Relationship between eHealth literacy and psychological status during COVID-19 pandemic: A survey of Chinese residents

Bing Xiang Yang RN, BM, MSN, PhD, Associate Professor1,2,3 | Lin Xia RN, BSc, Post-graduate Student1 | Run Huang RN, BSc, Post-graduate Student1 | Pan Chen RN, BSc, Post-graduate Student1 | Dan Luo RN, PhD, Lecturer1 | Qian Liu RN, PhD, Lecturer1 | Li Jun Kang BM, MD, Doctor of Medicine2 | Zhi-jiang Zhang PhD, Associate Professor4 | Zhongchun Liu PhD, MD, Professor2 | Sihong Yu RN, MSN, Associate Chief Nurse1 | Xiaofen Li RN, BSc, Nurse-in-charge2 | Xiao Qin Wang RN, MSN, PhD, Lecturer1

1Faculty of School of Health Sciences, Wuhan University, Wuhan, China
2Department of Psychiatry, Renmin Hospital of Wuhan University, Wuhan, China
3Population and Health Research Center, Wuhan University, Wuhan, China
4Department of Preventive Medicine, School of Health Sciences, Wuhan University, Wuhan, China

Correspondence
Xiao Qin Wang, Sihong Yu, Faculty of School of Health Sciences, Wuhan University, No. 115 Donghu Road, Wuchang, Wuhan, Hubei, 430071 China.
Emails: xiaojin_wang78@163.com (XQW); 934072690@qq.com (SY)
Xiaofen Li, Department of Psychiatry, Renmin Hospital of Wuhan University, Wuhan, China.
Email: 724861251@qq.com

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Abstract
Aims: To investigate the eHealth literacy and the psychological status of Chinese residents during the COVID-19 pandemic and explore their interrelationship.

Background: The COVID-19 outbreak has placed intense psychological pressure on community residents. Their psychological status may be affected by eHealth literacy due to home isolation during this rampant pandemic.

Methods: This is a Web-based cross-sectional survey conducted on the JD Health platform, which resulted in 15,000 respondents having participated in this survey. The eHealth Literacy Questionnaire (EHLQ), Patient Health Questionnaire-9 (PHQ-9), Insomnia Severity Index (ISI) and Impact of Event Scale-Revised (IES-R) were used. The Pearson correlation was used to analyse the relationship between eHealth literacy and depression, insomnia and post-traumatic stress disorder.

Results: The score of eHealth literacy was 48.88 ± 8.46, and 11.4%, 6.8% and 20.1% of respondents experienced moderate to severe depression, insomnia and post-traumatic stress disorder. eHealth literacy negatively correlated with depression (r = −0.331), insomnia (r = −0.366) and post-traumatic stress disorder (r = −0.320).

Conclusion: eHealth literacy is closely related to psychological status. Improving eHealth literacy may contribute to maintaining good psychological well-being.

Implications for Nursing Management: It is necessary to strengthen the education of primary health care providers to enhance their ability to help community residents effectively use eHealth information.

KEYWORDS
Chinese, COVID-19, eHealth literacy, psychological status
At the end of 2019, the novel coronavirus disease 2019 (COVID-19) broke out in Wuhan, China, and attracted global attention. This coronavirus spreads quickly and widely, and is difficult to prevent and control, which has brought unprecedented challenges to global public health. According to statistics from the World Health Organization, as of 10:45 a.m. CET, 9 November 2020, 50,030,121 people worldwide have been infected with COVID-19, and the death toll was 1,252,072 (WHO, 2020a). Because of its high morbidity and mortality, people all over the world are affected by the COVID-19 pandemic (Lin, Wang et al., 2020). It has not only affected the health of the public, but also caused social, economic and political damage (WHO, 2020b).

In order to effectively prevent and control COVID-19, residents are recommended to stay at home, maintain social distance and reduce social interactions. Due to the severe challenges of the pandemic and concerns about their own health, coupled with long-term expectations of being indoors and reduced social activities, residents are prone to mental health problems. A study conducted in the early stage of the pandemic in China found that 53.8% of respondents rated the pandemic as having a moderate or severe psychological impact (Wang et al., 2020). There are also studies that showed that depression, insomnia and post-traumatic stress disorder (PTSD) are frequent mental health problems during the pandemic (Huang & Zhao, 2020; Lin, Wang et al., 2020; Ramirez et al., 2020).

In the era of big data, with the rapid development of modern information technologies, the Internet has become an important channel for the public to obtain a variety of health information. During the pandemic, more and more residents used social media to access information about COVID-19, such as the development of the disease, news reports, prevention and control measures. However, the COVID-19 pandemic was also accompanied by an ‘infodemic’, that is misinformation or fake news, which spread rapidly on social media and other platforms (Chong et al., 2020). The massive amount of information generated by the Internet placed high demands on the public’s ability to screen, evaluate and apply information. Incomplete, untrue and false health information affects people’s abilities to apply this information to decision-making regarding their health. Therefore, it is particularly important to have good eHealth literacy (Nair et al., 2020).

According to Norman and Skinner (2006), eHealth literacy refers to ‘the ability to seek, find, understand and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem’. Good eHealth literacy is beneficial to alleviating psychological stress. Xie et al. (2020) explored the relationship between eHealth literacy and depressive symptoms among female nursing students, and found that the better their eHealth literacy, the lower the risk of depressive symptoms. Similarly, another study also found that health literacy can reduce depressive symptoms among women with breast cancer (Kugbey et al., 2019). The research by Yang et al. (2017) showed that college students with higher eHealth literacy can manage stress more effectively. The research by Zhang et al. (2019) showed that individuals with higher health literacy had significantly fewer psychological symptoms. Another longitudinal study conducted in Iran found that improving the eHealth literacy of patients with heart failure can not only reduce their insomnia and psychological distress, improve their quality of life, but also reduce the occurrence of cardiovascular events (Lin, Ganji et al., 2020). However, few studies have explored the impact of eHealth literacy on the psychological status of the general population during the COVID-19 pandemic.

Therefore, this study aimed to investigate eHealth literacy and psychological status of residents during the COVID-19 pandemic and explore their interrelationship, which can provide theoretical support for information dissemination, the adjustment of residents’ emotions and the alleviation of psychological stress in the later stage of the pandemic, as well as the basis for subsequent public health decisions.

## METHODS

### Research design

The present study was a cross-sectional survey carried out in China, on 6 June 2020.

### Participants and sample size

Chinese residents participated in this study by clicking the questionnaire website link on the JD Health platform (JD Health, healthservice.jd.com). This link was accessed by 15,694 residents, of which 15,000 agreed to participate and completed the questionnaire for a response rate of 95.58%.

### Setting

The online survey was conducted on the JD Health platform, which is a popular and well-known online platform providing medical e-commerce, Internet medical and health services. Permission was obtained from JD Health to use their platform to distribute the survey and its questionnaires and maintain their security. An agreement was signed by the researchers and JD Health officials that data obtained would remain confidential and be used only for research purposes.

### Data collection

Data collection began on 6 June 2020 using the JD Health platform, it lasted two days. The website link to the questionnaire was titled ‘A survey on public eHealth literacy and psychological status during the COVID-19 pandemic’ and was attached to the home page of the platform. Visitors to the platform had the option of clicking on
this link, which then introduced them to the research study. Once they click on the link, an introduction to the study will come out. If they chose to participate, they could then continue and complete the online questionnaire. Informed consent was obtained in the first item of the online questionnaire. Participants received electronic coupons upon completion of the questionnaire.

2.5 | Materials

2.5.1 | General demographic questionnaire

Respondents completed a general demographic questionnaire including gender, age, nationality, education level, location in the past month and current health issues.

2.5.2 | eHealth Literacy Questionnaire (EHLQ)

In this study, the eHealth literacy of respondents was assessed by the eHealth Literacy Questionnaire (EHLQ). This was a researcher-designed questionnaire in Chinese, based on Sørensen et al.’s (2012) conceptual model of health literacy and Norman and Skinner’s (2006) definition of eHealth literacy. The core of Sørensen’s integrated conceptual model of health literacy is the ability to access, understand, appraise and apply health-related information. Noman’s definition also mentioned that eHealth literacy includes the ability to seek, find, understand, appraise and apply health information. Therefore, the researchers developed the underlying dimensions and questionnaire items referring to previous studies. Semi-structured interviews were conducted using a sample of seven participants to identify participants’ experiences, thoughts and understanding of eHealth literacy related to COVID-19. Based on their feedback, the preliminary items and dimensions of the questionnaire were developed. Using the Delphi method, six experts (including two experts in psychometrics, a nursing academic with doctorate degree, a computer scientist, a psychiatrist and a psychiatric clinical nurse specialist) were invited to review and evaluate the questionnaire content. A focus group with 10 participants (covered different ages and different levels of education) was conducted to avoid words that may be difficult to understand. Each person was given a questionnaire at the beginning of the focus group with questions of formal consent for participation, and the interview was recorded. After completing the questionnaire, participants were asked some questions developed by the researchers, which include the following: Could you tell us whether this questionnaire was clear? Have we missed any important information? Have you any comments about how we can improve the questionnaire? Then, pre-tests were conducted with 25 participants to adjust items, and the six experts were then invited to participate in round 2 of the Delphi process. In this way, the final version of the questionnaire was developed and consisted of 15 items covering information retrieval, information judgement, information utilization and the importance of the information. This questionnaire utilized a 4-point Likert scale (1 = strongly disagree, 4 = strongly agree), with a total score ranging from 15 to 60. Higher scores indicate that the respondent has better eHealth literacy. In this study, the EHLQ had good reliability with a Cronbach’s $\alpha$ of 0.952 and the test-retest reliability was 0.814. In addition, the EHLQ had a good scale content validity index value (S-CVI = 0.865) and item content validity index value (I-CVI = 0.825). Exploratory factor analysis (EFA) was used to analyse the validity of the questionnaire, and the KMO coefficient was 0.947 ($\chi^2 = 224,117.447, p < .001$). Confirmatory factor analysis (CFA) was conducted with Amos version 21.0 after the modifications. $\chi^2 = 7,035.070, \chi^2/df = 83.750, CFI = 0.969, GFI = 0.936, RMR = 0.015$ and RMSEA = 0.074.

2.5.3 | Patient Health Questionnaire-9 (PHQ-9)

The Patient Health Questionnaire-9 of Kroenke et al. (2001) was used to assess the severity of participants’ depressive symptoms in the past week. The PHQ-9 has good psychometric properties (Cronbach’s $\alpha = 0.89$) and consists of nine items, and each is rated on a 4-point Likert scale (0 = not at all, 1 = several days, 2 = more than half of the days and 3 = nearly every day) (Kroenke et al., 2001). The total score ranges from 0 to 27 points, in which 0–4 points mean no depression, 5–9 points mean mild depressive symptoms, 10–14 points mean moderate depressive symptoms and 15–27 points mean severe depression. Good reliability of the PHQ-9 has been shown in prior studies conducted of Chinese residents (Chen et al., 2013). In the present study, the Cronbach’s $\alpha$ was 0.92.

2.5.4 | Insomnia Severity Index (ISI)

The 7-item Insomnia Severity Index is a self-report questionnaire used to assess the nature, severity and impact of insomnia (Bastien et al., 2001). Item responses are scored on a 5-point Likert scale from 0 (not at all) to 4 (extremely). The total score varies from 0 to 28: 0–4 points mean no clinically significant insomnia, 5–14 points mean subthreshold insomnia, 15 to 21 shows clinical insomnia (moderate), and 22 to 28 indicates clinical insomnia (severe). The ISI has good reliability with a Cronbach’s $\alpha$ of 0.90 (Chahoud et al., 2017). The Chinese version of the ISI has been validated in an elderly population with good psychometric properties (Chen et al., 2013). In the present study, the Cronbach’s $\alpha$ was 0.915.

2.5.5 | Impact of Event Scale-Revised (IES-R)

The presence of PTSD caused by COVID-19 was measured using the Impact of Event Scale-Revised. The IES-R has 22 items and is composed of three subscales representing the main symptoms of PTSD such as intrusion, avoidance and hyperarousal (Weiss & Marmar, 1997). Items are rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (extremely). The total scores range from 0 to 88, with
higher scores indicating more severe PTSD. The Chinese version of the IES-R has good reliability with a Cronbach’s α of 0.89 (Guo et al., 2007). In the current study, the Cronbach’s α was 0.965.

2.6 | Data analysis

Data analysis was performed using SPSS version 21.0 for Windows (IBM Corp, 2012). Descriptive statistics (frequency, means and standard deviations) were used to describe sample characteristics, eHealth literacy, depression, insomnia and PTSD. The Pearson correlation was used to analyse the relationship between eHealth literacy and depression, insomnia and PTSD. For all statistical analyses, the significance level was set to p < .05.

3 | RESULTS

3.1 | Sample characteristics

Table 1 shows the socio-demographic characteristics of respondents. In the total sample (n = 15,000), 42.9% were males and 57.1% were females, and 42.5% of the respondents were between ages 31 and 40.

3.2 | eHealth literacy and psychological status of respondents

Scores for eHealth literacy, depression, insomnia and PTSD can be found in Table 2. In the total sample, the EHLQ score of the participants was higher (M = 48.88, SD = 8.46) than the median (median = 48), which indicated that participants had good eHealth literacy. In the EHLQ, the two highest scoring items were as follows: item 11 ‘the information is validated’ (Mean = 3.45, SD = 0.72) and item 13 ‘the news came from authorities’ (Mean = 3.44, SD = 0.73). Moreover, the score on depression of the respondents was 4.35 ± 4.66, of which 30.7% had mild depression, 7.9% had moderate depression and 3.5% had severe depression. The mean score related to insomnia was 5.38 (SD = 5.34), and the proportions of subthreshold insomnia, moderate insomnia and severe insomnia were 24.1%, 6.0% and 0.8%, respectively. The mean PTSD score was 14.99 (±13.95), among which 37.8%, 15.4% and 4.7% had mild, moderate and severe PTSD.

3.3 | Pearson’s correlation analysis between eHealth literacy and depression, insomnia and PTSD

Table 3 examines the relationship between eHealth literacy and depression, insomnia and PTSD. It indicates that eHealth literacy negatively correlated with depression (r = −0.331, p < .001), insomnia (r = −0.366, p < .001) and PTSD (r = −0.320, p < .001). Higher eHealth literacy was associated with lower depression, insomnia and PTSD.

4 | DISCUSSION

4.1 | eHealth literacy

According to the current study, the eHealth literacy score of Chinese residents was (M = 48.88, SD = 8.46), indicating that Chinese residents had good eHealth literacy during the COVID-19 pandemic. The possible explanation is that popularization of the Internet and the development of modern communication technology have provided a platform for residents to search Web-based medical resources in recent years. The outbreak of COVID-19 has increased people’s demand for eHealth resources and as residents are forced to isolate themselves at home, using the Internet to find medical information...
TABLE 2 Scores on eHealth literacy and psychological status

|                  | M    | SD   | n   | %   |
|------------------|------|------|-----|-----|
| EHLQ             | 48.88| 8.46 |     |     |
| Information retrieval | 9.94 | 2.00 |     |     |
| Information judgement | 9.28 | 2.14 |     |     |
| Information utilization | 9.53 | 1.99 |     |     |
| Importance of information | 20.11 | 3.83 |     |     |
| PHQ-9            | 4.35 | 4.66 |     |     |
| 0–4 (none)       | 8,673| 57.8 |     |     |
| 5–9 (mild)       | 4,604| 30.7 |     |     |
| 10–14 (moderate) | 1,191| 7.9  |     |     |
| 15–27 (severe)   | 532  | 3.5  |     |     |
| ISI              | 5.38 | 5.34 |     |     |
| 0–7 (none)       | 10,366| 69.1|     |     |
| 8–14 (subthreshold insomnia) | 3,610| 24.1|     |     |
| 15–21 (moderate) | 902  | 6.0  |     |     |
| 22–28 (severe)   | 122  | 0.8  |     |     |
| IES-R            | 14.99| 13.95|     |     |
| 0–8 (none)       | 6,319| 42.1 |     |     |
| 9–25 (mild)      | 5,663| 37.8 |     |     |
| 26–43 (moderate) | 2,317| 15.4 |     |     |
| 44–88 (severe)   | 701  | 4.7  |     |     |

Abbreviations: EHLQ, eHealth Literacy Questionnaire; IES-R, Impact of Event Scale-Revised; ISI, Insomnia Severity Index; PHQ-9, Patient Health Questionnaire-9.

TABLE 3 Correlation analysis of eHealth literacy and psychological status

|          | EHLQ     | PHQ-9    | ISI       |
|----------|----------|----------|-----------|
| PHQ-9    | \( r = -0.331^{**} \) | - | - |
| ISI      | -0.366** | -        | -         |
| IES-R    | -0.320** | 0.637** | 0.598** |

**Significant correlation at level 0.01 (double-tailed).

has become an important resource to meet individual psychological and physical health needs.

In this current research, residents not only used the Internet to search for information related to the pandemic, but also attached great importance to the reliability of information. For example, they believed that verified information and official information are very important. Unfortunately, there was a lot of complicated, contradictory and incorrect information on social media during the COVID-19 pandemic (Zarocostas, 2020). The dissemination of incorrect and contradictory information may not only affect the public’s appropriate behaviour, but also endanger official efforts to prevent and control COVID-19 (Chong et al., 2020). Therefore, it is necessary for social and traditional media to provide residents with timely, scientific and helpful information (Zarocostas, 2020).

4.2 | Psychological status

The results of this study showed that 11.4% of respondents experienced moderate to severe depressive symptoms, 6.8% experienced moderate to severe clinical insomnia, and 20.1% experienced moderate to severe PTSD. These findings are similar to a study conducted in Italy where 17.3% and 7.3% of respondents reported to have severe depression and clinical insomnia (Rossi et al., 2020) and another study in Saudi Arabia that found that the level of moderate to severe PTSD was 23.6% (Alkhamees et al., 2020). During the COVID-19 crisis, due to the uncertainty of the development of the pandemic, fear of being infected and a reduction in social activities, the majority of people are suffering from insurmountable psychological pressure, which may increase the risk of depression (Ge et al., 2017). The COVID-19 pandemic is a major public health emergency. The experience of such a traumatic event can severely disrupt the integrity and continuity of individual sleep and cause insomnia (Lin, Wang et al., 2020; Sinha, 2016). Meanwhile, it can have a significant impact on the individual’s mental health and may lead to PTSD (Schwartz et al., 2019).

In addition, the current study also found a correlation between depression, insomnia and PTSD. Depression is a common comorbidity of PTSD (Short et al., 2018). A study showed that 36.4% of patients with depression had PTSD comorbidities (Tao et al., 2020). Depression and insomnia also interact. During COVID-19, people’s normal sleep patterns are easily disturbed by psychological problems such as depression caused by the pandemic, which increases the risk of sleep disorders, especially insomnia (Lin, Wang et al., 2020; Sinha, 2016). Conversely, persistent insomnia also increases the risk of depression (Vargas & Perlis, 2020). People with insomnia are twice as likely to experience depression compared with individuals without insomnia (Baglioni et al., 2011). Interactive association may exist between insomnia and PTSD (Short et al., 2020; Tayor et al., 2016). A prospective study conducted among American soldiers found that insomnia was associated with an increased risk of PTSD and helps predict the development of PTSD (Wang et al., 2019). However, another study conducted among female military veterans in the United States found that compared to women without PTSD, women with PTSD experienced more severe sleep disorders, perceived sleep quality worsened and had more severe insomnia symptoms (Hughes et al., 2013).

4.3 | Relationship between eHealth literacy and psychological status

Findings from this study indicated that eHealth literacy is associated with depression \( (r = -0.331, p < .001) \), insomnia \( (r = -0.366, p < .001) \) and PTSD \( (r = -0.320, p < .001) \). Individuals with higher eHealth literacy might be inclined to have better psychological status, which is consistent with previous studies (Xie et al., 2020; Zhang et al., 2019). A study from Vietnam found that individuals with higher health literacy, even if they are suspected of
having COVID-19 symptoms, have a lower incidence of depression (Nguyen et al., 2020). Another study conducted in Iran showed that good eHealth literacy can improve symptoms of insomnia and anxiety (Lin, Ganji et al., 2020). In addition, a survey of American veterans found that those with higher eHealth literacy tended to search for health information on the Internet in order to better manage negative emotions and related symptoms caused by PTSD (Whealin et al., 2016).

Good eHealth literacy means that individuals have higher utilization of health resources obtained on the Internet, and better health self-management and adjustment capabilities (Xie et al., 2020). Therefore, when individuals suffer from psychological problems such as depression, insomnia and PTSD due to the COVID-19 pandemic, it is possible to effectively find and make full use of online medical resources to maintain and promote mental health. In addition, Osborn et al. (2011) and colleagues also found through path analysis that health literacy affects self-efficacy through knowledge and ultimately has a direct or indirect impact on health status. Therefore, in view of the positive impact of eHealth literacy on psychological status, it is very important to take measures to improve residents’ eHealth literacy to promote mental health.

4.4 | Limitation

There are some limitations in this study. First, the use of self-reporting methods to measure the eHealth literacy and psychological status of the participant may not fully reflect the true situation of the participant. Second, the cross-sectional research design makes it impossible to establish causality. Third, the participants in this study were Chinese residents, but 530 disclosed that in the previous month, they had not been living in China. There was no way to determine whether they had been travelling abroad for a short time, participating in study programmes or lived abroad for an extended period. Finally, this study is an electronic survey conducted on the JD Health platform, requiring respondents to have good electronic equipment, a high level of education and well-developed Internet skills. Therefore, this may cause the sample to be under-represented.

5 | CONCLUSIONS

This research found that during the COVID-19 pandemic, Chinese residents have good eHealth literacy, but at the same time, some residents also have varying degrees of depression, insomnia and PTSD. This suggests that public mental health problems during the pandemic cannot be ignored. Moreover, this study also emphasizes the close correlation between eHealth literacy and psychological status as individuals with lower eHealth literacy might be inclined to have poor psychological status. The research findings suggest that improving eHealth literacy may be an effective way to maintain good psychological status.

5.1 | Implications for nursing management

The psychological impact of COVID-19 on the public is long-lasting. In view of the close connection between eHealth literacy and psychological status, it is vital to take necessary measures to improve individuals’ eHealth literacy in order to more effectively deal with the psychological problems caused by the COVID-19 pandemic. Measures that can be considered include not only ensuring the reliability and authenticity of the information, but also paying attention to the presentation of information. Social media should use brief forms such as cartoons, pictures and short videos to present and disseminate health information, and avoid the use of professional terminology to ensure that residents can better understand and use the information.

Moreover, nurses play an important role in the health care system. Therefore, community health nurses should assist residents to understand and use eHealth resources to promote and improve their health. Nurse administrators of community and public health nursing services should offer enhanced education and training to nurses in the dissemination of evidence-based health information and the use of electronic resources to better serve the residents in their community. Community health nurses need a high level of eHealth literacy so they can teach their patients to use online resources effectively.

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ETHICAL APPROVAL

Ethical approval (code: WDRY2020-K004) by the Ethics Committee of Renmin Hospital of Wuhan University was obtained on 29 January 2020. The purpose of the study was stated in the questionnaire, and informed consent of respondents was obtained in the first item of the questionnaire. In addition, this study used anonymous questionnaires to protect the personal privacy of participants. Respondents participated voluntarily, and they were allowed to refuse to participate or withdraw from the survey at any time.

AUTHOR CONTRIBUTIONS

Bing Xiang Yang, Lin Xia, Run Huang, Xiao Qin Wang, Sihong Yu and Xiaofen Li designed the study and wrote the research protocol. Bing Xiang Yang, Lin Xia, Zhongchun Liu and Run Huang did the literature review, quality control, statistical analysis and prepared the manuscript draft. Sihong Yu, Pan Chen, Dan Luo, Qian Liu, Li Jun Kang and Zhi-jiang Zhang supervised the survey and checked the data. Bing Xiang Yang and Xiao Qin Wang contributed to the revisions in depth for the manuscript. All authors contributed to and approved the final manuscript.
DATA AVAILABILITY STATEMENT
Research data are not shared.

ORCID
Bing Xiang Yang https://orcid.org/0000-0002-0227-4342

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