

# The associations among individual factors, eHealth literacy, depression symptoms and health related quality of life among Chinese elderly: a cross-section study

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## Research article

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# Abstract

**Background:** The higher level of eHealth literacy the elderly has, the easier it is to acquire benefits of health-seeking information online. The aim of this study is to evaluate the psychometric properties of the eHealth Literacy Scale (eHEALS) and examine the associations of eHEALS scores with depression, health-related quality of life (HRQoL), lifestyles among the elderly.

**Methods:** A survey of 6183 participants (age 60 years and above) from 17 communities were conducted in June, 2019. Participants answered questions related to socio-demographics, eHEALS, geriatric depression scale and the short-form health survey (SF-36, assessing health-related quality of life). Two mediation models were conducted. A multi-linear regression analysis was performed to explore the association between the eHEALS scores and associated factors using Statistical Package for Social Science version 20.0. Significance was obtained at 95% CI and  $P < 0.05$ .

**Results:** Exploratory factor analysis identified one component structure, accounting for 78.52% of the total variance. The factor loadings of eHEALS ranked from 0.832 to 0.905. The Cronbach  $\alpha$  of overall scale was 0.961. eHEALS was significant higher in men ( $B = 0.616$ , 95%CI 0.235~0.997,  $P = 0.002$ ), those with living in the city ( $B = 1.471$ , 95%CI 1.064~1.878,  $P < 0.000$ ), those with high educated ( $B = 1.713$ , 95%CI 1.581~1.844,  $P < 0.000$ ), and those with living with family ( $B = 6.436$ , 95%CI 4.574~8.298,  $P < 0.000$ ), as compared to their counterparts, respectively. Moreover, chronic diseases ( $B = -2.218$ , 95%CI -2.632~-1.804,  $P < 0.000$ ) and depression symptoms ( $B = -0.116$ , 95%CI 0.153~0.078,  $P < 0.000$ ) were found negatively associated with eHEALS, while actively obtaining health information positively influenced eHEALS ( $B = 3.350$ , 95%CI 2.950~3.749,  $P < 0.000$ ) after adjusting socio-demographics, lifestyles and HRQoL. Furthermore, depression symptoms had direct and indirect effects on HRQoL, as mediated by eHealth literacy.

**Conclusions:** The eHEALS was a valid and reliable survey tool. As eHealth literacy was a protector for the aged, efforts to improve the older adults' eHEALS scores can help to main health status. Therefore, healthcare providers formulate effective programs to improve eHealth literacy for the elderly, which can bring benefits for health aging.

## 1. Background

In an aging society where the requirements for extended care services are a prerequisite to meet the needs of older adults, the adoption of digital technologies health is seen as a solution. Benefiting from digital technologies, the use of Internet among older adults has become a ubiquitous and almost indispensable part of their daily lives. Recent data indicates that more than 96 million aged 60 years and above were netizens, and the number has increased by 3.6% compared to the previous report surveyed in March, 2020 [1, 2]. According to reports, a growing number of Chinese elderlies tended to obtain health care information derived from the Internet [3, 4]. Since the onset of the coronavirus disease 2019 (COVID-19) pandemic, users' demand for online medical services has continued to increase. As of June 2020, the number of online medical users had reached 276 million, accounting for 29.4% of the total Internet users [1]. Previous studies have reported that older adults expected convenient and easy healthcare as facilitated via electronic health (eHealth), which increasingly accessed to medical information, the provision of interpersonal support among patients, online educational meetings, the checking prescriptions, online consultations from hospitals and medical staffs and medical decision-making alternatives [5-7]. These benefits, in turn, may have a positive impact on their health, as well as on their families and communities [8]. Furthermore, eHealth has the potential to reduce barriers to access to care services and to facilitate health care delivery. In the terms of risk, there are problems of exposure to inappropriate health information, inability to identify the correct information available online, or the misuse of these health information—all of which may be overwhelming and lead to insecurity or anxiety [9].

Disinformation and misinformation online as public concerning issues have been raised [10, 11]. eHealth literacy, defined as "the ability to select, appraise, and utilize good quality health information from the Internet", is of great important to motivate health information seeking and scanning behaviors, evaluate health information, and maximize the potential

benefits of eHealth for their health-related lifestyle [12-16]. Moreover, it had reported that limited eHealth literacy was an obstacle for online health information-seeking behaviors in patients with chronic diseases [17]. In conclusion, high level of eHealth literacy is associated with better health outcomes. Additionally, ever increasing studies have consistently found that age, education and low income are significant predictors of eHealth literacy [18-20]. The elderly is more likely to have difficulty in using Internet applications to manage their health and lifestyles [21]. Although the proportion of elderlies searching for health-related information online is high, the level of their eHealth literacy varies greatly. Therefore, many older adults utilize inappropriate or incorrect information obtained from low-quality health-related content online, which may bring a negative impact on their health. In general, assessing the level of eHealth literacy is an essential prerequisite for guiding the elderly to maintain and promote health, prevent and manage diseases via using electronic resources.

eHealth literacy plays an important role in evaluation and adoption of health information online, which is critical for people who are overwhelmed by diverse information and sources posted online. It has reported that health and eHealth literacy support the development of interactive eHealth interventions toward fostering better patient engagement in skeletal health management among older adults [22]. Even though there is ever growing interest in eHealth among older adults, lack of experience with technology, or a fear of accessing and selecting inaccurate or unreliable information, or hearing and visual impairments, or a difficulty in communicating, or cognitive impairment are main obstacle to using eHealth resources, which are, in turn, resulting in low level of eHealth literacy [23]. However, it is precisely because of their illness that they need receive various aspects health education and services including diet, regular exercise and lifestyle, in order to manage self-health, which require the older adults' competencies to both utilize eHealth technologies and own high level of eHealth literacy. In addition, low eHealth literacy can compromise the effectiveness of eHealth services and health promotion. Therefore, it is essential to evaluate the eHealth literacy and explore determinants of eHealth literacy among the elderly.

In this study, we evaluated the psychometric properties of the eHealth literacy scale (eHEALS) and examined the predictors of eHEALS and examined the relationship between depression and health-related quality of life (HRQoL) as mediated by eHealth literacy. The results of this study may provide evidence for development of Internet-based interventions and, therefore, determine the role of eHealth literacy in improving the health of the aged.

## **2. Methods**

### **2.1 Research design**

The research was a descriptive and correlational study.

### **2.2 Sample and Data collection**

Using convenience sampling, 6309 respondents were recruited from 17 communities in Wuhan, China. The criteria for involvement in the research were as follows: respondents with age 60 years and above; the ability to surf the Internet; the ability to self-report and voluntarily cooperate with the study. In contrast, the exclusion criteria were as follows: participants with severe and terminal diseases, severe cognitive impairment, hearing and visual impairments or sequelae of stroke and psychiatric disorders, which result in failure to cooperate with the study. Data were collected using structured-questionnaires in June, 2019. Participants filled out questionnaires by themselves; if necessary, the trained research assistants read the questions to the participants and marked their responses on the questionnaires. The sample of 6183 (98% of the population) completed survey; 126 were excluded as a result of missing values.

### **2.3 Instruments**

eHealth Literacy Scale: the scale was developed by Norman and Skinner, original used with adolescents in Canada [24]. The modified Chinese version was revised by Ma and Wu [25]. The responses to the eight questions were rated on a 5-point Likert from 1 (strongly disagree) to 5 (strongly agree). Scores are from 8 to 40, with higher scores indicating better level of eHealth literacy.

30-item Geriatric Depression Scale (GDS) [26]: the instrument is widely used in research among older adults which consists of 30 objective questions about depression symptoms, all taking yes or no answer. A higher score indicates an elevated level of depression symptoms. Severity classifications are defined as follows: 0-10 for no depression, 11-20 for moderate depression, and 21-30 for severe depression. The Cronbach's  $\alpha$  of the present data was 0.832.

The Short-Form Health Survey (SF-36) [27]: SF-36 from the Medical Outcomes Study has been the most frequently used tool for assessing HRQoL. SF-36 measures self-reported health status and contains eight subscales: physical function (PF), role-physical (RP), body pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE) and mental health (MH). The mental component summary (MCS) is composed of VT, SF, RE and MH, and the physical component summary (PCS) is composed of PF, RP, BP and GH. Higher scores indicate better level of HRQoL.

Demographic questionnaire: a demographic information sheet is used to acquire basic information, such as gender, age, residence, education, parents' monthly income, marital status, smoking, drinking, physical activity and so on.

## 2.4 Ethical Consideration

The study was reviewed and approved by the Institutional Ethical Review Committee of Hubei University of Chinese Medicine (2018-ICE-033). Prior to the collection of data, the purposes and procedures of this study were explained to the respondents. Participants were informed that they would withdraw from the study at any time. Data were collected only from those who voluntarily agreed and provided written consent to participate in the study.

## 2.5 Data Analysis

The construct validity of the eHEALS was evaluated by exploratory and confirmatory factor analysis. A Kaiser-Meyer Olkin (KMO) measure of sampling adequacy was  $\approx 0.6$ . A Bartlett Test of Sphericity value was  $< 0.5$ , which suggests these data were suitable for principal component analysis (PCA). The Spearman correlation was used to determine the relationship between ordinal variables. The data were shown as the mean  $\pm$  standard deviation (SD) and analyzed using SPSS 20.0 software package with chi-square (fisher exact probability), t-test, and one-way analysis of variance (ANOVA). The statistical significance was defined as a difference between groups of  $P < 0.05$ . A multi-linear regression analysis was designed and performed for each independent variable and a  $P < 0.20$  was included in the final model. The strength of association was explained in terms of regression coefficient (B) and 95% confidence interval (95%CI).

# 3. Results

## 3.1 Sample Characteristics

Sample characteristics are presented in Table 1. The mean age of participants was 72.6 (SD = 5.36), with a range of 60-92 years. Of the 6183 participants, 55.3% were female, 51.8% lived in the rural. Most participants were married (65.0%) and were not highly educated. In terms of participants' type of living, 43.9% of them lived alone, and 31.0% lived with children. A total of 29.5% of the participants had chronic diseases. 58.5% never smoked, 47.5% never drank and 35.4% had "rarely" physical activity level. Among the respondents, 59.9% reported that they actively obtained health information. 27.5% reported getting health information from family and friends, while 33.5% reported getting information via Internet. The mean (SD) scores of eHEALS, GDS, PCS and MCS were 21.17 (8.25), 10.84 (6.30), 62.95 (15.83) and 63.91 (15.58), respectively. The eHEALS varied by gender, residence, marital status, education, employment status, type of living, stable income, chronic disease, smoking, drinking, physical activity, actively obtain health information, ways to seek health information and depression symptoms.

Table 1 General characteristics of the participants according to eHealth literacy (n = 6183)

Variables	n	%	eHealth Literacy Mean (SD)	F / t-value	P-value
Sex					
Female	3422	55.3	20.77 (8.38)	13.433	0.000
Male	2761	44.7	21.67 (8.07)		
Residence					
Rural	3205	51.8	19.57 (8.39)	108.69	0.000
City	2978	48.2	22.88 (7.74)		
Marital Status					
Unmarried	705	11.4	23.94 (8.09)	58.674	0.000
Married	4022	65.1	21.14 (8.08)		
Divorce, bereaved, separated	1456	23.5	19.88 (8.47)		
Education					
No education or elementary school	2756	44.6	17.92 (8.41)	357.292	0.000
Middle school	1085	17.5	21.53 (7.07)		
High school	882	14.3	23.80 (6.50)		
College or higher	1460	23.6	25.46 (7.05)		
Employment status					
Unemployment	2392	38.7	21.17 (7.90)	179.594	0.000
Employment	865	14.0	24.95 (6.63)		
Farm work	1800	29.1	18.10 (8.41)		
Other	1126	18.2	23.16 (8.05)		
Living alone					
Yes	2714	43.9	20.85 (8.42)	-3.396	0.000
No	3469	56.1	21.57 (8.00)		
Type of living- living with children					
Yes	1915	31.0	21.27 (8.25)	9.163	0.002
No	1554	25.1	20.35 (8.26)		
Religious belief					
Yes	875	14.2	20.30 (8.68)	15.706	0.000
No	5308	85.8	21.31 (8.17)		
Stable income					
Yes	5122	82.8	23.18 (7.64)	92.650	0.000
No	1061	17.2	20.08 (8.37)		

Chronic disease					
Yes	2175	35.2	23.18 (7.64)	92.650	0.000
No	4008	64.8	20.08 (7.64)		
Smoking					
Never	3617	58.5	20.95 (8.47)	9.518	0.000
Rarely	1122	18.1	22.47 (7.57)		
Sometimes	544	8.8	20.99 (7.30)		
Often	589	9.5	20.26 (8.85)		
Quit	311	5.0	21.11 (8.03)		
Drinking					
Never	2935	47.5	20.66 (8.60)	17.294	0.000
Rarely	1927	31.2	22.03 (7.81)		
Sometimes	851	13.8	21.98 (7.41)		
Often	364	5.9	19.78 (8.59)		
Always	106	1.7	17.80 (9.00)		
Physical activity					
Never	985	15.9	18.23 (8.47)	48.441	0.000
Rarely	2186	35.4	20.95 (8.10)		
Sometimes	1417	22.9	21.95 (7.67)		
Often	1139	18.4	22.77 (7.99)		
Always	456	7.4	21.17 (9.17)		
Actively obtain health information					
No	2478	40.1	18.07 (8.33)	142.388	0.000
Yes	3705	59.9	23.24 (7.51)		
Ways to seek health information					
Books and newspapers	1151	18.6	23.56 (7.26)	114.91	0.000
Family and friends	1699	27.5	19.25 (8.31)		
Internet	2074	33.5	22.69 (7.77)		
Medical staff	568	9.2	21.47 (8.47)		
other	691	11.2	17.09 (8.18)		
GDS-30					
0~10	3019	48.8	22.01 (8.59)	55.082	0.000
11~20	2819	45.6	20.71 (7.73)		
21~30	345	5.6	17.50 (8.12)		

### 3.2 Psychometric properties of eHealth literacy

As shown in Table 2, the KMO value of sampling adequacy in the overall scale was 0.954. The Bartlett Test of Sphericity reached statistical significance ( $P = 0.000$ ), which supported the factorability of the correlation matrix. Overall, one factor extracted from the 8 items of the eHEALS accounting for 78.52% of the variance. The factor loading values of 8 items were ranked from 0.832 to 0.905. The correlations between each item and the scale range from 0.835 to 0.904, indicating satisfactory convergent validity. Furthermore, reliability analyses showed good internal consistency in the eHEALS. The value of overall scale Cronbach  $\alpha$  was 0.961.

Table 2 Construct, convergent, and criterion validity, and internal consistency of the 8-item eHealth Literacy Scale (n = 6183).

Construct validity, factor loadings	Values
eHealth Literacy scale items	
I know what health resources are available on the internet	0.832
I know where to find helpful health resources on the internet	0.893
I know how to find helpful health resources on the internet	0.905
I know how to use the internet to answer my questions about health	0.902
I know how to use the health information I find on the internet to help me	0.902
I have the skills I need to evaluate the health resources I find on the internet	0.895
I have the skills needed to tell high-quality health resources from low-quality health resources on the internet	0.879
I feel confident in using information from the internet to make health decisions	0.880
Percentage of variance, %	78.52
Item-scale convergent validity, mean of $P^a$ (range)	0.886 (0.835~0.904)
Internal consistency, Cronbach $\alpha$	0.961

<sup>a</sup>  $P$ : Spearman correlation coefficient.

### 3.3 Determinants of eHealth literacy

Results of the multivariate analysis depicted in Table 3 indicated that older adults with higher eHEALS scores were men (unstandardized regression coefficient [B] = 0.616, 95%CI 0.235~0.997,  $P = 0.002$ ), those with living in the city (B = 1.471, 95%CI 1.064~1.878,  $P < 0.000$ ), those with graduating from college or higher (B = 1.713, 95%CI 1.581~1.844,  $P < 0.000$ ), and those with living with family (B = 6.436, 95%CI 4.574~8.298,  $P < 0.000$ ), as compared to their counterparts, respectively. According to the results a multivariate analysis (Table 4), both chronic diseases (B = -2.218, 95%CI -2.632~-1.804,  $P < 0.000$ ) and depression symptoms (B = -0.116, 95%CI 0.153~0.078,  $P < 0.000$ ) were found negatively associated with eHEALS, while actively obtaining health information positively influenced eHEALS (B = 3.350, 95%CI 2.950~3.749,  $P < 0.000$ ) after adjusting socio-demographics, drinking and SF-36.

Table 3 Multivariate line regression analyses for predictive factors of eHealth literacy

Variables	Unstandardized Coefficients	Standardized Coefficients	95%CI	t	P
	B	$\beta$			
Constant	5.604		3.239~7.969	4.646	0.000
Sex	0.616	0.037	0.235~0.997	3.170	0.002
Residence	1.471	0.089	1.064~1.878	7.078	0.000
Marital Status	-0.693	-0.049	-1.050~-0.335	-3.799	0.000
Education	1.713	0.067	1.581~1.844	25.489	0.000
Employment status	-0.146	0.053	-0.251~-0.041	2.732	0.006
Living alone	6.436	0.387	4.574~8.298	6.777	0.000
Living with children	1.472	0.321	0.963~1.981	5.667	0.000
Income	0.967	0.056	0.536~1.399	4.394	0.000

Table 4 Determinants of eHealth literacy among older adults

Variables	Model 1			Model 2			Model 3		
	B	95%CI	P value	B	95%CI	P value	B	95%CI	P value
Chronic diseases	-3.130	-3.547~-2.712	0.000	-2.446	-2.823~-2.011	0.000	-2.218	-2.632~-1.804	0.000
Physical activity	0.526	0.355~0.697	0.000	0.259	0.093~0.425	0.002	0.249	0.083~0.416	0.003
Actively obtain health information	4.468	4.063~4.873	0.000	3.438	3.041~3.834	0.000	3.350	2.950~3.749	0.000
Ways to seek health information	-0.369	-0.529~-0.264	0.000	-0.302	0.920~1.087	0.000	-0.309	0.918~1.089	0.000
Depression	-0.131	-0.169~0.092	0.000	-0.104	-0.141~-0.067	0.000	-0.116	-0.153~-0.078	0.000
MCS	-0.066	-0.093~-0.039	0.000	-0.033	-0.052~-0.013	0.000	-0.036	-0.054~-0.019	0.000
GH	0.031	0.016~0.046	0.000	0.036	0.021~0.050	0.000	0.039	0.024~0.053	0.000

Model 1: Adjusted smoking, drinking, PF, RP, BP, VT, SF, RE, MH, PCS

Model 2: Additionally, adjusted sex, residence, marital status, education level, employment status, religious belief

Model 3: Additionally, adjusted type of living, income, medical insurance

### 3.4 Mediation of eHealth literacy between depression and HRQoL

Figure 1 depicts how eHealth literacy mediates the relationship between depression symptoms and SF-36. Depression symptoms, an independent variable, was significantly associated with MCS and the dependent variable ( $B = -1.323$ ,  $P < 0.000$ ). Depression symptoms was also significant associated with eHealth literacy, a mediator ( $B = -0.220$ ,  $P < 0.000$ ).

Further analysis of the indirect effects of eHealth literacy was conducted based on relationship between the main variables; when regressing MCS on depression symptoms and eHealth literacy, the B value decreased from -1.323 to -1.315 ( $P < 0.000$ ). Moreover, depression symptoms, an independent variable, was significantly associated with PCS and the dependent variable ( $B = -1.111$ ,  $P < 0.000$ ) (Figure 2). Further analysis of the indirect effects of eHealth literacy was conducted based on relationship between the main variables; when regressing PCS on depression on eHealth literacy and depression symptoms, the B value decreased from -1.111 to -1.069 ( $P < 0.000$ ). This implies that eHealth literacy partially mediated the relationship between depression symptoms and SF-36.

## 4. Discussion

Healthy aging is the only way that government cope with ever-growing older population in China. Providing the elderly with usable, accessible, acceptable and high-quality health services, and maintaining and promoting health of the elderly are inevitable requirement for social stability. eHealth is playing an increasingly significant role in using eHealth services and making decisions of health-related issues. Nevertheless, the Internet is flooded with inaccurate and misleading health information, which requires the elderly to have a high level of eHealth literacy to evaluate information. This study identified the predictors of eHEALS scores as well as the mediating effect by eHealth literacy.

The eHEALS was found to be valid and reliable for assessing the eHealth literacy of the aged. The tool was found to have satisfactory construct validity, convergent validity and reliability, which is analogous to the findings in the context of different populations [20, 25, 28]. The mean eHEALS score was higher than those surveyed in the previous report [29]. This inconsistent result could be due to the high proportion of the sample with college or higher. In this study, men had higher eHEALS scores. This finding is inconsistent with previous studies conducted among the general population in Hungary and in health care professionals in Ethiopia, in which men had lower scores than women [30, 31]. This inconsistency could be explained by fact that although the population had fewer males (44.7% versus 55.3% female), the proportion of men with high school or higher was higher than that of women (38.7% versus 37.2%). People with less educated had lower eHEALS scores than other participants in this study. People without a college degree reported low confidence in evaluating online health sources and distinguishing between high-quality and low-quality resources [32]. Notably, people living with children had higher level of eHealth literacy than those who lived alone or lived with spouse. Moreover, living status was a significant predictor of eHealth literacy. A negative association between the eHEALS scores and living status was prominently found in previous study [33]. These findings imply that socioeconomic factors are independent indicators, which are worth to be considered in formulating interventions to improve eHealth literacy.

In this study, people without chronic disease had higher eHEALS scores. Even though people with chronic had strong desire to seek for health information on the internet for medication information, nutrition, disease management and prevention actions, and so on. It has reported that those who rated their health as good or excellent had significantly higher eHEALS scores than those who rated their health as fair or poor [34]. In addition, participants in the high eHEALS scores group exercised more frequently than those in the low score group. This association was significant after adjusting for participant characteristics. This was similar to the findings of previous study in the context of health care workers and university students [20, 35, 36]. Smoking and excessive alcohol were not associated with eHEALS scores. The results were consistent with general surveys of Japanese adults, in which the eHEALS scores was not associated with smoking or alcohol consumption but were associated with physical activity [35, 37]. This may be because the rates of habitual drinkers (470/6183, 7.6%) and current smokers (589/6183, 9.5%) were low in this study; thus, it is difficult to assess the association of eHEALS scores and drinking and smoking.

As expected, the aged who actively obtained health information had higher eHEALS scores. Our result was in line with previous studies, which showed that higher eHealth literacy was correlated with positive attitudes towards health information among chronic patients [38]. Most participants got health information via Internet or family and friends; moreover, people who obtained health information through Internet or books and newspapers had higher eHEALS scores.

Internet was the most utilized source of health information among patients with chronic rheumatic diseases and Alborz medical sciences students [39, 40]. Increased access to the Internet has facilitated widespread availability of health information. Therefore, the increasing use of the Internet is as a source of health information around the world. Furthermore, the eHEALS scores were positive with frequency of the Internet use for health-related purposes [33, 41].

Consistent with the findings of previous study [42], this study found that older persons had a high prevalence of depressive symptoms. As hypothesized, people who had self-reported depression symptoms had lower eHEALS, which is analogous to the finding in the context of Iranian older patients with heart failure [43]. However, evidence showed that eHEALS scores in the older age group were inversely associated with a depression diagnosis, suggesting that older adults with depression were more likely to use internet than those without depression [33]. This inconsistency could be explained by the fact that the proportion of depression symptoms with less educated (1606/6183, 26.0%) was higher than of depression with high educated (588/6183, 10.5%) in this survey. Moreover, our results showed that the impact of depression on HRQoL could be mediated through eHealth literacy. A significant negative correlation between depression and HRQoL has been demonstrated in previous cross-section studies [42, 44]. Depression is the most common mental disorder found in the elderly population, as late-life depression might have serious consequences, such as cognitively impaired, immune dysregulation, and an increased risk of suicide [45-47]. Notably, with decreased the level of eHealth literacy, elderly persons' physical and mental status declined. Older adults who reported having high level eHealth literacy may be capability to screen, understand, and analyze health information, suggesting being willing to maintain a healthy lifestyle.

This study had some limitations. First, some of the studied variables (e. g. HRQoL and depression symptoms) were reported using self-administered questionnaires. Therefore, our findings may suffer from the negative effects of recall bias and social desirability. Second, the study could not control for other factors, such as Internet use, informational social support, attitudes towards Internet. Thus, future studies should include these variables. Third, a cross-sectional design was used, which cannot provide evidence of the causal relationships among studied variables. Furthermore, the convenient sampling technique used may limit the generalizability of the findings.

## 5. Conclusion

In general, the eHEALS questionnaire was found to be valid and reliability for assessing the eHealth literacy of the elderly. eHealth literacy was significantly higher in men, those with high educated, those living with children, those living in city. eHealth literacy was associated with healthier status and lifestyle (no chronic disease and regularly more physical activity), more willing to obtain health-related information, and a lower likelihood of depression symptoms. Furthermore, this study identified the association of depression and HRQoL, as mediated by eHealth literacy. eHealth literacy could be a protector for the aged to avoid serious health outcomes. Through improved eHealth literacy, the aged may reduce health-related problems. Thus, healthcare providers in the community may plan effective programs to improve the eHealth literacy for the elderly.

## Abbreviations

BP: Body pain; COVID-19: The coronavirus disease 2019; eHealth: electronic health; eHEALS: eHealth Literacy Scale; GH: General health; GDS: Geriatric Depression Scale; HRQoL: Health-related quality of life; KMO: Kaiser-Meyer Olkin; MCS: Mental component summary; MH: Mental health; PCA: Principal component analysis; PCS: Physical component summary; PF: Physical function; RE: Role-emotional; RP: Role-physical; SF-36: The short-form health survey; SF: Social functioning; VT: Vitality;

## Declarations

The authors declare that they have no competing interests.

## Ethics approval and consent to participate

Ethics approval of this survey was granted from the Institutional Ethical Review Committee of Hubei University of Chinese Medicine (2018-ICE-033), and written informed consent was obtained from all participants. In case participants would decide to withdraw their consent, it was guaranteed that individual data was not used in data analysis and deleted.

## Consent for publication

Not applicable

## Availability of data and materials

The data used to support the findings of this study are available from the corresponding author upon request. The data are not publicly available due to privacy or ethical restrictions.

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## Authors' contributions

ZX grafted the manuscript and analyzed the data. ZX and YF were responsible for the conception of this study and study design. YF participated in data collection. All authors read and approved the final manuscript.

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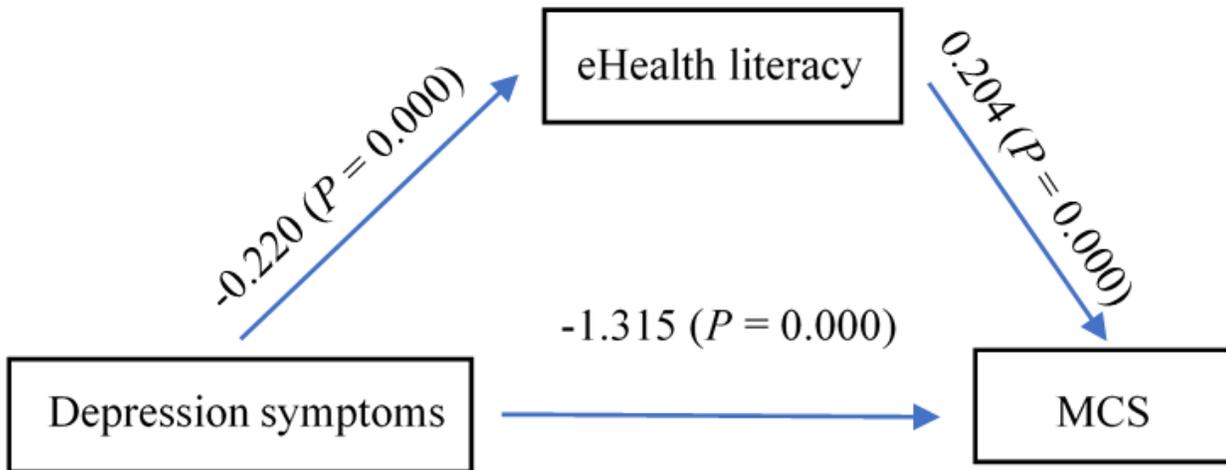
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## Figures



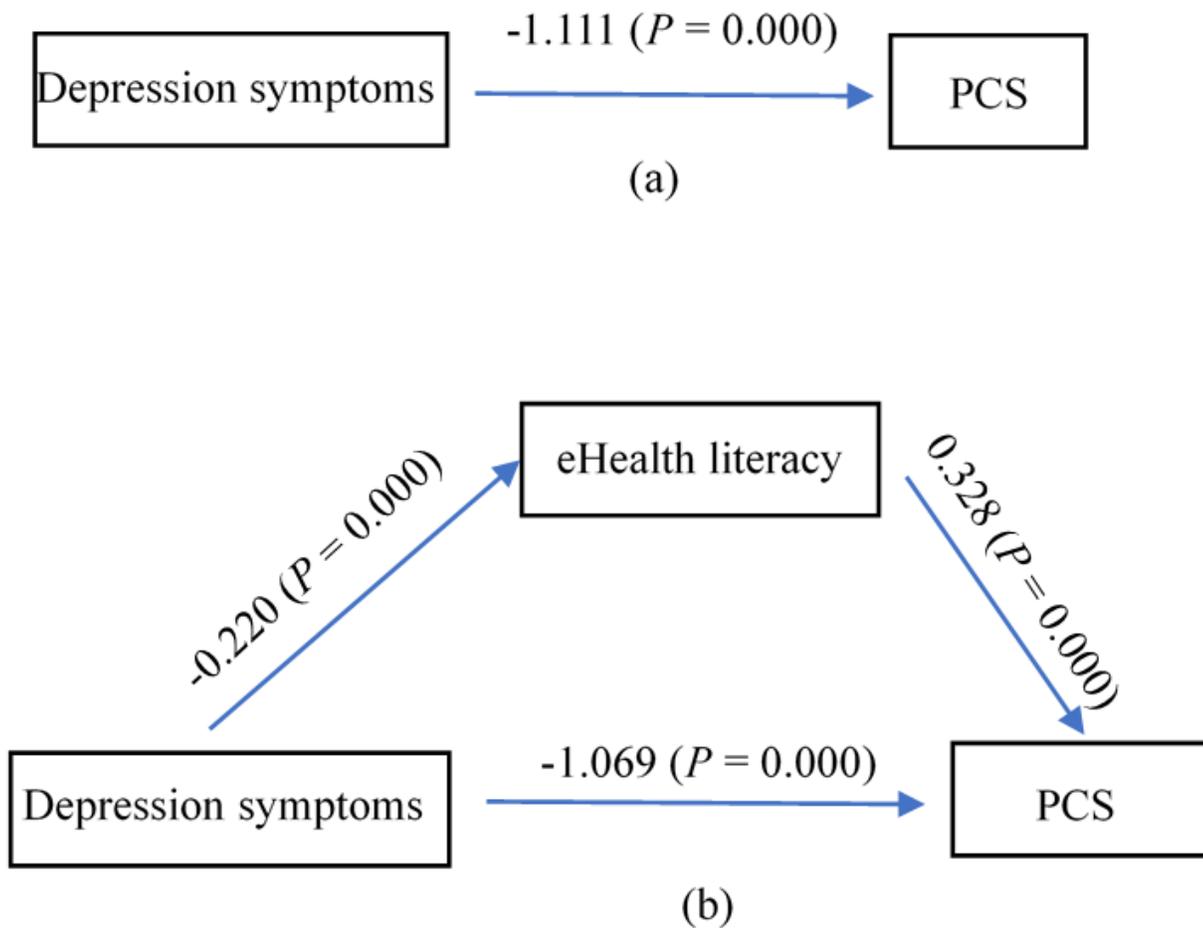
(a)



(b)

**Figure 1**

Relationships of eHealth literacy, depression symptoms and MCS. (a) Direct effect of depression symptoms on MCS; (b) Mediation of eHealth literacy between depression symptoms and MCS.



**Figure 2**

Relationships of eHealth literacy, depression symptoms and PCS. (a) Direct effect of depression symptoms on MCS; (b) Mediation of eHealth literacy between depression symptoms and PCS.

## Supplementary Files

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