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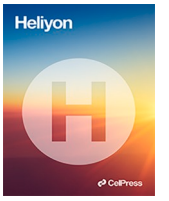

Exploring associations between eHealth literacy, cyberchondria, online health information seeking and sleep quality among university students: A cross-section study

Xinhong Zhu *, Taoyun Zheng, Linlin Ding, Xiaona Zhang

School of Nursing, Hubei University of Chinese Medicine, Wuhan, China

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ABSTRACT

Background: University students are increasingly inclined to use the Internet for health-related purposes, and their sleep problems are becoming increasingly prominent. Currently, the relationship between sleep quality and online health-related searches is poorly understood. The aim of this study was to exam the associations of sleep quality, Internet use, eHealth literacy, online health information seeking and cyberchondria in the sample of Chinese university students.

Methods: A total of 2744 students completed self-reported questionnaires online containing the Pittsburgh Sleep Quality Index (PSQI), eHealth Literacy Scale, Online Health Information Seeking, Cyberchondria Severity Scale (CSS) and questions regarding sleep duration, Internet use, health status, and demographic information.

Results: The prevalence of poor sleep quality (PSQI >7) among the university students was 19.9% and 15.6% students slept less than 7 h per day. As time spent on online daily and playing phone before bed increased, the prevalence of sleep disturbance gained. Sleep disturbance was significantly associated with cyberchondria (OR = 1.545, $p = 0.001$), health status [good (OR = 0.625, $p = 0.039$), poor (OR = 3.128, $p = 0.010$), and fair (OR = 1.932, $p = 0.001$)]. Sleep quality, online health information seeking and eHealth literacy positively influenced with cyberchondria. Compared to 7–8 h sleep duration, online health information seeking (OR = 0.750, $p = 0.012$) was significantly associated with ≥8 h sleep duration.

Conclusion: Our findings highlighted poor health status, too much time spent on online daily and high cyberchondria level might decrease sleep quality in the sample of Chinese university students, further suggesting the need for developing interventions based on online health-related searches for improving sleep quality among university students.

1. Introduction

University students frequently suffer from poor sleep quality [1,2]. The prevalence of insomnia in university students worldwide has been found to be 18.5%, significantly higher than the rates of 7.4% reported in the general population [3]. The overall pooled prevalence of sleep disturbance and those being subjected to insomnia symptoms in Chinese university students were 25.7% (95% CI: 22.5–28.9%) and 23.6% (95% CI: 18.9–29.0%), respectively [4]. Sleep has been considered as a major contributor for brain and body homeostasis, and proven to have a significant influence in cardiovascular diseases, immune processes, inflammation system, gut

* Corresponding author.
E-mail address: zxh88@hbtcm.edu.cn (X. Zhu).

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microbiome diversity, and cognitive impairment [5–9]. As for students, studies highlighted that sleep quality was linked to academic performance, sustained attention, mental health, and suicidal behaviors [10–13]. Therefore, it is necessary to explore affecting factors of sleep quality among university students.

Factors related to Internet use and psychological well-being have been reported to be associated with sleep quality, such as problematic Internet use [14,15], Internet gaming disorder [16], mobile phone addiction [17], screen time [18], fear of missing out [19], intolerance of uncertainty [20], and depression and anxiety [21]. Internet use is increasingly prominent among university students and penetrating all aspects of their life. According to the statistics provided by the China Internet Network Information Center (CNNIC) by July 2021, Internet use grew exponentially to nearly 1.01 billion users in China, and Internet users aged 20–29 years older accounted for 17.4% [22]. The relationships of delayed sleep onset, poor sleep quality and increased time spent on internet were well documented [23,24]. Extensive Internet use shared a bidirectional relationship with increased prevalence of sleep disturbance [25, 26]. The Internet characterized by anonymous, readily, convenient space-time-independent accessibility [27], lead to more and more people turn to the Internet for health-related queries. Survey in China showed that 239 million were online medical users, accounting for 22.7% of the total Internet users [22]. However, little is known about bidirectional relationship between using Internet for health-related activities and sleep quality.

Despite some advantages of online health-related searches, due to uncontrollable quality and credibility of online information, those individuals who are overly anxiety or stress about their health, are at risk for maladaptive health-related behaviors called as cyberchondria [28]. Several studies have highlighted that cyberchondria shares phenomenology with a variety of psychiatric disorders: depression [29], problematic usage of the Internet [30], health anxiety [31], and intolerance of uncertainty [32], which are important factors resulting in disturbed sleep [33–36]. Furthermore, in a national community sample of Turkish participants, it was identified that individuals with cyberchondria were prone to suffer from poor sleep quality [37]. Cyberchondria refers to abnormal behavioral pattern characterized by excess online health information seeking [38]. Therefore, we hypothesized excessive online health information would lead to poor sleep quality.

As an abnormal state of online health information seeking, cyberchondria might be related to eHealth literacy [39,40]. eHealth literacy describes individuals' ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem [41]. Individuals with a low level of eHealth literacy are vulnerable to develop problematic search behavior online [42]. Additionally, subjects with higher eHealth literacy are more likely to seek health information online [43,44]. Significant associations of excessive social media use, poor mental health outcomes and poor sleep quality were observed [26]. It was reported that improving eHealth literacy in heart failure patients may decrease insomnia, psychological distress, and improve quality of life [45]. In addition, college students with high eHealth literacy engaged better in health-promoting activities [46]. Accordingly, we hypothesized that eHealth literacy is related to sleep quality among university students.

Taken together, sleep quality appears to be associated with a plethora of factors including cyberchondria, online health information seeking, eHealth literacy and Internet use. However, most of the previous studies addressed relationships in part between potential influencing factors of sleep quality. Nevertheless, the associations between an entire set of these variables of interest has still elusive. To this end, the present study was set out to investigate the complex associations between those variables of interest. It was speculated that cyberchondria, online health information seeking, eHealth literacy and Internet use would server as influencing variables of sleep quality and duration. We also hypothesized that, given the complex relationships between these variables of interest, sleep quality would affect cyberchondria and online health information seeking. In accordance with these findings, we proposed a model in this study that is depicted graphically below.

Although the association between Internet use and sleep problems has been confirmed. The relationships of sleep quality, eHealth literacy, online health information seeking and cyberchondria are still poorly understood. In this study, our main objectives in general are to identify the influencing factors of sleep quality and examine the relationship of sleep quality, Internet use, eHealth literacy, online health information seeking and cyberchondria among Chinese university students as postulated in Fig. 1, which would promote the effectiveness of preventive and curative interventions, particular related to online health-related searches.

2. Methods

2.1. Participants and data collection

A cross-sectional survey research design was applied, using a non-probability convenience sampling technique. 3015 participants were recruited in 4 universities and 4 vocational and technical colleges/schools in Wuhan comprising junior college students, undergraduate students, and graduate students. Participants were approached by the faculty from 8 university/colleges/schools. The criteria for involvement in the research were being voluntary to participate in the study and cooperate with the study. After obtaining

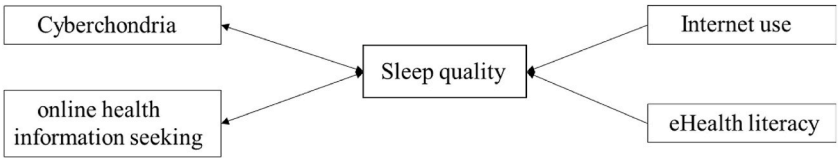

Fig. 1. Relationships of sleep quality, Internet use, eHealth literacy, online health information seeking and cyberchondria.

the approval, all participants were informed about their rights as participants (e.g., they could withdraw from the study at any time without negative repercussions). Data were collected using structured-questionnaires in February 2021. Questionnaires was sent by email. Participants voluntarily filled out an anonymous questionnaire online via Questionnaire Star without any monetary incentives. Data from 3015 were used for analysis; 271 respondents were excluded due to missing data. The response rate was 91.0% (n = 2744).

2.2. Instruments

2.2.1. eHealth Literacy Scale

The scale was developed by Norman and Skinner [41] and revised by Ma and Wu [47]. The tool contains eight items with response option on a five-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Scores are from 8 to 40, with a higher score indicating better level of eHealth literacy. The Cronbach's α value of the whole scale was 0.962. The participants were divided into two groups using the median score of eHealth literacy for statistical analysis: a high score group (≥20, n = 1471) and a low score group (<20, n = 1273).

2.2.2. Cyberchondria Severity Scale (CSS)

The scale was developed by McElroy and Shevlin [48], original used with undergraduate students in the UK. The modified scale, which was culturally fit and appropriate to be used in Chinses cultural, was further referenced to the CSS short form [49,50]. The tool contains 12 items with response options on a five-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Scores are from 12 to 60, with a higher score indicating higher level of cyberchondria. The Cronbach's α value of the whole scale was 0.946. The participants were divided into two groups using the median score of CSS for statistical analysis: a high score group (≥24, n = 1581) and a low score group (<24, n = 1163).

2.2.3. Online health information seeking

The scale was composed of four questions as follows: 1) How often do you search the Internet for health information? 2) How often do you use health apps? 3) Facing health problems, do you actively search health-related information? 4) Do you always pay attention to online health-related information? Responses for each item are rated by using a seven-point scale ranging from 1(strongly disagree) to 7 (strongly agree). High score indicates a high level of online health information seeking behavior. The Cronbach's α value of scale was 0.925. The participants were divided into two groups using the median score of online health information seeking for statistical analysis: a high score group (≥12, n = 1557) and a low score group (<12, n = 1187).

2.2.4. Pittsburgh Sleep Quality Index (PSQI)

The Chinese version scale was translated by Liu et al. [51]. The scale contains 19 items articulated in 7 subscales: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The total score ranges from 0 to 21 points (0–3 points for each subscale), with a higher score indicating worse sleep quality. The cut-off value for sleep disturbance is 7 [51]. In this study, the Cronbach's α value of the PSQI was 0.663.

2.2.5. Sleep duration

We assessed sleep duration by asking the respondents the following questions: "For how many hours did you usually sleep at night in the past month?" The responses for sleep duration are as follows: "<6 h", "6–7 h", "7–8 h", and "≥ 8 h. In the phase of data analysis, these responses were divided into three categories subsequently: "< 7 h", "7–8 h", and "≥ 8 h".

2.2.6. Internet use

Internet use was ascertained with the following items: (1) Category of online information you prefer; (2) Platform for obtaining online information; (3) Motivations for obtaining information via online; (4) Time spent online daily; (5) Playing phone before bed.

Demographic questionnaire: a demographic information sheet is used to acquire basic information, such as gender, age, residence, education, single-child, and self-reported health status.

2.3. Ethical consideration

The study was approved by the Hubei University of Chinese Medicine human ethics committee (2022001), and carried out in accordance with the requisite ethical standards (e.g., the Helsinki declaration). Prior to the collection of data, the purposes and procedures of this study were explained to the respondents. Data were collected only from those who voluntarily agreed and provided written consent to participate in the study.

2.4. Data analysis

Descriptive analysis was performed to summarize participants' socio-demographic characteristics The extent of Internet use, CSS, eHealth literacy and online health information seeking were described using frequency, percentage, and median and interquartile. The difference on PSQI score was analyzed using SPSS 25.0 software package with equivalent non-parametric test and Chi-square test. Logistic regression models were fitted to identify significant factors ($p < 0.05$) associated with Internet use, cyberchondria, online health information seeking, and eHealth literacy in sleep quality and duration. Logistic regression models were reported in Tables 3–5:

(1) Model in Table 3 included sleep quality as the dependent variable and Internet use, cyberchondria, online health information seeking, eHealth literacy and demographic variables as the independent variables. (2) Model in Table 4 specified "cyberchondria" as the dependent and Internet use, sleep quality, online health information seeking, eHealth literacy and demographic influencing factors as the independent variables. Model in Table 4 specified "online health information seeking" as the dependent and Internet use, sleep quality, cyberchondria, eHealth literacy and demographic influencing factors as the independent variables. (3) Model in Table 5 included sleep duration as the dependent variable and Internet use, cyberchondria, online health information seeking, eHealth literacy and demographic variables as the independent variables. The strength of association was explained in terms of odds ratio (OR) and a 95% confidence interval (CI). The models' goodness of fit was check using omnibus tests of model coefficients for overall fitness of the model and Hosmer and Lemeshow test for fitness of the data to the model.

3. Results

3.1. Participant characteristic

Sample characteristic was shown in Table 1. The mean age of respondents was 20.08 (SD = 2.37) with a range of 18~30 years old. Of the 2744 participants, 69.2% were female, 56.3% lived in rural and 69.4% were single-child. Fifty-eight percent of participants were undergraduate students and above. One percent of respondents reported their health status were poor.

3.2. The prevalence of sleep disturbance and internet use

Based on 7 as the threshold value for the PQSI, 547 (19.9%) reported disturbed sleep. As depicted in Table 2, regarding the item "The category of online information you prefer", 71.0% participants preferred to search knowledge, and 68.8% students preferred to search friends' updates. The motivations for obtaining information via online were as followed: ease of use (93.4%), large amount of information (76.4%), and entertainment (60.2%). Thirty-seven percent of respondents spent 2–4 h per day online. Sleep quality varied by time spent online daily, playing phone before bed, cyberchondria and online health information seeking. As time spent on online daily and playing phone before bed increased, the prevalence of sleep disturbance gained.

3.3. Relationships of eHealth literacy, cyberchondria, online health information seeking and sleep quality

As depicted in Table 3, self-reported health status [bad (OR = 3.128, $p = 0.010$), fair (OR = 1.932, $p = 0.001$], and cyberchondria (OR = 1.545, $p < 0.001$) positively affected sleep quality. eHealth literacy and online health information seeking did not significantly influence sleep quality. Furthermore, sleep quality (OR = 1.534, $p < 0.001$), online health information seeking (OR = 5.242, $p < 0.001$), and eHealth literacy (OR = 1.813, $p < 0.001$) were positively associated with cyberchondria (Table 4). eHealth literacy (OR = 7.377, $p < 0.001$), and cyberchondria (OR = 5.263, $p < 0.001$) positively affected online health information seeking.

3.4. Relationships of eHealth literacy, cyberchondria, online health information seeking and sleep duration

Fifteen percent of participants reported that they had short sleep duration (<7 h), and 56.2% students slept more than 8 h per day. Compared to 7–8 h sleep duration, high level of online health information seeking (OR = 0.750, $p = 0.012$) negatively affected ≥8 h sleep duration (Table 5). However, compared with the category of 7~8 h sleep duration, cyberchondria, eHealth literacy and online health information seeking did not significantly affect short sleep duration (<7 h).

Table 1
General characteristics of the participants (n = 2744).

Variables	n	%
Gender		
Female	1, 899	69.2
Residence		
City	1, 199	43.7
Rural	1, 545	56.3
Single-child (Yes)	1, 905	69.4
Education		
Junior college students	1, 147	41.8
Undergraduate students and above	1, 597	58.2
Self-reported health status		
Good	2, 235	81.5
Fair	481	17.5
Bad	28	1.0
Chronic disease	38	1.4
History of serious illness	18	0.7
Family history	11	0.4

Table 2
Internet use of the participants according to sleep quality (n = 2744).

Variables	Median or n (%)	Normal sleep quality (n = 2,197, 80.1%)	Sleep disturbance (n = 547, 19.9%)	χ2/Z-score	*p*-value
Category of online information you prefer					
Friends' updates	1887 (68.8)	1492 (67.9)	395 (72.2)	3.773	0.052
News	1612 (58.7)	1302 (59.2)	310 (56.7)	1.212	0.271
Entertainments	1710 (62.3)	1372 (62.4)	338 (61.8)	0.081	0.777
Services	853 (31.1)	680 (31.0)	173 (31.6)	0.093	0.760
Knowledge	1949 (71.0)	1565 (71.2)	384 (70.2)	0.227	0.634
Health information	1060 (38.6)	866 (39.4)	194 (35.5)	2.884	0.089
Sports	429 (15.6)	351 (16.0)	78 (14.3)	0.979	0.323
Goods	476 (17.3)	376 (17.1)	100 (18.3)	0.416	0.519
Others	500 (18.2)	408 (18.6)	92 (16.8)	0.902	0.342
Platform for obtaining online information					
Social media apps	2449 (89.2)	1953 (88.9)	496 (90.7)	1.450	0.228
Portal websites	877 (32.0)	708 (32.2)	169 (30.9)	0.356	0.551
Search engine	1748 (63.7)	1414 (64.4)	334 (61.1)	2.063	0.151
Overseas websites	186 (6.8)	149 (6.8)	37 (6.8)	0.000	0.988
Academic websites	683 (24.9)	553 (25.2)	130 (23.8)	0.462	0.497
Motivations for obtaining information via online					
Ease of use (Yes)	2563 (93.4)	2060 (93.8)	503 (92.0)	2.324	0.127
Large amount of information (Yes)	2096 (76.4)	1680 (76.5)	416 (76.1)	0.042	0.837
Entertainment (Yes)	1652 (60.2)	1306 (59.4)	346 (63.3)	2.653	0.103
High credibility of online information (Yes)	868 (31.6)	710 (32.3)	158 (28.9)	2.385	0.122
Satisfaction with information (Yes)	978 (35.6)	763 (34.7)	215 (39.3)	3.998	0.046
Great interaction (Yes)	1057 (38.5)	838 (38.1)	219 (40.0)	0.663	0.415
Time spent online daily					
0~2 h	516 (18.8)	448 (20.4)	68 (12.4)	50.167	<0.001
2~4 h	1020 (37.2)	839 (38.2)	181 (33.1)		
4~6 h	743 (27.1)	575 (26.2)	168 (30.7)		
6~8 h	267 (9.7)	206 (9.4)	61 (11.2)		
8 h~	198 (7.2)	129 (5.9)	69 (12.6)		
Playing phone before bed					
Never	74 (2.7)	67 (3.0)	7 (1.3)	42.592	<0.001
Rarely	282 (10.3)	241 (11.0)	41 (7.5)		
Sometimes	927 (33.8)	779 (35.5)	148 (27.1)		
Often	813 (29.6)	639 (29.1)	174 (31.8)		
Always	648 (23.6)	471 (21.4)	177 (32.4)		
Cyberchondria	24 (17, 34)	24 (17, 33)	27 (21, 36)	−6.769	<0.001
Online health information seeking	12 (8, 16)	12 (8, 16)	14 (9, 16)	−5.171	<0.001
eHealth literacy	20 (16, 24)	20 (16, 24)	22 (16, 24)	−1.650	0.099

Table 3
Factors associated with sleep quality among university students.

Variable	Unadjusted OR (95%CI)	*p* value	Adjusted OR (95%CI)	*p* value
Cyberchondria	**1.741 (1.393~2.175)**	**0.000**	**1.545 (1.216~1.946)**	**0.001**
eHealth literacy	0.949 (0.761–1.182)	0.638	1.057 (0.838–1.335)	0.638
Online health information seeking	1.106 (0.873–1.403)	0.404	1.043 (0.811–1.343)	0.742
Self-reported health status				
Good			**0.625 (0.400~0.977)**	**0.039**
Fair			**1.932 (1.290~2.894)**	**0.001**
Bad			**3.128 (1.313~7.451)**	**0.010**
Chronic disease			1.582 (0.768–3.260)	0.213
History of serious illness			0.946 (0.279–3.213)	0.929
Family history			2.438 (0.625–9.513)	0.199
The reasons I obtain information via online				
High credibility of online information (Yes)			**0.736 (0.573~0.944)**	**0.016**
Time spent online daily				
0~2 h				
2~4 h			1.263 (0.917–1.740)	0.153
4~6 h			**1.571 (1.121~2.201)**	**0.009**
6~8 h			**1.683 (1.004~2.252)**	**0.046**
8 h~			**2.565 (1.665~3.951)**	**< 0.001**

a OR: odds ratio.
b Adjusted for gender, residence, education, single-child, platform, playing phone before bed and category of online information you prefer.

Table 4
Adjusted logistic regression analysis of cyberchondria and online health information seeking.

Variables	Cyberchondria[a]			Online health information seeking[b]		
	Adjusted OR	95%CI	p-value	Adjusted OR	95%CI	*p*-value
Sleep quality	**1.534**	1.210–1.943	<0.001	1.066	0.827–1.373	0.622
Online health information seeking	**5.242**	4.302–6.387	<0.001	–	–	——
eHealth literacy	**1.813**	1.489–2.208	<0.001	7.737	6.066–8.971	< **0.001**
Cyberchondria	——	–	–	5.263	4.317–6.415	< **0.001**
The reasons I obtain information via online						
Large amount of information (Yes)	0.892	0.776–1.244	0.883	1.435	1.117–1.844	**0.005**
Entertainment (Yes)	**1.300**	1.053–1.605	0.015	0.974	0.776–1.222	0.819
Gender						
Male	Ref			Ref		
Female	**0.540**	0.431–0.677	<0.001	0.936	0.735–1.191	0.590
Self-reported health status						
Fair (Yes)	**1.586**	1.036–2.429	0.034	1.424	0.896–2.262	0.135
Playing phone before bed						
Never	Ref			Ref		
Rarely	0.897	0.480–1.677	0.734	1.634	0.843–3.165	0.146
Sometimes	1.788	0.995–3.214	0.052	1.720	0.925–3.199	0.087
Often	**2.250**	1.237–4.093	0.008	1.707	0.905–3.221	0.099
Always	**2.270**	1.236–4.172	0.008	1.664	0.874–3.169	0.121

[a] The adjusted logistic regression model for education, residence, single-child, platform, time spent online daily, and category of online information you prefer.
[b] The adjusted logistic regression model for education, residence, single-child, platform, time spent online daily, and category of online information you prefer.

Table 5
Factors associated with sleep duration among university students.

Variables	<7 h[a]		≥8 h[a]	
	Adjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
Cyberchondria				
Low	Ref		Ref	
High	1.181 (0.890–1.567)	0.248	1.174 (0.952–1.446)	0.133
eHealth literacy				
Low	Ref		Ref	
High	0.949 (0.716–1.258)	0.715	1.227 (0.996–1.512)	0.054
Online health information seeking				
Low	Ref		Ref	
High	0.854 (0.630–1.158)	0.310	**0.750 (0.599~0.939)**	**0.012**
Gender				
Female	Ref		Ref	
Male	0.937 (0.701–1.252)	0.659	**0.662 (0.531~0.824)**	< **0.001**
Education				
Junior college students	1.175 (0.898–1.539)	0.239	**1.936 (1.613~2.388)**	< **0.001**
Undergraduate students and above	Ref.		Ref.	

a: 7–8 h as the reference category.

4. Discussion

Nowadays, because of medical information widely available and easily accessible on the Internet, a growing number of people turn to the Internet to search for health-related information. However, excessive or repeated online health information searches are associated with cyberchondria [52]. To the best of our knowledge, this study is one of the very few to detect associations of sleep quality with cyberchondria, eHealth literacy and online health information seeking. We found nearly 19.9% students reported poor sleep quality and 15.6% slept less than 7 h daily. Sleep disturbance was significantly associated with health status, time spent on online daily, and cyberchondria. Furthermore, cyberchondria shared a bidirectional relationship with increased prevalence of poor sleep quality.

The phenomenon of cyberchondria is particularly evident in the context of public crises. For instance, during the coronavirus disease 2019 (COVID-19) pandemic, individuals were prone to suffer from health anxiety and cyberchondria [53]. In this study, the mean score of CSS was exactly the same as that of college students in UK, and was slightly higher than the average of previous study in the context of COVID-19 pandemic [49,53]. Due to the difference in sample characteristics, an earlier study found that older participants were less likely to experience worsening of anxiety during and after online searching for medical information than younger participants [54]. Meanwhile, students with high level of eHealth literacy were vulnerable to experience cyberchondria in this study.

Consistent with the previous study [43,44], person with higher eHealth literacy are more likely to seek health information online, which may trigger excess searches online. Meanwhile, the positive relationship between eHealth literacy and cyberchondria was observed in communities during the epidemic period of COVID-19 [55], which is in line with our findings. Online health information seeking could positively affect cyberchondria level to some extent [52], which is consistent with our results. It appears that individuals with excessive online health information seeking are more prone to be vulnerable to cyberchondria [52].

In the current study, 19.9% prevalence of sleep disturbance was revealed in our sample of university students, which was lower than that of Chinese university students (25.7%) [4]. 15.4% respondents slept less 7 h was lower than that of university students (27.4%) in the previous study [12]. 28.2% students had 7∼8 sleep duration per day. Compared with 7 h, all other sleep durations were associated with a significantly increased mortality risk in East Asian populations [56]. Therefore, we chose 7–8 sleep duration as category reference in this study. The significant association between sleep quality and self-reported health status was consistent prior study [57]. In general, there is complex reciprocal relationship between health status and sleep disorders. In line with existing studies, excessive Internet use was associated with sleep quality and duration [17,18,58]. Excessive time spent on Internet daily simultaneously contributed to poor sleep quality of university students. Long time Internet use directly reduced netizen's time spent on sleep and quality of sleep leading to poor sleep [58].

Concerning the links among online health information seeking, cyberchondria and sleep quality, we found as scores in cyberchondria increased, PSQI scores reduced. Although cyberchondria was suggested as a separate phenomenon [28], it is by definition related to both health anxiety, hypochondriasis and Internet use [59]. Numerous studies have confirmed that Internet use, and health anxiety are associated with sleep disorder [17,58,60]. Furthermore, in the context of patients with ruptured aneurysm post-treatment and post-surgery meningioma patients, hypochondriasis was positively associated with subjective sleep complaints and sleep-related dysfunctional cognitions [61]. Regarding the hypochondriacal attitudes in teens, the "hypochondriacal responses" were significantly associated with higher levels of psychological distress, decreased well-being, and some unhealthy behaviors: smoking, physical inactivity, and short sleep [62]. Moreover, it found that those individuals with cyberchondria were likely to experience poor sleep quality in a national community sample of Turkish participants [37]. Due to bidirectional relationships of health status, anxiety and sleep quality [26,63,64], sleep quality might contribute to cyberchondria. In this study, online health information seeking negatively influenced long sleep duration. Although there are few studies to explore the associations between online health information seeking and sleep duration, repeated or excessive online health information seeking meant that respondents spent much time on browsing website, subsequently resulting in reduced sleep duration.

5. Conclusion

This study had some limitations. First, some of the studied variables (e. g. cyberchondria, online health information seeking, eHealth literacy and sleep quality) were reported using self-administered questionnaires. There might be respondent bias as the findings were self-reported and based on a subjective scale, resulting in underestimating, and overestimating their behaviors. Meanwhile, regarding the item of self-reported health status, no criteria were included to indicate what constitutes the difference between good and fair. Individuals' interpretations of those terms could vary substantially from one another, which may lead to resulting in underestimating, and overestimating their behaviors. Second, there might be selection bias that may have occurred due to non-response. Due to selective non-response bias, the prevalence of self-reported variables such as sleep quality, Internet use, cyberchondria, online health information seeking, and eHealth literacy may be significantly underestimated. Third, the study could not control for other factors, such as anxiety, intolerance of uncertainty. Thus, future studies should include these variables. Last, 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.

This is the first study designed to understand sleep quality and online health-related behaviors in the Chinese university students. Our study found that nearly 20% of students impaired sleep quality, and 15.6% students slept less than 7 h. The related factors including self-reported health status, high credibility of online information, time spent online daily, and cyberchondria were associated with sleep quality. Cyberchondria shared a bidirectional relationship with increased prevalence of poor sleep quality. Nevertheless, eHealth literacy and online health information seeking were not significantly associated with sleep quality and short sleep duration. Given the common phenomenon of Internet use in the university students and the relationship between online health-related behaviors and sleep problems, administrators and health workers at universities should more pay attention to in terms of research and interventions to sleep disorders among students. Further investigations should include more variables related to psychology and Internet use, and explore causal relationships between online health-related behaviors and sleep problems using cohort study, which could provide stronger evidence for developing interventions.

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Author contribution statement

Xinhong Zhu: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Taoyun Zheng; Linlin Ding; Xiaona Zhang: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Data availability statement

Data will be made available on request.

Declaration of competing interest

None declared.

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Appendix A. Supplementary data

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