background: People are overloaded with online health information (OHI) of variable quality. eHealth literacy is important for people to acquire and appraise reliable information to make health-related decisions. While eHealth literacy is widely studied in developed countries, few studies have been conducted among patients in low- and middle-income countries (LMICs).

Objective: We aimed to determine the level of eHealth literacy in patients attending a primary care clinic in Malaysia and its associated factors.

Methods: A cross-sectional study using a self-administered questionnaire was conducted in an urban primary care clinic. We used a systematic random sampling method to select patients aged 18 years and above who attended the clinic. The eHealth literacy scale (eHEALS) was used to measure eHealth literacy.

Results: A total of 381 participants were included. The mean eHEALS was 24.4 ± 7.6. The eHEALS statements related to skills in appraising OHI were scored lower than statements related to looking for online resources. Higher education level of attending upper secondary school (AOR 2.53, 95% CI 1.05–6.11), tertiary education (AOR 4.05, 95% CI 1.60–10.25), higher monthly household income of >US$470 (AOR 1.95, 95% CI 1.07–3.56), and those who had sought OHI in the past month (AOR 1.95, 95% CI 1.13–3.36) were associated with a higher eHealth literacy level.

Conclusions: This study found a low eHealth literacy level among primary care patients in Malaysia. While the patients were confident in searching for OHI, they lacked skills in appraising them. Our findings inform the interventions for improving eHealth literacy in LMICs, especially educating the public about OHI appraisal.

Keywords

eHealth literacy, eHealth, low-and middle-income country, primary care, consumer health informatics, health information

Submission date: 19 July 2022; Acceptance date: 11 October 2022

Introduction

The pattern of health information-seeking has evolved in recent years due to the advancement of digital technology.1 Traditionally, the public and patients searched and received health information from their healthcare providers, mainstream media, and paper-based patient education materials. With the increased availability and accessibility to the internet, facilitated by the rising use of mobile phones, the internet has become the main source of health information.2 This

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change is also observed in low-middle income countries (LMICs); recent studies found that there is a rising prevalence of online health information-seeking and exposure in LMICs, including Malaysia.\(^5\)

eHealth literacy is the ability to access, understand, and appraise health information from electronic sources and apply the knowledge gained to address a health problem.\(^6\)

eHealth literacy involves information, scientific, media, and computer literacies in evaluating the user’s analytic and context-specific skills.\(^7\) It has become an important skill for people to obtain reliable information to make health-related decisions. eHealth literacy has also been shown to enhance the provision of patient-centred care services and improve shared decision-making,\(^8\) promote desirable health behaviour,\(^9\) and improve self-care and health outcomes.\(^10\)

While the internet provides an unprecedented opportunity to access health information, the quality of health information on the internet is highly variable and unregulated; this increases the risk of people being misled by misinformation and making erroneous health decisions. Online misinformation has a significant impact on public health; for instance, internet has resulted in a rapid spread of misinformation about COVID-19 vaccines, causing widespread vaccine hesitancy and low vaccine uptake across the world.\(^11\)-\(^14\) Those with low eHealth literacy are more likely to be influenced by internet misinformation, and resulting in making poor health decisions.\(^15\)-\(^16\) Hence, enhancing digital health literacy levels in the population is critical to ensure proper understanding, appraisal and utilisation of online health information, particularly in the current infodemic.

So far, most studies on eHealth literacy were conducted mostly in developed and high-income countries.\(^17\)-\(^19\); there is a dearth of information on eHealth literacy in LMICs.\(^20,21\) A scoping review on health literacy research in Malaysia revealed only three studies examining media and eHealth literacy.\(^20\) However, these studies focused on media, such as television, rather than internet as the source of information. Yilmra et al.\(^22\) examined the eHealth literacy in students but only focused on the searching domain. Therefore, there is a lack of studies in Malaysia to measure eHealth literacy comprehensively in terms of searching, appraising and applying online health information. Also, more research about eHealth literacy is needed to be conducted among patients because the online health information that they encounter would potentially influence their health behaviour.\(^23\) Understanding the current level of eHealth literacy and its associated factors in LMICs is important so that tailored interventions can be designed and implemented in a resource-limited context. Therefore, we aim to determine the eHealth literacy level and its associated factors in patients attending a primary health clinic in Malaysia.

**Method**

**Setting**

We conducted a cross-sectional study in an urban outpatient primary care clinic at University of Malaya Medical Centre (UMMC), Kuala Lumpur, Malaysia from June to July 2019. The clinic served an average of 300 patients per day. Ethical approval was granted by the Medical Research Ethics Committee (MREC), University of Malaya Medical Centre (MREC ID No.: 2019227-7175).

**Participants**

Patients aged 18 years and above who attended the primary care clinic were recruited. We excluded patients who were unable to read Malay, English, or Chinese, and those with cognitive impairment that precluded informed consent and participation in the study.

The sample size was calculated using OpenEpi Version 3. Using high eHealth literacy skill as the primary outcome and the odds ratio of 3.48 from Shiferaw et al.,\(^21\) with an α of 0.05 and β of 80%, the estimated sample size was 157. As this study was part of a larger study, which looks at the online health information-seeking behaviour among patients in a primary care clinic, we have used the calculated sample size of 379 from the main study.\(^4\)

**Study instrument**

The study instrument was a self-administered questionnaire, which was developed by the research team based on literature review on eHealth literacy. An expert panel of two family medicine physicians, one public health specialist, and one computer science expert with health informatics knowledge evaluated the questionnaire for content validity.

The first section of the questionnaire captures participants’ demography (age, sex, ethnicity, marital status, educational level, and monthly household income), clinical characteristics (medical illness, long-term medication use, smoking status) and self-rated health status. For educational level, lower secondary school is Form 1–3 (equivalent to Year 7–9 UK education system) while upper secondary school means Form 4-5 (equivalent to Year 10-11 UK education system). We categorised the income groups according to national household income classification in Malaysia i.e., B40 (<US$470), M40 (US$470-950) and T20 (>US$950).\(^24\)

The second section captures the participant’s eHealth literacy level. We used the original English version eHealth Literacy Scale (eHEALS) instrument,\(^7\) which consists of 8 items scored on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). It assesses perceived abilities in finding, evaluating, and applying online health information to health problems. The eHEALS instrument evaluates the functional literacy (basic reading and
writing skills to be able to understand health information) and critical literacy (cognitive skills to critically analyse and use the information). The total score for all items ranges from 8 to 40, with higher values indicating a better level of eHealth literacy.

eHEALS has been validated in various languages in Asian countries. In our study, eHEALS was translated into Malay and Chinese languages following the Principle of Practice for Translation and Cultural Adaptation Process guideline. For each of the language translation (Malay and Chinese), two forward translations were performed independently by two native speakers. Reconciliation of forward translations into the final translation was done by an independent native speaker who was not involved in the forward translations. Subsequently, a backward translation was performed by another native speaker who was unaware of the original English version of eHEALS. We conducted face-validation with 15 patients from the same clinic. For the validation of questionnaire internal consistency, the Cronbach alpha of the English, Malay and Chinese versions of eHEALS were 0.961, 0.970, and 0.983, respectively. This indicates a high level of internal consistency and is consistent with the original study’s Cronbach alpha of 0.88.

Data collection

This study employed a systematic random sampling approach. It was estimated that about 300 patients aged 18 years and above attended the clinic every day. The first patient was selected randomly from queue number 1 to 5 every day; this was followed by enrolment of every fifth successive patient who met the criteria. A research assistant explained the study to the patient using a patient information sheet. Patients were given time to read and ask questions before giving a written consent. Once consented, patients were asked to complete the questionnaire.

Data analyses

The Statistical Package for Social Sciences (SPSS) version 23 was used for all statistical analyses. Descriptive statistics were used to describe the demographic data of participants and their eHealth literacy level. Continuous variables were reported using mean and standard deviation (SD) as the data was normally distributed. The categorical data were presented using percentages and frequencies. We divided the total score into two groups based on the mean of the total score (mean = 24.4): those with a high eHealth literacy score (mean ≥24.4) and those with a low eHealth literacy score (mean <24.4), for analysis purposes.

Patients’ demographic, socioeconomic, and technology use characteristics were compared between the low and high eHealth literacy groups using univariate analyses (unadjusted odds ratio). Variables with p-values <0.25 from the univariate analyses were included in the multiple logistic regression model to determine the independent predictors of high eHealth literacy and the results were reported as adjusted odds ratio (95% confidence intervals). A p-value of <0.05 was used as the level of significance.

Result

Out of 450 patients were eligible for the study, 69 declined to participate. Therefore, the response rate was 84.7% (381/450). Table 1 shows the sociodemographic and clinical characteristics of the study population. The mean age of participants was 57.1 ± 16.9 years and 62.7% (n = 239) of them were females. The participants were mainly Chinese (n = 163, 42.8%), followed by Malay (n = 134, 35.2%) and Indian (n = 68, 17.8%). A majority of the participants had at least secondary education (n = 337, 88.5%). Most of the participants had underlying medical illnesses (n = 307, 80.6%) and were taking long-term medications (n = 262, 68.8%). 72.4% (n = 276) of the participants used the internet for an average of 2.38 hours a day.

eHEALS

The mean eHealth literacy score was 24.4 ± 7.6 (range of score: 8–40). Figure 1 shows the eHEALS scores for each statement. The participants achieved a higher score for items on searching for online health information (item 1–3; mean score range 3.14–3.16) but scored lower on the evaluation of the quality of online health information (item 6 & 7; mean score range: 2.91–2.95) and their application for health decision making (item 4, 5 & 8; mean score range: 2.91–3.14).

Predictors of eHealth literacy

The multivariate logistic regression analysis (Table 2) showed that participants who had upper secondary (AOR 2.53, 95% CI 1.05–6.11) or tertiary education (AOR 4.05, 95% CI 1.60–10.25), a higher monthly household income >US$470 (AOR 1.95, 95% CI 1.07–3.56) and sought health information in the past month (AOR 1.95, 95% CI 1.13–3.36) were significantly associated with a higher eHealth literacy level. The logistic regression model was statistically significant, X²(19) = 97.749, p < 0.001. The Nagelkerke R² was 0.314 and correctly classified 74.7% of the cases. The Hosmer-Lemeshow test with p = 0.968 (>0.05) indicates that the assumption was met, and the model fit. There was no multicollinearity or interaction among the variables.

Discussion

This study found a low eHealth literacy level among patients in a Malaysian primary care setting. While these patients were able to search for online health information...
| Variable                      | n    | %    | Mean ± SD |
|-------------------------------|------|------|-----------|
| Age (years)                   | 57.1 | 16.9 | 57.1 ± 16.9 |
| Sex                           |      |      |           |
| Male                          | 142  | 37.3 |           |
| Female                        | 239  | 62.7 |           |
| Ethnicity                     |      |      |           |
| Malay                         | 134  | 35.2 |           |
| Chinese                       | 163  | 42.8 |           |
| Indian                        | 68   | 17.8 |           |
| Others                        | 16   | 4.2  |           |
| Marital status                |      |      |           |
| Single                        | 60   | 15.7 |           |
| Married                       | 267  | 70.1 |           |
| Divorced                      | 10   | 2.6  |           |
| Widowed                       | 44   | 11.5 |           |
| Educational level             |      |      |           |
| No formal education           | 10   | 2.6  |           |
| Primary school                | 34   | 8.9  |           |
| Lower secondary school        | 47   | 12.3 |           |
| Upper secondary school        | 125  | 32.8 |           |
| Tertiary education            | 165  | 43.3 |           |
| Monthly household income      |      |      |           |
| Less than US$470              | 141  | 37.0 |           |
| US$470 – US$950               | 105  | 27.6 |           |
| More than US$950              | 127  | 33.3 |           |
| Missing data                  | 8    | 2.1  |           |
| Medical illness               |      |      |           |
| Total with medical illness    | 307  | 80.6 |           |
| Diabetes                      | 118  | 31.0 |           |
| High blood                    | 190  | 49.9 |           |
| High cholesterol              | 139  | 36.5 |           |
| Stroke                        | 17   | 4.5  |           |
| Heart disease                 | 35   | 9.2  |           |
| Cancer                        | 9    | 2.4  |           |
| Asthma                        | 20   | 5.2  |           |

(continued)
Table 1. Continued.

| Variable                                      | n   | %    | Mean ± SD |
|-----------------------------------------------|-----|------|-----------|
| Depression                                    | 10  | 2.6  |           |
| Osteoarthritis                                | 52  | 13.6 |           |
| No known medical illness                      | 74  | 19.4 |           |
| Long-term medication use                      | 262 | 68.8 |           |
| Self-rated of health status                   |     |      |           |
| Very poor                                     | 2   | 0.5  |           |
| Poor                                          | 54  | 14.2 |           |
| Neutral                                       | 153 | 40.2 |           |
| Good                                          | 161 | 42.3 |           |
| Excellent                                      | 11  | 2.9  |           |
| Visited a doctor in the past year             | 343 | 90.0 |           |
| Self-rated experience of visiting a doctor    |     |      |           |
| Very poor                                     | 3   | 0.8  |           |
| Poor                                          | 3   | 0.8  |           |
| Neutral                                       | 92  | 24.1 |           |
| Good                                          | 243 | 63.8 |           |
| Excellent                                     | 38  | 10.0 |           |
| Missing data                                  | 2   | 0.5  |           |
| Usage of internet (Yes)                       | 276 | 72.4 |           |
| Duration of internet use in a day (hours)     |     |      | 2.38 ± 3.11 |
| The need for health information               |     |      |           |
| Never                                         | 23  | 6.0  |           |
| Seldom                                        | 60  | 15.7 |           |
| Sometimes                                     | 185 | 48.6 |           |
| Often                                         | 84  | 22.0 |           |
| Always                                        | 29  | 7.6  |           |
| Sought health information on the internet in the past one month? (Yes) | 207 | 54.3 |           |
| Devices used to search for online health information |     |      |           |
| Mobile phone                                  | 219 | 57.5 |           |
| Laptop                                        | 75  | 19.7 |           |
| Desktop                                       | 70  | 18.4 |           |
| Tablet                                        | 27  | 7.1  |           |
from various online sources, they were not confident in evaluating the quality of health resources and using the information to assist them in decision-making. Those who had a higher eHealth literacy level tend to have a higher educational level, higher household income, and had sought online health information recently.

The eHealth literacy level reported in our study (eHEALS score: 24.4) is lower than those reported in developed countries such as the United States (eHEALS score: 30.34),30 and Australia (eHEALS score: 27.1).31 A lower eHealth literacy level in this study is consistent with other eHealth literacy studies conducted in LMICs, such as Ethiopia (eHEALS score: 24.6)21 and China (eHEALS score: 17.24).32 The eHealth literacy level in our study population was lower than those of another Malaysian study conducted by Lee et al.33 (eHEALS score: 27.38) in an inpatient setting. The difference may be attributed to an older population in our study (mean: 57 years) as compared to those by Lee et al.33 (mean: 47 years). Although the health literacy in Malaysian general population was reported at an acceptable status,34 there was a high prevalence of limited health literacy among patients with diabetes and asthma,35,36 consistent with our finding of a lower eHealth literacy level. Suboptimal economic strategies such as unavailability of long-term funding and affordability of technology in sustaining eHealth implementation is a factor influencing the eHealth literacy in LMICs.37,38 With limited resources for developing and maintaining medical informatics technology, there is a reduction in consumers’ involvement in eHealth and online health information seeking.39 Lacking of online health information written in the local languages, for example, Malay language in Malaysia, affects people’s access and understanding of health information in LMICs.40

In our study, participants were able to search for but were not confident in appraising online health information. These findings were similar to other eHealth literacy surveys, particularly among patients living with chronic obstructive pulmonary disease and patients with cardiovascular risks.33,41 Often, health information from social media, group chats, or websites was unregulated, and this increases the exposure of patients and the public to misinformation.16 Widespread misinformation and fake news have been shown to threaten public health, especially those involving infectious diseases.42,43 Therefore, there is a need for effective eHealth literacy interventions to improve the knowledge and skills of patients, especially older adults, in evaluating health information,44 which is necessary to empower patients in making health decisions.45 For instance, automated credibility appraisal tools may be useful to give signals to people about possible misinformation,46 and assist people in evaluating the quality of online health information.

Our study suggests that the key predictors of high eHealth literacy were higher educational level, higher monthly household income, and seeking health information in the past month. Higher educational levels have been associated with higher functional health literacy scores.10,21,47 Patients with a higher education background understand health information better, which sharpens their appraisal skills as compared to those with a lower education background. However, several studies in Malaysia and other populations did not find an association between educational level and health literacy.35,48,49 The predictor of high household income was consistent with other studies.21,33 A study has shown that having previously searched for health information online was consistently associated with higher eHealth literacy.19 This may be explained by the experience that they had acquired while browsing for information which polished their skills in evaluating and using the information to make health decisions. Therefore, eHealth literacy intervention should be focused on people with a lower educational level and poor economic background.

Figure 1. Extent of agreement and mean scores of eHEALS items.
Table 2. Univariate and multivariate logistic regression analysis of the predictors of high eHealth literacy.

| Variable                          | Unadjusted OR (95% CI) | P-value | Adjusted OR (95% CI) | P-value |
|-----------------------------------|------------------------|---------|----------------------|---------|
| **Age (years)**                   |                        |         |                      |         |
| <40                               | 1                      |         | 1                    |         |
| 40–59                             | 1.33 (0.69–2.55)        | 0.40    | 1.96 (0.85–4.56)     | 0.12    |
| 60–79                             | 0.47 (0.26–0.85)        | 0.01    | 1.06 (0.45–2.46)     | 0.90    |
| ≥80                               | 0.17 (0.07–0.41)        | <0.001  | 0.53 (0.16–1.70)     | 0.28    |
| **Sex**                           |                        |         |                      |         |
| Male                              | 1                      |         |                      |         |
| Female                            | 0.82 (0.54–1.25)        | 0.36    | -                    | -       |
| **Ethnicity**                     |                        |         |                      |         |
| Malay                             | 1                      |         |                      |         |
| Chinese                           | 0.47 (0.29–0.77)        | 0.002   | 0.67 (0.37–1.21)     | 0.19    |
| Indian                            | 0.41 (0.22–0.75)        | 0.004   | 0.71 (0.35–1.45)     | 0.35    |
| Others                            | 1.23 (0.37–4.08)        | 0.74    | 1.53 (0.37–6.39)     | 0.56    |
| **Educational level**             |                        |         |                      |         |
| No formal education/ primary school| 1                      |         | 1                    |         |
| Lower secondary school            | 2.12 (0.84–5.34)        | 0.11    | 1.50 (0.55–4.12)     | 0.43    |
| Upper secondary school            | 3.89 (1.76–8.59)        | 0.001   | 2.53 (1.05–6.11)     | 0.04<sup>b</sup> |
| Tertiary education                | 10.23 (4.63–22.59)      | <0.001  | 4.05 (1.60–10.25)    | 0.003<sup>b</sup> |
| **Monthly household income**      |                        |         |                      |         |
| Less than US$470                  | 1                      |         |                      |         |
| US$470 – US$950                   | 2.68 (1.58–4.53)        | <0.001  | 1.95 (1.07–3.56)     | 0.03<sup>b</sup> |
| More than US$950                  | 4.75 (2.79–8.08)        | <0.001  | 1.95 (1.02–3.71)     | 0.04<sup>b</sup> |
| **Presence of medical illness**   |                        |         |                      |         |
| Yes                               | 1                      |         |                      |         |
| No                                | 1.52 (0.88–2.56)        | 0.14    | 1.23 (0.51–2.97)     | 0.64    |
| **Long-term medication use**      |                        |         |                      |         |
| Yes                               | 1                      |         |                      |         |
| (continued)                       |                        |         |                      |         |
While Tennant et al.\textsuperscript{50} found that increasing age predicts lower eHEALS scores in healthy older adults, our result was similar to the original study conducted by Norman et al.,\textsuperscript{7} where age was not a predictor of eHealth literacy. Increasingly, older people are embracing modern technology, the internet can become a valuable source of health information for the elderly with chronic diseases. It helps to promote healthy behaviour, enhance knowledge, and improve psychological wellbeing.\textsuperscript{51} In high-income countries, a study reported that increasing age is correlated with higher eHealth literacy level.\textsuperscript{52} Efforts are needed to improve the eHealth literacy of the elderly in LMICs in using digital resources to obtain accurate and reliable health information.\textsuperscript{53}

### Strengths and limitations

This study used a systematic sampling approach to reduce selection bias. In addition, respondents’ age, ethnicity, and socioeconomic status reflect the sociodemographic background of the urban population in Malaysia. However, there are several limitations in this study. Firstly, the findings of this study could not be extrapolated to the Malaysian general population as it was undertaken in a single urban primary care setting. A larger and more diverse sampling from different areas of Malaysia will yield more representative results. Besides, the underlying medical issues and health status of the participants were self-reported data, which may not be as reliable as data collected from medical records due to recall bias.

### Implications and recommendations

This study highlights a need to improve the eHealth literacy among primary care patients, especially on how to appraise the credibility of online health information. In clinical practice, we recommend using eHEALS to assess the eHealth literacy of patients, especially for those with a lower educational level and socioeconomic background, who may require more guidance in using digital resources or eHealth interventions. Our study also calls for action from the government agencies, healthcare providers and patient groups to consider an effective approach to curbing negative impact of misinformation by improving public

### Table 2. Continued.

| Variable                                      | Unadjusted OR (95% CI) | P-value | Adjusted OR (95% CI) \textsuperscript{a} | P-value |
|-----------------------------------------------|------------------------|---------|------------------------------------------|---------|
| Visited a doctor in the past year             |                        |         |                                          |         |
| Yes                                           | 1                      |         |                                          |         |
| No                                            | 1.37 (0.68–2.78)       | 0.38    | -                                        | -       |
| The need for health information               |                        |         |                                          |         |
| Never                                         | 1                      |         |                                          |         |
| Seldom                                        | 1.07 (0.38–3.05)       | 0.9     | 0.63 (0.19–2.11)                         | 0.46    |
| Sometimes                                     | 3.23 (1.26–8.31)       | 0.02    | 1.18 (0.39–3.55)                         | 0.77    |
| Often                                         | 5.94 (2.14–16.49)      | 0.001   | 1.89 (0.56–6.43)                         | 0.31    |
| Always                                        | 5.36 (1.59–18.06)      | 0.007   | 1.66 (0.35–6.11)                         | 0.61    |
| Sought health information in the past one month |                        |         |                                          |         |
| No                                            | 1                      |         |                                          |         |
| Yes                                           | 3.50 (2.28–5.37)       | <0.001  | 1.95 (1.13–3.36)                         | 0.02\textsuperscript{b} |

\textsuperscript{OR, odds ratio; AOR, adjusted odds ratio; CI, confidence interval.}

\textsuperscript{a}Adjusted for age, ethnicity, educational level, monthly household income, presence of medical illness, long-term medication use, the need for health information, and sought health information in the past month.

\textsuperscript{b}Predictors that are significantly associated with eHealth literacy level after adjusting for confounders (p < 0.05).
eHealth literacy. Further qualitative research is needed to explore how people appraise and trust online health information, and how it affects their health behaviour.

**Conclusion**

The eHealth literacy of patients attending the primary care clinic in this study was low as compared to those in high-income countries, particularly in the aspect of information appraisal. This study highlights the need for developing tailored intervention in improving eHealth literacy focusing on the appraisal skills of online health information and those with lower educational levels and poorer economic backgrounds.

**Acknowledgements:** We thank Dr Lee Kah Hang for his assistance in proofreading and referencing this manuscript. We would like to express our gratitude to the staff of the RUKA primary care clinic, UMMC for their assistance throughout the data collection.

**Declaration of conflicting interests:** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Contributorship:** HML and CJN conceptualized and designed the study. SSW, AJZC, FWSC and KCY developed the research tools and conducted data collection. SSW, HML and CHT analyzed the data. SSW drafted the manuscript. HML, CJN, CHT and AA contributed to the writing and critically revised the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

**Ethical approval:** Ethical approval was granted by the Medical Research Ethics Committee (MREC), University of Malaya Medical Centre (MREC ID No.: 2019227-7175).

**Funding:** The author(s) received no financial support for this research project.

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**References**

1. Maon SN, Hassan NM and Seman SAA. Online health information seeking behavior pattern. *Adv Sci Lett* 2017; 23: 10582–10585.
2. Bach RL and Wenz A. Studying health-related internet and mobile device use using web logs and smartphone records. *PloS One* 2020; 15: e0234663.
3. Ghweeba M, Lindenmeyer A, Shishi S, et al. What predicts online health information-seeking behavior among Egyptian adults? A cross-sectional study. *J Med Internet Res* 2017; 19: e216.
4. Lim HM, Wong SS, Yip KC, et al. Online health information-seeking behaviour of patients attending a primary care clinic in Malaysia: a cross-sectional study. *Fam Pract* 2022; 39: 38–45.
5. Parjia PP, Tiwari P, Sharma P, et al. Determinants of online health information-seeking behavior: a cross-sectional survey among residents of an urban settlement in Delhi. *J Educ Health Promot* 2020; 9: 44.
6. Norman CD and Skinner HA. Ehealth literacy: essential skills for consumer health in a networked world. *J Med Internet Res* 2006; 8: e9.
7. Norman CD and Skinner HA. eHEALS: the eHealth literacy scale. *J Med Internet Res* 2006; 8: 27.
8. Xu RH, Zhou L-M, Wong E, et al. The association between patients’ eHealth literacy and satisfaction with shared decision-making and well-being: multicenter cross-sectional study. *J Med Internet Res* 2021; 23: e26721.
9. Kim SH and Son YJ. Relationships between eHealth literacy and health behaviors in Korean adults. *Comput Inform Nurs* 2017; 35: 84–90.
10. Guo SH, Hsing HC, Lin JL, et al. Relationships between mobile eHealth literacy, diabetes self-care, and glycemic outcomes in Taiwanese patients with type 2 diabetes: cross-sectional study. *JMIR Mhealth Uhealth* 2021; 9: e18404.
11. Bin Naeeim S and Kamel Boulos MN. COVID-19 misinformation online and health literacy: a brief overview. *Int J Environ Res Public Health* 2021; 18: 8091. DOI: 10.3390/ijerph18158091
12. Chong YY, Cheng HY, Chan HYL, et al. COVID-19 pandemic, infodemic and the role of eHealth literacy. *InterJ Nurs Stud* 2020; 108: 103644.
13. Dib F, Mayaud P, Chauvin P, et al. Online misinformation and vaccine hesitancy in the era of COVID-19: why we need an eHealth literacy revolution. *Hum Vaccines Immunother* 2022; 18: –3.
14. Meppelink CS, Smit EG, Fransen ML, et al. I was right about vaccination”: confirmation bias and health literacy in online health information seeking. *J Health Commun* 2019; 24: 129–140.
15. Paige SR, Krieger JI and Stellefson ML. The influence of eHealth literacy on perceived trust in online health communication channels and sources. *J Health Commun* 2017; 22: 53–65.
16. Swire-Thompson B and Lazer D. Public health and online misinformation: challenges and recommendations. *Ann Rev Public Health* 2020; 41: 433–451.
17. Chesser A, Burke A, Reyes J, et al. Navigating the digital divide: a systematic review of eHealth literacy in underserved populations in the United States. *Inform Health Soc Care* 2016; 41: 1–19.
18. Holch P and Marwood JR. Ehealth literacy in UK teenagers and young adults: exploration of predictors and factor structure of the eHealth literacy scale (eHEALS). *JMIR Form Res* 2020; 4: e14450.
19. Wong DK and Cheung MK. Online health information seeking and eHealth literacy among patients attending a primary care clinic in Hong Kong: a cross-sectional survey. *J Med Internet Res* 2019; 21: e10831.
20. Abdullah A, Liew S, Salim H, et al. Health literacy research in Malaysia: a scoping review. *Sains Malays* 2020; 49: 1021–1036.
21. Shiferaw KB, Tilahun BC, Endehabtu BF, et al. E-health literacy and associated factors among chronic patients in a low-income country: a cross-sectional survey. *BMC Medical Inform Decis Mak* 2020; 20: 181.

22. Yilma TM, Inthiran A, Reidpath DD, et al. Context-based interactive health information searching. *Inf Res* 2019; 24: 1–22.

23. Bujnowska-Fedak MM and Wegierek P. The impact of online health information on patient health behaviours and making decisions concerning health. *Int J Environ Res Public Health* 2020; 17: 880.

24. Department of Statistics Malaysia. Household income & basic amenities survey report 2019, https://www.dosm.gov.my/v1/index.php (2022, accessed 30 August 2022).

25. 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: 259–267.

26. Ma Z and Wu M. The psychometric properties of the Chinese eHealth literacy scale (C-eHEALS) in a Chinese rural population: cross-sectional validation study. *J Med Internet Res* 2019; 21: e15720.

27. Mitsutake S, Shibata A, Ishii K, et al. [Developing Japanese version of the eHealth literacy scale (eHEALS)]. *Nihon Koshu Eisei Zasshi* 2011; 58: 361–371.

28. Wijaya MC and Kloping YP. Validity and reliability testing of the Indonesian version of the eHealth literacy scale during the COVID-19 pandemic. *Health Informatics J* 2021; 27: 1460458220975466.

29. Wild D, Grove A, Martin M, et al. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation. *Value Health* 2005; 8: 94–104.

30. Paige SR, Krieger JL, Stellefson M, et al. Ehealth literacy in chronic disease patients: an item response theory analysis of the eHealth literacy scale (eHEALS). *Patient Educ Couns* 2017; 100: 320–326.

31. Richtering SS, Morris R, Soh SE, et al. Examination of an eHealth literacy scale and a health literacy scale in a population with moderate to high cardiovascular risk: rasch analyses. *PloS One* 2017; 12: e0175372.

32. Cui GH, Li SJ, Yin YT, et al. The relationship among social capital, eHealth literacy and health behaviours in Chinese elderly people: a cross-sectional study. *BMC Public Health* 2021; 21: 45.

33. Lee WL, Lim ZJ, Tang LY, et al. Patients’ technology readiness and eHealth literacy: implications for adoption and deployment of eHealth in the COVID-19 era and beyond. *Comput Inform Nurs* 2021; 40: 244–250.

34. Jaafar N, Perialathan K, Krishnan M, et al. Malaysian Health literacy: scorecard performance from a national survey. *Int J Environ Res Public Health* 2021; 18: 5813.

35. Abdullah A, Ng CJ, Liew SM, et al. Prevalence of limited health literacy and its associated factors in patients with type 2 diabetes mellitus in perak, Malaysia: a cross-sectional study. *BMJ Open* 2020; 10: e039864.

36. Salim H, Shariff Ghazali S, Lee PY, et al. Health literacy levels and its determinants among people with asthma in Malaysian primary healthcare settings: a cross-sectional study. *BMC Public Health* 2021; 21: 1186.

37. Fanta G, Pretorius L and Erasmus L. Economic analysis of sustainable eHealth implementation in developing countries: A systematic review. In: IAMOT 2018 International Conference on Management of Technology, Birmingham, United Kingdom, 2018.

38. Schweitzer J and Synowiec C. The economics of eHealth and mHealth. *J Health Commun* 2012; 17: 73–81.

39. Clifford G. E-health in low to middle-income countries. *J Med Eng Technol* 2016; 40: 336–341.

40. Salim H, Young I, Lee PY, et al. Insights into how Malaysian adults with limited health literacy self-manage and live with asthma: a photovoice qualitative study. *Health Expect* 2022; 25: 163–176.

41. Stellefson ML, Shuster JJ, Chaney BH, et al. Web-based health information seeking and eHealth literacy among patients living with chronic obstructive pulmonary disease (COPD). *Health Commun* 2018; 33: 1410–1424.

42. Bitar AN, Zawiah M, Al-Ashwaly FY, et al. Misinformation, perceptions towards COVID-19 and willingness to be vaccinated: a population-based survey in Yemen. *PloS One* 2021; 16: e0248325.

43. Islam MS, Kamal AM, Kabir A, et al. COVID-19 vaccine rumors and conspiracy theories: the need for cognitive inoculation against misinformation to improve vaccine adherence. *PloS One* 2021; 16: e0251605.

44. Xie B. Effects of an EHealth literacy intervention for older adults. *J Med Internet Res* 2011; 13: e90.

45. Muscat DM, Morony S, Trevena L, et al. Skills for shared decision-making: evaluation of a health literacy program for consumers with lower literacy levels. *Health Lit Res Pract* 2019; 3: S58–S74.

46. Shab Z, Surian D, Dyda A, et al. Automatically appraising the credibility of vaccine-related web pages shared on social media: a Twitter surveillance study. *J Med Internet Res* 2019; 21: e14007.

47. Green G. Seniors’ eHealth literacy, health and education status and personal health knowledge. *Digit Health* 2022; 8: 2055207622109803.

48. McDougall GJ, Mackert M and Becker H. Memory performance, health literacy, and instrumental activities of daily living among community residing older adults. *Nurs Res* 2012; 61: 70–75.

49. Nakayama K, Osaka W, Togari T, et al. Comprehensive health literacy in Japan is lower than in Europe: a validated Japanese-language assessment of health literacy. *BMC Public Health* 2015; 15: 505.

50. Tennant B, Stellefson M, Dodd V, et al. EHealth literacy and web 2.0 health information seeking behaviors among baby boomers and older adults. *J Med Internet Res* 2015; 17: e70.

51. Buył R, Beogo I, Fobelets M, et al. e-health interventions for healthy aging: a systematic review. *Syst Rev* 2020; 9: 28.

52. Lee J and Tak SH. Factors associated with eHealth literacy focusing on digital literacy components: a cross-sectional study of middle-aged adults in South Korea. *Digit Health* 2022; 8: 20552076221102765.

53. Gordon NP and Hornbrook MC. Older adults’ readiness to engage with eHealth patient education and self-care resources: a cross-sectional survey. *BMC Health Serv Res* 2018; 18: 220.