Association between Sleep Quality and Interactive Health Literacy among Chinese College Students: A Cross-sectional Study

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Abstract

Background

Increasing studies have shown that the improvement of interactive health literacy (IHL) can develop healthy behaviors. Although healthy behaviors could contribute to good sleep quality, few studies explored the association between IHL and sleep quality. This study aimed to examine the relationship between IHL and sleep quality among Chinese college students.

Methods

A cross-sectional survey was conducted among 12007 college students aged 15–26 years. IHL was evaluated using Chinese Adolescent Interactive Health Literacy Questionnaire, and sleep quality was reported by a self-reported question. Multivariate logistic regressions analysis were conducted to examine the association between IHL and sleep quality.

Results

The prevalence rates of good sleep quality among college students was 77.6%. After adjusting for potential confounders, multivariate logistic regressions analysis revealed a significant inverse association between HL and risk of good sleep quality. The OR (95%CI) of good sleep quality among different IHL level were 1.00 (reference) for low level, 1.628 (1.467, 1.807) for middle level and 2.756 (2.442, 3.111) for high level. Similarly, the significant associations were also found when gender were separately analyzed.

Conclusion

Our findings suggest that improving IHL may contribute to maintaining good sleep quality. Further intervention research is needed to explore the causal relationship between IHL and the sleep quality among Chinese population. It is therefore necessary to strengthen the health education of Chinese college students to develop their health-promoting behaviors.

Background

College stage is the beginning of a completely independent life, college students experience a unique transition from adolescence to adulthood. They are required to balance their lives and studies in an unfamiliar environment, including academic responsibilities, financial concerns, building new social networks, and living adjustments. These stresses may leave college students at increased risk for developing poor sleep quality, e.g., nightmares, difficulties falling asleep and frequent night awakenings [1, 2, 3]. Current research reveals that most college students experience poor sleep quality. For example,
about 46% of college students reported having poor sleep quality in the England [4]; In German, 48.9% university students reported having underwent poor sleep quality [5]; similarly, the incidence of poor sleep quality among Chinese freshmen is higher, ranging from approximately 31.0% and 43.28% [6, 7]. Poor sleep quality not only damages physical health such as obesity [8], type 1 diabetes [9], and cardiovascular disease [10]; but also contributes to a number of negative mental health outcomes such as depression [11], anxiety [12], attention deficit [13], and negative personality traits [14]. Therefore, exploring positive and effective methods are crucial to prevent poor sleep quality among college students.

Developing healthy lifestyles are the most effective way to prevent and treat chronic non-communicable diseases, including poor sleep quality [5]. However, Strengthening the various forms of health education to achieve a good level of health literacy among residents is a precondition and a basis for promoting the development of a healthy lifestyle [15, 16].

Health literacy (HL) is defined as an individual’s ability to obtain, understand, appraise and use information to make decisions and take actions that will promote and maintain good health status [17]. To distinguish personal literacy and numeracy skill-level differences, Nutbeam categorized HL as functional, interactive, and critical levels. Compared with others, IHL could help individual to obtain health information from various communications and applying it to change health status [18], and therefore could help individual to develop healthy behaviors. So far, although the association between healthy behaviors and sleep quality have been widely reported [5, 19, 20, 21], the association between IHL and sleep quality is limited to Junior high school students [22]. Previous study also pointed out that college students have a lower level of IHL compared to others in China [23]. Therefore, to highlight the importance of IHL, it is worthy to further explore the association between IHL and sleep quality among Chinese college students.

Methods

Study Participants

This was a cross-sectional study that included college students from 7 colleges in China. They are distributed in the east (Liaoning University), south (Southwest University, Chongqing Nursing Vocational University, Chongqing Electronic Engineering Vocational University, and Chongqing Electric Power University), west (Guangxi Arts University) and north (Changchun Normal University) of China. Among all 12680 participants, 12330 participants agreed to participate in this study, and written informed consent were obtained from participants aged ≥ 16 years or their parents or from the legal guardians of participants aged < 16 years. We excluded 323 participants with missing information on sleep duration (n = 291), sleep medication use (n = 17), age (n = 15). Finally, 12007 participants (3995 males and 8012 females; mean age, 18.9, SD, 1.2) were included in this study. Ethics approval was obtained from the Ethical Committee of the College of Physical Education of Southwest University.

Assessment of Health Literacy
A validated version of the Chinese Adolescent Interactive Health Literacy Questionnaire (CAIHLQ) was used to assess individual’s health literacy level. This scale consists of 31 questions including 6 dimensions: (1) 6 items regarding physical activity (e.g., “Follow a planned exercise program.”); (2) 5 items regarding interpersonal relationship (e.g., “Take time with your family or friends.”); (3) 6 items regarding stress management (e.g., “Relax for 15–20 minutes every day.”); (4) 4 items regarding self-actualization (e.g., “Work hard to achieve your goal.”); (5) 5 items regarding health awareness (e.g., “Look at the nutritional composition table in the food packaging bag.”); (6) 5 items regarding Dietary Behavior (e.g., “Eat 200 to 400 g fresh fruit and vegetable each day.”). All items include 5 responses (never and no desire, never but with desire, occasionally and irregularly, often, and routinely). All 20 items are summed up to generate a total score, and a higher score indicates that individual having better health literacy level. The range of the total score is between 31 and 155, and a higher score indicates that individual having better health literacy level. We identified tertiles of the score: low (31–93), middle (94–115) and high (116–155) according to the distribution of the total score. A previous study has demonstrated the validity and reliability of the questionnaire [24]. In this study, Cronbach’s $\alpha$ coefficient for the CAIHLQ was 0.946, Cronbach’s $\alpha$ of each dimension was 0.645 ~ 0.935, indicating the CAIHLQ had a good internal consistency reliability.

**Assessment of Sleep Quality**

Sleep quality was assessed by using a self-reported question: “During the past month, how would you rate your overall sleep quality?”. Previous study conducted a test-retest for this item to evaluate measurement stability among Chinese population [25]. Everyone answered this question using following four answers: very good, good, very poor, poor. Individuals who choose very good and good are considered to have good sleep quality, while those who choose very poor and poor are considered to have poor sleep quality.

**Relevant Covariates**

A self-reported questionnaire was applied to assess individual’s demographic variables [gender, age (continuous variable), residence (urban or rural), and parent’s education level (primary, secondary, higher secondary, or graduate)] and lifestyle variables [drinking status (never, occasionally, or regularly), sleep duration (< 6 h/d, 7–8 h/d, or > 8 h/d), and sleep medication frequency (never, 1 time/week or 2 and ≥ 3 time/week)].

**Data Analysis**

Statistical analysis was performed using IBM SPSS Statistics 27.0 software (IBM SPSS Inc., Chicago, IL, United States). The categorical variables are expressed as proportions (%). A chi-square-test was used to analyze the differences of participants’ characteristics between IHL tertiles.

Sleep quality and IHL were used as dependent and independent variables, respectively, multiple logistic regression analysis was performed to examine the association between IHL and sleep quality. Model 1 was a crude univariate model; model 2 adjusted for gender (male or female), age (continuous variable),
residence (urban or rural), parent’s education level (primary, secondary, higher secondary, or graduate); and model 3 further adjusted for the drinking status (never, occasionally, or regularly), sleep duration (< 6 h/d, 7–8 h/d, or > 8 h/d), sleep medication frequency (never, 1 time/week or 2 and ≥ 3 time/week). P < 0.05 was considered statistically significant for all two-sided tests.

Results

Participants’ characteristics according to the IHL are presented in Table 1. Compared with participants with lowest IHL level, participants with highest IHL level were more likely to be female, to be younger, and to live in a rural. The proportion of participants with higher IHL, who drank alcohol and used sleep medication frequency, was statistically lower. In addition, college students with good sleep quality had higher IHL.
Table 1
Participants’ characteristics according to tertiles of IHL\textsuperscript{a}

<table>
<thead>
<tr>
<th></th>
<th>N = 12007</th>
<th>Low IHL (n = 4018)</th>
<th>Mild IHL (n = 4124)</th>
<th>High IHL (n = 3865)</th>
<th>P for trend\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHL range, score</td>
<td></td>
<td>31–93</td>
<td>94–115</td>
<td>116–155</td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3995 (33.3)</td>
<td>1475 (36.7)</td>
<td>1217 (29.5)</td>
<td>1303 (33.7)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Female</td>
<td>8012 (66.7)</td>
<td>2543 (63.3)</td>
<td>2907 (70.5)</td>
<td>2562 (66.3)</td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–20</td>
<td>10892 (90.7)</td>
<td>3564 (88.7)</td>
<td>3743 (90.8)</td>
<td>3585 (92.8)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>21–26</td>
<td>1115 (9.3)</td>
<td>454 (11.3)</td>
<td>381 (9.2)</td>
<td>280 (7.2)</td>
<td></td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>4937 (41.1)</td>
<td>1510 (37.6)</td>
<td>1644 (39.9)</td>
<td>1783 (46.1)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Rural</td>
<td>7070 (58.9)</td>
<td>2508 (62.4)</td>
<td>2480 (60.1)</td>
<td>2082 (53.9)</td>
<td></td>
</tr>
<tr>
<td>Father’s education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>2871 (23.9)</td>
<td>1120 (27.9)</td>
<td>979 (23.7)</td>
<td>772 (20.0)</td>
<td>0.152</td>
</tr>
<tr>
<td>Secondary</td>
<td>4758 (39.6)</td>
<td>1629 (40.5)</td>
<td>1660 (40.3)</td>
<td>1469 (38.0)</td>
<td>0.042</td>
</tr>
<tr>
<td>Higher secondary</td>
<td>2566 (21.4)</td>
<td>765 (19.0)</td>
<td>900 (21.8)</td>
<td>901 (23.3)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Graduate</td>
<td>1812 (15.1)</td>
<td>504 (12.5)</td>
<td>585 (14.2)</td>
<td>723 (18.7)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mother’s education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>3835 (31.9)</td>
<td>1495 (37.2)</td>
<td>1317 (31.9)</td>
<td>1023 (26.5)</td>
<td>0.231</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Categorical variables as expressed as percentages (95%CI)

\textsuperscript{b} Categorical variables were assessed for correlation using a chi-square test
<table>
<thead>
<tr>
<th></th>
<th>N = 12007</th>
<th>Low IHL (n = 4018)</th>
<th>Mild IHL (n = 4124)</th>
<th>High IHL (n = 3865)</th>
<th>P for trend&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary</td>
<td>4369 (36.4)</td>
<td>1466 (36.5)</td>
<td>1551 (37.6)</td>
<td>1352 (35.0)</td>
<td>0.050</td>
</tr>
<tr>
<td>Higher secondary</td>
<td>2240 (18.7)</td>
<td>658 (16.4)</td>
<td>747 (18.1)</td>
<td>835 (21.6)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Graduate</td>
<td>1563 (13.0)</td>
<td>399 (9.9)</td>
<td>509 (12.3)</td>
<td>655 (16.9)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Drinking status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>7710 (64.2)</td>
<td>2441 (60.8)</td>
<td>2688 (65.2)</td>
<td>2581 (66.8)</td>
<td>0.034</td>
</tr>
<tr>
<td>Occasionally</td>
<td>4016 (33.4)</td>
<td>1470 (36.6)</td>
<td>1355 (32.9)</td>
<td>1191 (30.8)</td>
<td>0.012</td>
</tr>
<tr>
<td>Regularly</td>
<td>46 (0.4)</td>
<td>27 (0.7)</td>
<td>12 (0.3)</td>
<td>7 (0.2)</td>
<td>0.156</td>
</tr>
<tr>
<td>Sleep duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 7h</td>
<td>2389 (19.9)</td>
<td>1079 (26.9)</td>
<td>801 (19.4)</td>
<td>509 (13.2)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>7-8h</td>
<td>8058 (67.1)</td>
<td>2507 (62.4)</td>
<td>2854 (69.2)</td>
<td>2697 (69.8)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>&gt; 8 h</td>
<td>1560 (13.0)</td>
<td>432 (10.8)</td>
<td>469 (11.4)</td>
<td>659 (17.1)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sleep medication frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>11634 (96.9)</td>
<td>3825 (95.2)</td>
<td>4014 (97.3)</td>
<td>3795 (98.2)</td>
<td>0.002</td>
</tr>
<tr>
<td>1 time/week</td>
<td>134 (1.1)</td>
<td>71 (1.8)</td>
<td>39 (0.9)</td>
<td>24 (0.6)</td>
<td>0.003</td>
</tr>
<tr>
<td>2 time/week</td>
<td>115 (1.0)</td>
<td>51 (1.3)</td>
<td>43 (1.0)</td>
<td>21 (0.5)</td>
<td>0.253</td>
</tr>
<tr>
<td>≥ 3 time/week</td>
<td>124 (1.0)</td>
<td>71 (1.8)</td>
<td>28 (0.7)</td>
<td>25 (0.6)</td>
<td>0.184</td>
</tr>
<tr>
<td>Sleep quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>good</td>
<td>9315 (77.6)</td>
<td>2695 (67.1)</td>
<td>3243 (78.6)</td>
<td>3377 (87.4)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>poor</td>
<td>2692 (22.4)</td>
<td>1323 (32.9)</td>
<td>881 (21.4)</td>
<td>488 (12.6)</td>
<td></td>
</tr>
</tbody>
</table>

IHL interactive health literacy

<sup>a</sup> Categorical variables are expressed as percentages (95% CI)

<sup>b</sup> Categorical variables were assessed for correlation using a chi-square test
In this cross-sectional study, the prevalence of sufficient sleep quality was 77.6% (9315/12007). Table 2 shows the crude and adjusted significant relationships between the tertiles of IHL and sufficient sleep quality. In the crude model, the ORs of sufficient sleep quality across tertiles of IHL were 1.000 (reference) for tertile 1, 1.807 (95% CI: 1.636, 1.996) for tertile 2, and 3.397 (95% CI: 3.027, 3.813) for tertile 3 (P for trend < 0.001). In the final model, the adjusted ORs for sufficient sleep quality across tertiles of IHL were 1.000 (reference) for tertile 1, 1.628 (95% CI: 1.467, 1.807) for tertile 2, and 2.756 (95% CI: 2.442, 3.111) for tertile 3 (P for trend < 0.001). Moreover, multiple logistic regression analysis also showed that each dimension for IHL was significantly associated with good sleep quality when gender were separately analyzed (Fig. 1).

Table 2

<table>
<thead>
<tr>
<th>N = 12007</th>
<th>Low IHL (n = 4081)</th>
<th>Mild IHL (n = 4124)</th>
<th>High IHL (n = 3865)</th>
<th>P for trend^e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Case</td>
<td>2695</td>
<td>3243</td>
<td>3377</td>
<td></td>
</tr>
<tr>
<td>Model 1^a</td>
<td>1.000 (reference)^d</td>
<td>1.807 (1.636, 1.996)</td>
<td>3.397 (3.027, 3.813)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Model 2^b</td>
<td>1.000 (reference)</td>
<td>1.778 (1.609, 1.966)</td>
<td>3.378 (3.005, 3.796)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Model 3^c</td>
<td>1.000 (reference)</td>
<td>1.628 (1.467, 1.807)</td>
<td>2.756 (2.442, 3.111)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Model 1 are a crude univariate model;
Model 2 adjusted for gender (male or female), age (continuous variable), residence (urban or rural), parent’s education level (primary, secondary, higher secondary, or graduate);
Model 3 additionally adjusted for drinking status (never, occasionally, or regularly), sleep duration (< 6 h/d, 7–8 h/d, or > 8 h/d), sleep medication frequency (never, 1 time/week or 2 and ≥ 3 time/week).
Adjusted data are expressed as odds ratio (95% confidence intervals)
P for trend were obtained using multivariate logistic regression analyses

Discussion

In this study, we examine the association between IHL and sleep quality among Chinese college students. The result indicates that high IHL is independently associated with sufficient sleep quality after adjustment for gender, age, residence, parent’s education level, drinking status, sleep duration, and sleep medication frequency. To our knowledge, this is first study to examine the association between IHL and sleep quality among Chinese college students.
Although the mechanism for the association between IHL and sleep quality has not been clearly clarified, the mechanism by which health literacy promotes health can be explained through the following approach. On the one hand, previous study suggests that health literacy is an asset to build upon, a health education and communication outcome that promotes greater empowerment in health decision-making. Therefore, in this study, actions to improve health literacy are focused on developing health knowledge and self-efficacy, which is essential in enabling people to make effective health-related decisions. A Chinese residents-based study found that eHealth literacy is associated with insomnia [26]. Similarly, young adolescents with insomnia were more likely to seek help for their insomnia from multiple sources [27]. This also imply that individuals with higher health literacy could be easier to search for online health information, so that can regulate their health [26]. This study also speculates that college students can improve their health literacy level to enhance their health knowledge and self-efficacy, which is crucial for people to make reasonable and effective health-related decisions [28]. On the other hand, healthy behaviors could mediate this association. The regression mixture modeling of a previous study showed that higher health literacy level is negatively associated with lower health risk behaviors [29]. The mechanism may understand the process of health-promoting behaviors change through trans-theoretical Model of Change (TTM) [30]. The reason why the TTM can affect the individual's health-promoting behaviors is that TTM integrates self-efficacy and decision-making balance, and both of these factors influence health behaviors change [31]. In this study, individuals with higher IHL might tend to have health-promoting behaviors, such as balanced dietary patterns, regular physical activity habits, and positive emotions. These healthy behaviors might play important roles in preventing insomnia or improving sleep quality [32, 33, 34].

Limitations

There are several limitations in this study. First, although this study provides new insights in the association between IHL and sleep quality, the causal relationship between IHL and sleep quality could not be established due to the cross-sectional study design. Second, although a validated self-reported question was used to evaluate sleep quality, there may still be recall bias.

Conclusions

This cross-sectional study reveals a positive association between IHL and sleep quality. Our findings suggest that improving IHL may contribute to maintaining good sleep quality. Further intervention research is needed to explore the causal relationship between IHL and the sleep quality among Chinese population. It is therefore necessary to strengthen the health education of Chinese college students to develop their health-promoting behaviors.

Abbreviations

ANCOVA
Analysis of Covariance
Declarations

Acknowledgments

We thank the college students of Southwest University who agreed to participate in this study. We would also like to thank our staff from the Southwest University for their dedicated work.

Author Contributions

ZC and CB conceived and designed the experiments. XZ and ZR performed the experiments and conducted the data collection. analyzed the data. XZ and CZ contributed to the reagents, materials, and analysis tools. XZ and CZ wrote the manuscript. All authors contributed to the manuscript revision, read and approved the submitted version.

Funding

None.

Availability of data and materials

This study's datasets are available on request from the corresponding author.

Ethics approval and consent to participate

This research was approved by the Ethical Review Board of the College of Physical Education of Southwest University (SWU20180601). All methods were carried out in accordance with relevant guidelines and regulations. All individual participants consented to the research, and written informed consent were obtained from their participants’ legal guardian/next of kin.

Competing Interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Consent for publication
Not applicable.

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3 College of General Education, Guangxi Arts University, 530022, Nanning, Guangxi, China.

References


Figures
Figure 1

Associations between good sleep quality and IHL levels of college students in different genders. Adjusted for age (continuous variable), residence (urban or rural), parent’s education level (primary, secondary, higher secondary, or graduate), drinking status (never, occasionally, or regularly), sleep duration (<6 h/d, 7-8 h/d, or >8 h/d), sleep medication frequency (never, 1 time/week or 2 and ≥3 time/week). P for trend were obtained using multivariate logistic regression analyses. Data are expressed as odds ratio (95% confidence intervals).