

ORIGINAL ARTICLE

Electronic health literacy among older adults in the context of the COVID-19 pandemic: A mixed-methods study

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Funding information

National Key R&D Program of China, Grant/Award Number: 2018YFC1314600; National Social Science Fund of China, Grant/Award Number: 20BXW084; Independent Research Projects of School of Health Sciences (2018), Grant/Award Number: ZZKY005; Young Top-notch Talent Cultivation Program of Hubei Province

Abstract

Aim: This study aimed to investigate eHealth literacy about coronavirus disease 2019 (COVID-19) among older adults during the pandemic.

Background: The COVID-19 pandemic promoted the development of online health care. Higher demand for accessing information from the Internet was seen.

Methods: This was a sequential explanatory mixed-method study, involving a survey of older adults to explore the status and influencing factors of eHealth literacy regarding COVID-19. Semi-structured interviews were used to understand experiences and challenges regarding information retrieval, judgment and utilization.

Results: A total of 337 older adults participated in the online questionnaire survey. Overall, older adults had slightly higher scores on eHealth literacy during the COVID-19 pandemic. Participants' location in the past month and current health issues were associated with eHealth literacy. Qualitative data were collected from nine older adults and included that some older adults retrieved health-related information during the pandemic. However, those who used non-smartphones described difficulties in information retrieval. A glut of misinformation has resulted in an 'infodemic', which has not only increased the difficulty of judging information but also posed challenges in information utilization for older adults.

Conclusion: Improving older adults' eHealth literacy is essential in promoting an improved response to major public health events and in providing better health care for this group in the future. It is essential that government health agencies and health care providers provide evidence-based health information via social media platforms.

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Further efforts are needed to combine aspects of traditional and online health care services and provide reliable and updated online information and resources for older adults.

Implications for Nursing Management: Providing evidence to eHealth literacy improvement and health management of older adults in the context of public health events.

KEYWORDS

COVID-19, eHealth literacy, health information, older adult

1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has brought about unprecedented challenges to the world and significantly changed how people access information. As the pandemic requires home quarantine and isolation, face-to-face health communication has been considerably reduced. Various web-based sources, especially social media, are becoming more important resources for individuals to seek medical advice (Li & Liu, 2020). However, an infodemic has accompanied the COVID-19 pandemic as misinformation or rumours rapidly spread through the Internet and social media platforms (Zarocostas, 2020). The spread of such misinformation may bring panic and anxiety to the public, even lead to inappropriate behaviour, and jeopardize government efforts to manage COVID-19 (Centers for Disease Control and Prevention, 2020). In this context, the COVID-19 infodemic creates a great challenge for eHealth literacy.

eHealth literacy is defined as ‘the ability to seek, find, understand and appraise health information from the electronic source and apply the knowledge to addressing or solving health problems’ (Norman et al., 2006). eHealth literacy aims to endow individuals with network health resources to participate in health decision-making. During the pandemic, eHealth literacy is essential when people search and process COVID-19-related health information from the Internet and social media, and it plays an important role in people’s preventive behaviours (Li et al., 2019).

Existing studies indicated that the public had slightly higher scores on eHealth literacy during the COVID-19 outbreak, and they used web navigation to get information about COVID-19 and to make related health decisions (Guo et al., 2021; Li et al., 2021; Yang et al., 2021). The eHealth literacy was affected by sociodemographic characteristics, such as gender (Rush et al., 2021), age (Guo et al., 2021; Tennant et al., 2015) and education (An et al., 2021; Richtering et al., 2017). Older adults had a relatively low level of eHealth literacy, which may be related to lower usage of electronic devices and the pressure to use computers or the Internet among the older population (Guo et al., 2021; Richtering et al., 2017; Rush et al., 2021; Tennant et al., 2015). Compared with younger people, older adults were disproportionately experiencing more severe outcomes due to COVID-19 illness, less likely to obtain quality information or services on the Internet and more likely to experience

loneliness and social isolation (Morrow-Howell et al., 2020; Xie et al., 2020). Therefore, it’s vital to obtain an in-depth understanding about eHealth literacy of older adults during the COVID-19 epidemic. At present, studies regarding eHealth literacy of older adults remain limited.

This mixed-method study aimed to identify eHealth literacy regarding COVID-19 and its influencing factors among older adults and to explore the experiences of older adults about information retrieval, judgment and utilization related to COVID-19. The findings will facilitate understanding about eHealth literacy among older adults during the public health crisis, provide evidence to enhance eHealth literacy among older adults and help them to use appropriate eHealth resources to maintain health.

2 | METHODS

This mixed-methods study was conducted in China, from 6 June 2020 to 1 February 2021. An online questionnaire was used to investigate eHealth literacy among older adults and followed by a qualitative study involving semi-structured interviews.

2.1 | Participants

To expand the investigation scope and reduce costs, an online survey was used to investigate eHealth literacy regarding the COVID-19 pandemic in older adults. Convenience sampling was used in the quantitative study. G*Power 3.1 was used to calculate the sample size (effect size = 0.25, $\alpha = .05$, $1 - \beta = .99$); the minimal sample size was 278. Considering 15% loss of sample, 320 samples were required. Older adults who met the criteria were recruited in communities to participate in the interviews. Purposive sampling was used in the interview stage to achieve representation and generate information-rich cases. The inclusion and exclusion criteria for the online survey and face-to-face interviews were consistent. Inclusion criteria were (1) aged 60 years or older and (2) able to read, write, speak and understand Mandarin. Exclusion criteria were (1) mental illness or cognitive impairment (hearing or vision problems) and (2) other serious physical diseases. Participation was voluntary and anonymity was assured.

2.2 | Data collection

The online questionnaire (Supporting Information A) consisted of three sections: (1) consent to participate; (2) general information questionnaire; and (3) the eHealth Literacy Questionnaire (EHLQ). The Chinese version of the EHLQ was used to assess the eHealth literacy of participants related to COVID-19 (Yang et al., 2021). It consists of 15 items and 4 dimensions: information retrieval (1–3 items), information judgment (4–6 items), information utilization (7–9 items) and the importance of information (10–15 items). It uses a 4-point Likert scale, with '1 = *strongly disagree*', '2 = *disagree*', '3 = *agree*', '4 = *strongly agree*'. Total scores range from 15 to 60. Higher scores indicate greater ability to retrieve, judge and utilize online information about COVID-19, as well as a better awareness of important characteristics of reliable online information. In this study, the median score of 46 was used to divide participants into two groups: Score > 46 is considered higher eHealth literacy, and score ≤ 46 was lower eHealth literacy (DeCoster et al., 2011). The Chinese version of the EHLQ had good reliability, and Cronbach's α was .952, and test–retest reliability was .814. The content validity index (S-CVI) was .865, and the item content validity index (I-CVI) was .825 (Yang et al., 2021).

The online questionnaire survey was conducted on the Wen Juanxing and the JD health platform (JD Health, healthservice.jd.com). Wen Juanxing is a confidential, professional online questionnaire survey platform providing online questionnaire design, data collection and survey results analysis. The JD Health is one of the largest online health care platforms in China, providing convenient health care products and online health care services. The researchers and JD Health officials signed a confidential agreement regarding information security and the data would be used only for the current study. All questions were set as 'required', and the same user ID can only be used to complete the questionnaire once. When participants clicked on the survey link, the survey, the introduction and the informed consent were provided. Only potential participants who indicated they were age 60 years or older could proceed to the survey. Each participant received a coupon for use on the JD Health platform as a token of appreciation upon completion of the questionnaire.

The semi-structured interview was developed according to the research objectives, including 'How do you obtain health-related information about COVID-19 during the pandemic? How do you judge the information? What's your suggestion for reducing the difficulties of information discrimination?' (See Supporting Information B for additional details.) Interviews were conducted in a quiet place of the participant's preference in community, such as a park. Interviews lasted 20 to 40 min and were audio-recorded with the participant's permission. The recording was transcribed verbatim within 24 h of the interview. When the ninth participant was interviewed, there were no new themes emerging and data saturation was reached.

2.3 | Data analysis

The SPSS 21.0 was used to analyse quantitative data. Descriptive statistics were used to describe the eHealth literacy scores and sociodemographic characteristics by frequency, mean and standard deviation. Chi-square test was used to analyse sociodemographic variables among participants with different levels of eHealth literacy. The significant variables were involved in the logistic regression model. Logistic regression analysis was used to identify and compare the influencing factors affecting eHealth literacy. A p value of .05 was considered statistically significant.

The recorded interviews were transcribed in Chinese and translated into English. Thematic analysis was used to analyse the interview data. Several strategies were used to establish trustworthiness and credibility. First, credibility was achieved by in-depth interview followed by peer debriefing. Next, SL and QL read the transcripts several times to be familiar with these transcripts and then encoded the data separately. Then, researchers discussed and compared the codes based on the emerging information to reach consensus. Finally, researchers grouped themes into clusters and categories and determined the central themes. The audit trail was used to ensure all analysis steps are traceable back to original interview statements.

2.4 | Ethical considerations

Permission for this study was obtained from the Ethics Committee of Renmin Hospital of Wuhan University on 29 January 2020 (code: WDRY2020-K004).

3 | RESULTS

3.1 | Questionnaires

A total of 337 older adults participated in this study; 51.3% (173) were males, and 48.7% were females; 37.4% had a bachelor's degree or college education and 31.8% had completed junior high school education. Nearly two thirds (67.7%) of the group had lived in another Chinese province than Hubei during the previous month. Sociodemographic and other characteristics of participants are shown in Table 1.

3.1.1 | Scores of EHLQ

Table 2 shows the eHealth literacy regarding COVID-19 among older adults. The total mean score on eHealth literacy (46.47 ± 9.45) was slightly higher than the median (median = 46). The number of people with higher and lower eHealth literacy scores was 48.1% and 51.9%, respectively. In terms of the mean score of four dimensions of the

TABLE 1 Sociodemographic characteristics and comparison of self-reported eHealth literacy (N = 337)

	Total		Low eHealth literacy (≤ 46) (n = 162)		High eHealth literacy (> 46) (n = 175)		Chi-Square (χ^2)	p value
	n	%	n	%	n	%		
Gender							5.588	.018
Male	173	51.3	94	58.0	79	45.1		
Female	164	48.7	68	42.0	96	54.9		
Ethnicity							1.622	.203
Han	324	96.1	158	97.5	166	94.9		
Other	13	3.9	4	2.5	9	5.1		
Education level							2.931	.402
\leq Junior high school	107	31.8	56	34.6	51	29.1		
High school/technical school	86	25.5	38	23.5	48	27.4		
Bachelor's degree/college (3 years)	126	37.4	62	38.3	64	36.6		
\geq Master's degree	18	5.3	6	3.7	12	6.9		
Location in the past month							29.978	<.001
Hubei Province	97	28.8	69	42.6	28	16.0		
China (province other than Hubei)	228	67.7	90	55.6	138	78.9		
Outside China	12	3.6	3	1.9	9	5.1		
Current health issues							9.251	.002
None	223	66.2	94	58.0	129	73.7		
Mental illness/chronic disease	114	33.8	68	42.0	46	26.3		
Is there anyone around you who has been diagnosed with COVID-19?							3.785	.052
None	297	88.1	137	84.6	160	91.4		
Family member/friends/classmates/colleagues/ community resident	40	11.9	25	15.4	15	8.6		
Are you worried about being infected with COVID-19?							4.997	.025
No	224	66.5	98	60.5	126	72.0		
Yes	113	33.5	64	39.5	49	28.0		
What is your level of uncertainty towards COVID-19?							0.807	.668
None	14	4.2	2	1.2	1	0.6		
General	227	67.4	43	26.5	26	14.9		
Strong	96	28.5	117	72.2	148	84.6		
Has there been a change in your family relationship since COVID-19?							0.090	.956
Worse	14	4.2	7	4.3	7	4.0		
General	227	67.4	110	67.9	117	66.9		
Better	96	28.5	45	27.8	51	29.1		
Has there been a change in your relationship with others since COVID-19?							16.449	<.001
Worse	44	13.1	21	13.0	23	13.1		
General	168	49.9	98	60.5	70	66.9		
Better	125	37.1	43	26.5	82	29.1		
Information satisfaction							30.912	<.001
Dissatisfied	24	7.1	18	11.1	6	3.4		
Neutral	120	35.6	76	46.9	44	25.1		
Satisfied	193	57.3	68	42.0	125	71.4		

TABLE 2 Scores on the eHealth Literacy Questionnaire (EHLQ) (N = 337)

Items (score range)	Mean	SD	Strong disagree/disagree n (%)	Agree/strong agree n (%)
When I searched for information about COVID-19 on the Internet,				
<i>Information retrieval (1–3)</i>				
1. I can make a decision from all the retrieved information	3.17	0.74	-	-
2. I can use the appropriate words or search terms to find the information I want	3.18	0.81	64 (19.0)	273 (81.0)
3. I can find the information I want	3.18	0.77	57 (16.9)	280 (83.1)
3. I can find the information I want	3.16	0.78	64 (19.0)	273 (81.0)
<i>Information judgment (4–6)</i>				
4. I can determine if the information is reliable	2.95	0.72	-	-
5. I can determine if there is a commercial interest in the information	3.04	0.77	82 (24.3)	255 (75.7)
6. I can check different websites to see if they provide the same information	2.88	0.80	112 (33.2)	225 (66.8)
6. I can check different websites to see if they provide the same information	2.91	0.83	105 (31.2)	232 (68.8)
<i>Information utilization (7–9)</i>				
7. I can determine if the information found is applicable	3.05	0.70	-	-
7. I can determine if the information found is applicable	3.05	0.75	71 (21.1)	266 (78.9)
8. I can use the information I find in my daily life	3.08	0.72	64 (19.0)	273 (81.0)
9. I can use this information to make healthy decisions	3.01	0.76	79 (23.4)	258 (76.6)
<i>Importance of information (10–15)</i>				
10. I think that information being up to date is important	3.16	0.69	-	-
10. I think that information being up to date is important	3.20	0.81	66 (19.6)	271 (80.4)
11. I think that the information being validated is important	3.26	0.79	55 (16.3)	282 (83.7)
12. I think that we learn the most important things very quickly from the information retrieval is important	3.10	0.75	64 (19.0)	273 (81.0)
13. I think that the news from the authorities is important	3.36	0.79	51 (15.1)	286 (84.9)
14. I think that the information represents different points of view is important	2.97	0.81	91 (27.0)	246 (73.0)
15. I think that the question was discussed deeply is important	3.07	0.80	77 (22.8)	260 (77.2)
Total (15–60)	46.47	9.45	-	-

EHLQ, the highest was information retrieval (3.17 ± 0.74), followed by the importance of information (3.16 ± 0.69), information utilization (3.05 ± 0.70) and information judgment (2.95 ± 0.72).

3.1.2 | Univariate analyses of sociodemographic factors

Univariate analyses indicated that gender, location in the past month, current health issues, being worried about becoming infected with COVID-19, relationship change with others since COVID-19 and satisfaction with online information about COVID-19 were associated with eHealth literacy (see Table 1).

3.1.3 | Influencing factors of the EHLQ

The results of logistic regression are shown in Table 3. The logistic regression model was statistically significant ($\chi^2 = 53.483$, $p < .001$,

likelihood ratio = 413.197, $R^2 = .196$). Location in the past month and current health issues were significantly associated with the eHealth literacy of older adults ($p < .05$). Logistic regression showed that compared with older adults living in Hubei Province, those who had resided in other provinces in the past month (OR = 3.073, 95% CI: 1.797–5.254) and living outside China (OR = 6.600, 95% CI: 1.620–26.889) had higher scores on eHealth literacy; compared with older adults without current health issues, those with current health issues had lower scores on eHealth literacy (OR = .528, 95% CI: 0.352–0.962).

3.2 | Interviews

During recruitment, three older adults began the interview process but did not finish it due to time constraints; four adults refused to participate for privacy reasons and uncertainty about their ability to express themselves. Data collection and data analysis were conducted simultaneously.

TABLE 3 Logistic regression of influencing factors of eHealth literacy in older adults ($N = 337$)

Dependent variable	Factors	B	SE	Wald	Exp(B)	95% CI	p value
eHealth literacy (EHLQ)	Constant	-0.459	.417	1.212	0.632		.271
	Gender (male = 0, female = 1)	0.434	.238	3.333	1.543	0.969-2.457	.068
	Location in the past month (Hubei Province) ^a			19.336			<.001
	China (provinces other than Hubei)	1.123	.274	16.818	3.073	1.797-5.254	<.001
	Outside China	1.887	.717	6.933	6.600	1.620-26.889	.008
	Current health issues (none = 0, mental/chronic disease = 1)	-0.541	.256	4.454	0.528	0.352-0.962	.035
	Are you worried about being infected with COVID-19? (no = 0, yes = 1)	-0.436	.259	2.843	0.647	0.389-1.073	.092
	Relationship change with others since COVID-19 (worse) ^a			9.512			.009
	General	-0.540	.370	2.132	0.583	0.282-1.203	.144
	Better	0.250	.384	0.425	1.284	0.606-2.723	.541

Note: Likelihood ratio = 413.197, $R^2 = .196$.

^aReference category.

The average age of participants was 64.67 years ($SD = 4.06$). One participant was female, and the other eight were male. Five had completed junior high school, three participants finished high school and one had a bachelor's degree (Supporting Information C for characteristics of interviews with older adults).

3.2.1 | Obtaining information about COVID-19 and general health from varied resources

During the epidemic, participants obtained information about COVID-19 and general health from various resources, such as social media, China Central Television (CCTV) news broadcasts, family and friends with higher educational backgrounds. In addition, the community played an essential role in health-related information dissemination during the COVID-19 pandemic. Policemen, volunteers and staff in the community provided health-related information for residents. Two participants sought help from their children to obtain online information. However, four participants had difficulty in obtaining information online because they used non-smartphones, and they could not access the Internet, install social media apps or make medical appointments on their phones. Three participants suggested that it was essential to maintain windows or booths that provide health-related information/resource counselling for older adults.

The information older adults obtained about COVID-19 mainly focused on prevention and control strategies, such as early detection, diagnosis, isolation and treatment, washing hands and wearing masks and social distancing. They were also concerned about the epidemiology of COVID-19 in China and around the world. One participant mentioned COVID-19 vaccine information, including which age group should be vaccinated and when. To keep fit during the pandemic, participants also paid attention to general health information from CCTV or the Internet, including lifestyle (e.g., diet and exercise) and self-management of chronic diseases (see Table 4).

3.2.2 | Judging the reliability of the information according to the resources

Most participants felt it was difficult to distinguish appropriate online information in the era of information explosion. Online information was viewed as including true and false information and coming from various sources. Participants viewed CCTV news broadcasts and the government as the most reliable information resources. They also believed in information from well-known experts in respiratory and infectious diseases. But some of them pointed out that the expert interviews might be taken out of context or edited by Photoshop, so there were risks in obtaining online information from unreliable resources.

Half of the participants viewed the information containing advertising as unreliable. Commercial interests promote many kinds of advertisements. Participants claimed that information involved in money transactions was likely to be an advertisement, fictitious or has commercial interests. Older adults hoped that the government could help filter the information and provide reliable information on the Internet, so as to decrease difficulties in discriminating correct online information.

3.2.3 | Utilizing the information to prevent being infected with COVID-19 and promote health

All the older adults consciously followed the prevention and control strategies they had learned, such as wearing a mask, washing hands, using alcohol for disinfection, limiting personal contact and maintaining social distance. As health care providers also promoted Internet platforms to popularize health knowledge for the public, older adults applied health-related information to support good lifestyle habits and maintain health.

TABLE 4 Categories from interview data with explanatory quotes

Category	Sub-categories	Sample quotes
Obtaining information about COVID-19 and general health from varied resources	Content of information	'We usually get the information from official channels, such as the news broadcast of CCTV and Wuhan TV. These TV programs transmit much information about the COVID-19, including the transmission route of this virus, how to prevent it by washing hands and wearing masks. The COVID-19 is preventable and treatable. If you get this disease, you need to be treated, and don't be panic or be afraid.' [P1]
	Sources of information	'We mainly watch official TVs, such as CCTV, Hubei TV, Wuhan TV, and Phoenix InfoNews Channel During the pandemic of COVID-19, the policemen, volunteer team and social workers kept providing education in the community. They disseminated prevention and control information, including open windows and wash hands frequently, wear a mask when you need to go out, reduce going out and so on. The workers and volunteers in the Wuhan University community play an important role in providing us information. Anyway, if there is anything you do not understand or you want to know, just ask them.' [P2]
	Suggestions for CMT	'I suggested the hospital retain a window to provide service for the older adults. People could directly visit a doctor instead of using their smartphone to book appointments online. Our country has entered an aging society. Some individuals were long-term bedridden or taking a wheelchair, and they could not take care of themselves. The government should provide door-to-door services for bedridden patients and disabled older adults.' [P5]
Judging the reliability of the information according to the resources	Reliable information resources	'The information from the national government is reliable, we are more inclined to believe the information from the national government' [P6]
	Unreliable information resources	'I think there are cheaters all the time, so we are very cautious. When people advertise, post things, or sell something to you, the first thing is to judge whether there is deception. First of all, you should doubt whether he is a liar and whether he is deceiving you.' [P4]
	Challenges	'The information on the Internet is not easy to distinguish, and I do not know whether it is true or false. Anyway, I generally do not believe these things. There is too much information on the Internet, and a lot of information is fake. On the Internet, people sent whatever they want. A question can be posted several times, and it is difficult to identify online information.' [P4]
Utilizing the information to prevent becoming infected with COVID-19 and promote health	Changing behaviours for COVID-19 prevention and control	'We must obey the regulations of our country and stay at home. We should do all the preventive measures, such as washing hands, and using alcohol for disinfection. After we went out to buy vegetables, I spray alcohol on my cloth and wipe my mobile phones with alcohol pads.' [P1]
	Routine health care	'Do not stay up, stop smoking, limit alcohol, do more exercises and take a nap at noon. These are good for us. I usually go to bed at about 10 PM. Even when there are special things to do, I go to bed before 11 PM.' [P5]
Prioritizing the verified information from the government and CCTV		'The CCTV news is more reliable than that broadcast by other satellite TV stations.' [P8]

Abbreviations: CCTV, China Central Television; CMT, Cloud Medical Treatment.

3.2.4 | Prioritizing the verified information from CCTV

Participants claimed that the up-to-date and verified information from official channels was more critical for them. Eight out of nine participants preferred CCTV news broadcasts as the most important source to get COVID-19 information. The latest progress of the epidemic was broadcasted daily on the CCTV news broadcasts at a fixed time every day. For Chinese older adults, they were most familiar with this traditional media and trusted it the most.

4 | DISCUSSION

To the best of researchers' knowledge, studies on eHealth literacy about COVID-19 among older adults are limited. This mixed-method study showed that 51.9% of older adults had a higher eHealth literacy during COVID-19. Some of them had the ability to seek medical information from various web-based resources and know the important characteristics of reliable information. Nevertheless, older adults still faced challenges in online information retrieval due to limited use of smartphones and inability to use the Internet. Older adults' abilities to judge relevant information and use it appropriately need further improvement. In addition, this study found that eHealth literacy regarding COVID-19 among older adults was influenced by location in the past month and current health issues.

Compared with previous studies that indicated older adults had low scores on eHealth literacy (Rush et al., 2021), the results of the quantitative study showed slightly higher scores on eHealth literacy regarding COVID-19. This may be related to greater access to mobile technologies and the diffusion of high-speed Internet in recent years (Smail-Crevier et al., 2019). The Chinese Internet penetration rate reached 71.6%, and 12.2% of netizens were over 60 years of age in 2021 (China Internet Network Information Center, 2021). In this study, face-to-face interviews showed that among the nine participants, five of them used smartphones, and seven of them thought it was convenient to get information and communicate with others through smartphones during the COVID-19 pandemic. Before the outbreak of COVID-19, some older adults used smartphones for online payment (Liu et al., 2016), and WeChat was the most frequently used social media among them (Institute of Sociology & Chinese Academy of Social Sciences & Tencent Research Institute, 2017). More and more people would like to access the Internet to search for medical information (Hameen-Anttila et al., 2018). During the COVID-19 pandemic, the Internet offered convenience and opportunities for older adults to socialize at home and pay attention to hot events (Institute of Sociology & Chinese Academy of Social Sciences & Tencent Research Institute, 2017). A face-to-face visit with health care providers was limited due to home quarantine and isolation, so older adults also learned to seek medical care through the Internet (Jiang et al., 2021). In the post-pandemic era in China, when people entered public places and used public transportation, they needed to show their green health QR codes on their cell phones,

which indicated they were healthy and did not have close contact with suspected or confirmed cases of COVID-19. In this context, more and more older adults are accessing electronic devices and information technology to facilitate their life, such as health QR code queries online car-hailing and other operations (Chinese Academy of Sciences, 2021). Therefore, eHealth literacy among older adults has been promoted by the popularity of information technology and the requirement for normalization of epidemic prevention and control.

Results of the quantitative study showed that 83.1% of older adults could use the appropriate words or search terms to retrieve the information online, whereas two thirds of interviewees said they could search information through the Internet during the COVID-19 pandemic. The popularity of smartphones and technology has facilitated access to information for older adults. Social media spread information faster and increased access for older adults to get COVID-19 information. However, the qualitative study found that some older adults using non-smartphones had difficulties in information retrieval. This may be related to equipment costs, lack of technical experience, reduced access to technology or health problems, such as difficulties in hearing, cognition or communication. Some older adults may not be familiar with how to access health care from Internet-based medical services, such as cloud medical platforms.

The quantitative study showed that among the four dimensions of the EHLQ, the score on information judgment was the lowest. The interviewees also felt challenged to judge complex online information, because some online information was taken out of context, or involved in commercial interests, and so forth. Because a large amount of misinformation and reliable information were mixed during COVID-19 epidemic (Jayasinghe et al., 2020), older adults claimed that they sometimes had difficulties distinguishing appropriate information. This further influenced older adults' ability to make health-related decisions. Information utilization scores were slightly higher than information judgment in this study. This qualitative study indicated that older adults mainly utilized information to prevent being infected with COVID-19 and promote health. Nevertheless, complex online information also created some challenges for older adults in using this information. Previous studies reported that older adults distrust the abundance of information on the Internet, and it became a barrier in knowing if the retrieved information could be applied (Manafò & Wong, 2012). When it comes to taking steps to reduce the spread of COVID-19, such as washing hands, wearing masks and keeping distancing, there are other preventative measures available online, but some of these measures are not supported by evidence. The high volume of COVID-19-related information has led to increased uncertainty and anxiety, posing challenges for older adults to use COVID-19-related information. Both quantitative and qualitative results showed that older adults thought up-to-date, official and verified news or information were important for them. These characteristics of information were not only for older adults' own health management but also to narrow the spread of unreliable information and help the government manage COVID-19. Therefore, how to help older adults to access and apply information is the key to improving eHealth literacy during the pandemic.

This research found that eHealth literacy of older adults was influenced by location in the past month and current health issues. Compared with older adults who lived in Hubei Province, older adults living in other provinces or outside China in the past month had higher eHealth literacy. Hubei Province became the worst-hit city at the early stage of the COVID-19 outbreak (Tao et al., 2021). Older adults were uncertain about the severity of the COVID-19 pandemic and witnessed an increasing number of infections around them, which may have generated panic and anxiety (Huang & Zhao, 2020). They had a sense of uncertainty and even doubt about various preventative measures, and lacked confidence in using these preventative measures to protect themselves. In addition, 'information overload' was thought to be a barrier in that older adults were confused about how to better get information on COVID-19 and failed to judge what information is useful. Moreover, mixed information increased the difficulty in judging and utilizing information by older adults. In addition, older adults with mental or chronic disease had lower scores on eHealth literacy than those without mental or chronic disease in this study. Patients with mental or chronic diseases need regular and face-to-face follow-up. During the COVID-19 pandemic, the way older adults accessed health care has changed, but the need for self-management information still exists. Some of them may not be able to adapt to new ways of accessing information, such as using a smartphone network to log in to an online platform for communicating with doctors or searching for information on health management by themselves.

4.1 | Limitations

There are several limitations to this study. In the quantitative research, convenience sampling was used, which may make the sample not representative enough. Therefore, the generalization of results should be cautious. However, the current results still have some practical significance. Among the older adults who participated in the in-depth interview, the male elderly was more likely to participate in this research than the female elderly. The gender imbalance may cause certain selection biases in the results. This study was carried out in urban areas of Henan and Hubei Province, China, and the experience of older adults in rural and remote areas is not yet known. Therefore, future research should expand the sample size and the research area, increase research on the eHealth literacy experience of the elderly in rural and remote areas and improve the universality of the results, to effectively apply eHealth literacy capabilities to disease prevention, chronic disease management and physical examination.

5 | CONCLUSIONS

Improving eHealth literacy in older adults would be beneficial for them to manage their health, especially in the context of a major public health like COVID-19. Although older adults have slightly higher eHealth literacy, further improvement in information retrieval,

judgment and utilization is needed. In addition to offering guidance on information retrieval skills to older adults, some traditional services of accessing health care also need to be preserved; government officials and health care providers should use social media platforms to provide older adults with evidence-based and updated online information.

6 | IMPLICATIONS FOR NURSING MANAGEMENT

This mixed-method study explored the current situation during the pandemic and experiences of eHealth literacy among older adults and provided insight into the experiences and difficulties encountered by older adults. Although older adults may have the ability to retrieve and use online information during the pandemic, they still face some difficulties in retrieving, judging and utilizing online information. For older adults who are not good at using smartphones, community nurses could provide step-by-step guidance and simple user manuals for older adults to enhance smartphone use among the older adult population (General Office of the State Council of the People's Republic of China, 2020). It is necessary to provide information manual windows when older adults need health care. Regarding the difficulty in judging information, strengthening government oversight of online and media resources is important to help people understand discriminative information. In addition, health care providers and government officials should connect with social media platforms to correct inaccurate information on the Internet in a timely manner (Zarocostas, 2020). Online information could be filtered through government regulation by using a rating system to determine the credibility of online information (Manafò & Wong, 2012). This study also provides a basis for future proactive responses to public health events to provide better health care for older adults.

ACKNOWLEDGEMENTS

Sincere thanks are given to Dr. Sharon R. Redding (EdD, RN, CNE) for assistance in editing.

We appreciate the grant support from the National Key R&D Program of China (2018YFC1314600), the National Social Science Fund of China (20BXW084), the Independent Research Projects of School of Health Sciences (2018) (ZZKY005) and the Young Top-notch Talent Cultivation Program of Hubei Province.

CONFLICT OF INTEREST

The authors report no actual or potential conflicts of interest.

In addition, all authors approved the content of the manuscript and have contributed significantly to the research involved.

ETHICS STATEMENT

Permission for this study was obtained from the Ethics Committee of Renmin Hospital of Wuhan University on 29 January 2020 (code: WDRY2020-K004).

AUTHOR CONTRIBUTIONS

Shuo Liu, Xiao Qin Wang, Bing Xiang Yang, Dan Luo, Jun Zhao, Zhongchun Liu and Qian Liu designed the study and wrote the research protocol. Shuo Liu, Xiao Qin Wang, Bing Xiang Yang, Dan Luo, Yan Liu, Xiao Juan Fang, Simeng Ma, Lijun Kang, Hai-Shan Huang, Baili Lu, Jun Zhao, Zhongchun Liu and Qian Liu did the literature review, managed the field survey, quality control and statistical analysis and prepared the manuscript draft. Shuo Liu, Xiao Qin Wang, Bing Xiang Yang, Dan Luo and Qian Liu contributed to the revisions in depth for the manuscript. Shuo Liu and Qian Liu supervised the survey and checked the data. All authors contributed to and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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SUPPORTING INFORMATION

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How to cite this article: Liu, S., Wang, X. Q., Yang, B. X., Luo, D., Liu, Y., Fang, X. J., Ma, S., Kang, L., Huang, H.-S., Lu, B., Zhao, J., Liu, Z., & Liu, Q. (2022). Electronic health literacy among older adults in the context of the COVID-19 pandemic: A mixed-methods study. *Journal of Nursing Management*, 1–11. <https://doi.org/10.1111/jonm.13664>