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Sleep quality and emotional eating in college students: a moderated mediation model of depression and physical activity levels

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Abstract

Background Emotional eating is a prevalent maladaptive coping mechanism among college students, which is associated with mental health and sleep concerns. Though previous studies have established a link between sleep quality, depression and emotional eating, most of these have been in Western populations. In addition, few existing studies have taken physical activities into account, and the underlying mechanisms between these four variables remain to be further studied. Therefore, our study investigated the mediating role of depression and the moderating role of physical activity levels in the relationship between sleep quality and emotional eating among Chinese college students. Our study can help to understand the characteristics of this population and provide guidance on the intervention pathways for emotional eating.

Methods A convenience sampling method was employed to select eligible participants for investigation. The General Information Questionnaire, the Pittsburgh Sleep Quality Index Scale, the Patient Health Questionnaire, the Dutch Eating Behavior Scale, and the International Physical Activity Questionnaire were employed to measure the general condition, sleep quality, depression, emotional eating, and physical activity. A total of 813 college students (M_{age} = 19.14, SD = 1.12, range = 17 ~ 25 years old, 71.1% females) completed the survey. The moderated mediation analysis was carried out using the SPSS PROCESS macro.

Results After controlling for sex, age, and body mass index (BMI), sleep quality positively predicted emotional eating. Depression primarily mediated the association between them. Besides, physical activity levels moderated the relationship between sleep quality and emotional eating via depression. Depression significantly predicted emotional eating among students with low levels of physical activity; however, it was not significant among students with moderate or high levels of physical activity.

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Conclusions The role of depression mediates the link between sleep quality and emotional eating. Regular exercise can ease the symptoms of emotional eating through depression. This implies the importance of offering more sleep hygiene education and physical activity in university settings.

Plain English summary

College students often experience poor sleep quality and negative emotions due to different kinds of pressure, which can lead to emotional eating. But the mediating or moderating mechanism is not fully understood between them. Our research looked at how depression might explain this connection and whether physical activity can help. We surveyed 813 college students about their sleep quality, depression, emotional eating, and physical activity levels. The results showed that students with poor sleep were more likely to eat emotionally, which was totally mediated by depression. However, students who were physically active were less affected by this pattern. This means that regular exercise can weaken the impact of poor sleep and depression on emotional eating. Our findings suggest that encouraging good sleep habits and physical activity in colleges can help prevent emotional eating.

Keywords Sleep quality, Emotional eating, Depression, Physical activity, College students

Background

Emotional eating (EE) is defined as the tendency to overeat when experiencing positive or negative emotions [1, 2]. It is often linked to consuming energy-dense and sweet foods and drinks [3]. Recent studies conducted in China and other countries showed that the prevalence of EE ranged from 15.4–68% [4–7]. Lifestyle, psychological health, and gender all had impacts on the development of EE [8, 9], which was closely related to obesity [10], and then increased the risk of type 2 diabetes, high blood pressure, low self-esteem and social stigma [11, 12]. Apart from that, EE was also linked to eating disorders [13], poor health behaviors [14], poor psychological well-being and emotion regulation difficulties [15]. Importantly, adolescence is a critical period for the development of eating disorders [16]. Due to its high prevalence and negative outcomes, it is essential to pay attention to students with EE-related problems and provide targeted help.

Many factors may be related to increased risks of EE, including gender, unhealthy eating behaviors, lifestyle, psychological health and sleep [8, 9, 17, 18]. Sleep quality is an important indicator for measuring the body's health level and generally refers to people's subjective feelings about their sleep [19]. Previous studies confirmed that poor sleep quality was associated with EE [18], especially in populations with obesity [20]. It has been reported that sleep disorders may lead to serious cognitive function decline, psychological problems, and metabolic dysfunction [21–24]. Despite the high incidence of sleep disturbances (25.7%) and EE (52.7%) among Chinese college students [5, 25], there are few studies evaluating the underlying mechanisms at play in the relationship between them. Considering that both EE and sleep are linked to psychological health, more studies are needed to understand the interconnectedness and bidirectional relationships between them.

As a global mental health problem, depression has attracted a lot of attention in recent years. There is a complex link between depression and sleep. Studies showed that college students with poor sleep quality had a significantly higher risk of depression than those with good sleep quality [24, 26]. Depression is also associated with EE, individuals with elevated depressive symptoms reported higher levels of EE [20, 27, 28]. Thus, depression could play a mediating role in the relationship between sleep quality and eating disorders. A study of 690 female students with eating disorders found that the link between eating disorders and sleep disorders could be partially explained by depression [29]. An Italian study also confirmed the mediating role of depression in sleep and eating behavior [30], but few studies have been conducted on college students in China. It is known that western countries and China are different in terms of social culture, eating habits and geographical environment. Besides, the existing studies focused on patients with eating disorders, whose eating habits were unlike ordinary college students' eating habits. Therefore, the relationship between sleep, depression and EE may be different among Chinese college students.

Physical exercise is effective for maintaining and improving one's mental health and preventing diseases [31]. Evidence suggested that physical activity had a positive effect on alleviating depression, and moderate exercise could help individuals improve or maintain good moods [28]. In addition, physical activity is linked to EE. Especially under the influence of the novel coronavirus, reduced physical activity may be a risk factor for inducing EE [32]. However, the mechanisms at play in the relationships between physical activity, sleep quality, EE, and depression remain unclear. Physical activity appears to reduce EE symptoms by reducing depressive symptoms. Understanding the role of physical activity can, thus, help us design effective interventions for EE.

To date, the mutual relationships between sleep quality, depression, EE, and physical activity have been studied, but further research is needed to elucidate the underlying mediating and moderating relationships between them. Most of the research have been limited to Western populations or patients and have rarely taken physical activity into account. What's more, in view of the high prevalence of EE in Chinese college students and the large population in China, it implies that a large number of Chinese young people are suffering from the negative impacts of EE, such as obesity [10], poor psychological well-being and emotion regulation difficulties [15]. To solve the existing problems, this study explored two questions: First, whether depression plays a mediating role between sleep quality and EE in college students. Second, whether physical activity levels moderate the relationship between sleep quality and EE via depression. Therefore, we propose two hypotheses, as shown in Fig. 1. Hypothesis 1: Depression mediates the relationship between sleep quality and EE in college students. Hypothesis 2: Physical activity levels moderate the relationship between depression and EE.

Materials and methods

Study design

This study used a cross-sectional survey design. A convenience sampling method was used to select participants in a university. After obtaining online consent, participants spent 10–20 min to complete a questionnaire on the physical and mental health of college students. All the data obtained were used for subsequent analyses.

Participants and procedure

We used convenience sampling to select participants who met the criteria for inclusion at a public university in Jiangsu Province, China, from July 29, 2022, to September 17, 2022. We set up a research team and trained the researchers. Then the researchers who were trained publicized our survey to all colleges. After obtaining class monitors' consent, the survey link was distributed to class students. The criteria for inclusion were being a college student who volunteered to participate in the study. College students who were taking a leave of absence were excluded. All data were collected via self-reports entered on an online survey platform (https://www.wjx.cn/). On the first page of the questionnaire, participants were informed of the purpose of the research, the use and confidentiality of the questionnaire answers. Participants who filled in the questionnaire could earn credit for mental health activities at their university. According to the sample size calculation formula $N=Z^2p(1\text{-}p)/e^2$, where the prevalence of the population was set as 52% [5], the confidence interval was 95%, and the tolerance error was 5%, the sample size for this study was about 369 cases.

A total of 855 participants completed the study, and no questionnaires had missing values. There were 30 duplicate questionnaires, and 12 questionnaires with outliers were excluded (Eleven participants had BMIs that deviated more than 3 standard deviations from the mean, and one had a contradiction between bedtimes, waketimes, and total sleep duration). Finally, 813 questionnaires were included in the analysis.

Measures

Sociodemographic characteristics

Sociodemographic variables contained sex, age, grade, residence type, family income, weight, and height. Each participant's body mass index (BMI) was calculated based on the self-reported weight and height.

Sleep quality

The self-reported Chinese version of the Pittsburgh Sleep Quality Index (CPSQI) was used to assess participants' sleep quality during the last month [33]. The CPSQI contains seven sleep dimensions, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, sleep medication use, and daytime function. The total score ranges from 0 to 21. A

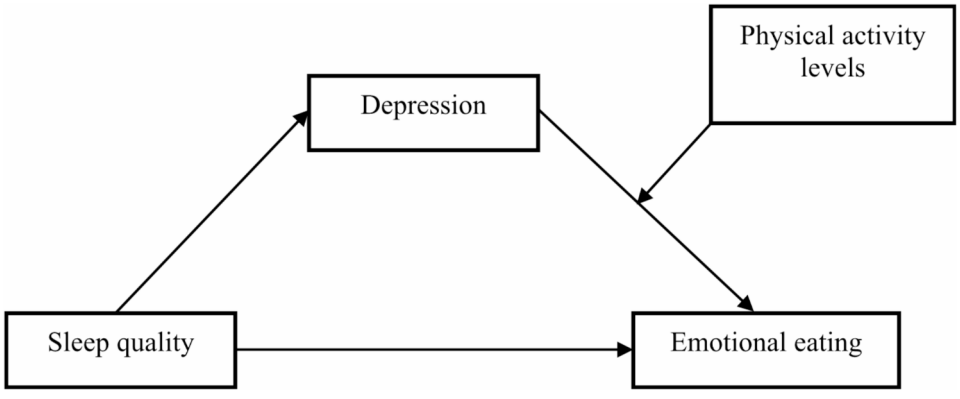

Fig. 1 The hypothesized moderated mediation model

higher score indicates poorer sleep quality and a score > 5 is considered to indicate clinical sleep disturbance [34]. The CPSQI is sensitive to change, valid, and reliable [33]. Cronbach's alpha for our study sample was 0.810.

Depression

The Patient Health Questionnaire consisting of nine items (PHQ-9), was used to assess participants' depression symptoms in the last two weeks [35]. The scale uses a 4-point Likert scale ranging from 0 ("not at all") to 3 ("nearly every day"), with an overall score range of 0 to 27. The scores of 5, 10, and 20 indicate the thresholds of mild, moderate, and severe depression, respectively [35]. The Chinese version of the PHQ-9 has been proven to be a valid and efficient tool [36]. In this study, the Cronbach's alpha of PHQ-9 was 0.898.

Emotional eating

A 13-item version of the Dutch Eating Behavior Questionnaire (DEBQ) Emotional Eating Scale was used to evaluate EE [37]. It uses a 5-point Likert scale ranging from 1 ("never") to 5 ("very often"). The total score of all items was used as a score for EE. A higher total score indicates a greater tendency to engage in EE. The Chinese version of the DEBQ has been proven to be effective for assessing eating behaviors in adolescents [38]. The Cronbach's alpha in this study was 0.970.

Physical activity

The Chinese version of the International Physical Activity Questionnaire (IPAQ-C), consisting of seven items, was used to assess physical activity levels [39]. It has been validated in the Chinese population with good reliability [39]. Participants needed to classify their physical activity levels during the past week according to three intensity classes: light (e.g., walking), moderate (e.g., jogging), and vigorous (e.g., lifting weights). They also reported the number of days per week they engaged in exercise and the duration of the exercise each time, and the total number of minutes of each intensity type of physical activity per week was computed. The ratio of the work metabolic rate to a standard resting metabolic rate (MET) was used to estimate the participants' weekly energy expenditure. The energy expenditure in MET-minutes per week (METs) can be estimated for specific activities based on type and intensity. According to the Compendium of Physical Activities, the average MET coefficient of each physical activity category was 3.3 for light exercise, 4.0 for moderate exercise, and 8.0 for vigorous exercise [40, 41]. Then, the sum of the product of the corresponding intensity (MET value) and duration (min/week) of the three intensity types of physical activity was taken as the METs-minutes per week. According to the IPAQ Working Group's recommendations, participants' physical activity can be divided into three incremental levels: low, moderate, and high [42].

Statistical analysis

Data analyses were carried out in IBM SPSS version 26.0, including the following steps. First, participants' characteristics were analyzed by descriptive statistics. The Mann-Whitney U test and the Kruskal-Wallis test were conducted to compare groups with different characteristics in terms of EE. To better compare the effects of sleep problems and depression on EE, participants were dichotomized according to the threshold values of CPSQI and PHQ-9: sleep disorder group (CPSOI > 5) and healthy sleep group (CPSOI ≤ 5); depression group (PHQ-9 ≥ 5), and no depression group (PHQ-9 < 5). Statistically significant variables were used as covariates. Second, the Harman common method deviation test was performed on the data [43]. Spearman's bivariate correlations were used to investigate the relationships among the measured variables. Third, Model 4 and Model 14 of the SPSS PROCESS macro version 3.3, developed by Hayes [44], were used to evaluate the mediating effect and moderating effect, respectively. The model was considered significant and accepted if the 95% bootstrap confidence interval (CI) did not include 0 [44].

Results

Demographic characteristics of research participants

In total, 813 participants with a mean age of 19.14 (±1.12) years were included in this study, of whom 71.1% were female. The mean scores of CPSQI, PHQ-9, and EE were 4.10 (±2.50), 3.96 (±4.09), and 24.84 (±12.18), respectively. The demographic characteristics of the participants and the results of the univariate analysis are shown in Table 1. According to Table 1, sex (P<0.001), BMI (P=0.008), sleep quality (P<0.001), and depression (P<0.001) were associated with EE.

Common method deviation test

We used the Harman single-factor test to check for common method deviation. The results indicated that the twelve factors' initial eigenvalues were >1. The variation explained by the first factor was 11.83%, which was less than the critical value of 40%, indicating that there was no serious common method bias in this study.

Correlation analysis of measurement variables

Spearman correlation analysis was conducted on the tested variables. Specifically, depression (r=0.610, P<0.01) and EE (r=0.258, P<0.01) were positively associated with the sleep quality index, while physical activity levels (r=-0.087, P<0.05) were negatively associated with the sleep quality index. In addition, depression (r=0.365, P<0.05) was positively correlated with EE.

Table 1 Characteristics of participants and univariate analysis for the factors related to emotional eating

Variable	Total	Emotional Eating Median (interquartile range)	Z/H	*P*
Sex				
Male	235(28.9)	17.00(13.00,27.00)	-5.424[a]	< 0.001
Female	578(71.1)	23.00(15.00,35.00)		
BMI (kg/m^2)				
< 18.5	140(17.2)	17.00(13.00,28.00)	11.891[b]	0.008
18.5–23.9	515(63.3)	22.00(14.00,33.00)		
24.0-27.9	123(15.1)	25.00(15.00,35.00)		
≥ 28.0	35(4.3)	22.00915.00,32.00)		
Grade				
first	409(50.3)	20.00(14.00,29.00)	5.252[b]	0.154
second	277(34.1)	22.00(14.00,33.00)		
junior	114(14.0)	24.00(15.75,35.25)		
senior	13(1.6)	18.00(14.00,36.00)		
Residence				
urban	332(40.8)	21.00(14.00,31.00)	0.811[b]	0.667
country	220(27.1)	22.50(15.00,32.00)		
town	261(32.1)	22.00(14.00,33.00)		
Family income (CNY)				
0-1999	47(5.8)	21.00(14.00,38.00)	2.400[b]	0.663
2000–4999	127(15.6)	25.00(15.00,33.00)		
5000–9999	238(29.3)	20.00(14.00,31.00)		
≥ 10,000	216(26.6)	21.00(13.00,30.00)		
unclear	185(22.8)	22.00(14.50,32.00)		
Sleep quality				
CPSQI ≤ 5	600(73.8)	19.00(13.00,29.00)	-5.752[a]	< 0.001
CPSQI > 5	213(26.2)	26.00(17.00,39.00)		
Depression				
PHQ-9 < 5	499(61.4)	18.00(13.00,27.00)	-8.84[a]	< 0.001
PHQ-9 ≥ 5	314(38.6)	26.00(18.00,39.00)		
Physical activity level				
low	591(72.7)	22.00(14.00,32.00)	1.434[b]	0.488
moderate	108(13.3)	21.50(14.25,31.50)		
high	114(14.0)	19.00(14.00,28.25)		

[a] Mann-Whitney U nonparametric test; [b] Kruskal-Wallis nonparametric test; BMI: Body Mass Index; CPSQI: the Chinese version of the Pittsburgh Sleep Quality Index; PHQ-9: Patient Health Questionnaire consisting of nine items

Mediating analysis

We used Model 4 (a simple mediation model) in the SPSS PROCESS macro to evaluate whether depression played a mediating role in the relationship between sleep quality and EE after controlling for sex, age, and BMI. As shown in Fig. 2, in the total effect model, sleep quality significantly predicted EE (β=0.2142, P<0.001). After adding the mediating variable, sleep quality also had a positive effect on depression (β=0.5893, P<0.001), and depression significantly predicted EE (β=0.3047, P<0.001), while sleep quality did not predict EE. However, we could not infer that depression played a total mediation role. Because we did not account for all possible mediators and there were often errors in psychological measurements. As recommended by Rucker, D. D. et al. [45], we suggested that depression played a primary mediation role in the relationship between sleep quality and EE. The indirect effect accounted for 83.8% of the total effect.

Moderated mediating analysis

We applied Model 14 (a moderating mediation model) of the SPSS PROCESS macro to examine the moderating mediation model. The covariables were sex, age, and BMI. The moderating variables were the physical activity levels. Considering that the physical activity levels were tripartite variables, two dummy variables were created. With low levels of physical activity as the reference group, W1 represented moderate levels of physical activity, and W2 represented high levels of physical activity. As displayed in Table 2; Fig. 3, moderate or high levels of physical activity mitigated the EE associated with depression, compared to low levels of physical activity. Both the interaction term for depression and W1 (β=-0.2338, P<0.05) and the interaction term for W2 (β=-0.3378, P<0.05) negatively predicted EE. To further examine the effects of different levels of physical activity on the association between depression and EE, a simple slope analysis was conducted, as depicted in Fig. 4, which revealed that the effect of depression on EE symptoms had a steeper slope for people with low levels of physical activity than for those with moderate or high levels of physical activity. For students with low levels of physical activity, depression significantly predicted EE (β=0.3542, P<0.001). However, the relationship between depression and EE was not significant for students with moderate or high levels of physical activity (β=0.1205, P>0.05; β=0.0165, P>0.05). This suggests that higher levels of physical activity are associated with the weaker relationship between depression and EE, which, in turn, indirectly weakens the effect of sleep quality on EE.

Exploratory analyses

Given the sex imbalance in this study, we conducted an exploratory analysis of participants grouped by sex to investigate whether the mediating model and the moderated mediating model still held true. The results showed that the mediating model held true in both males and females. However, in moderated mediating analysis, we found no significant interaction between physical activity levels and depression in males (P>0.05), that is, physical activity levels no longer moderated the effect of depression on EE in males, but remained significant in females.

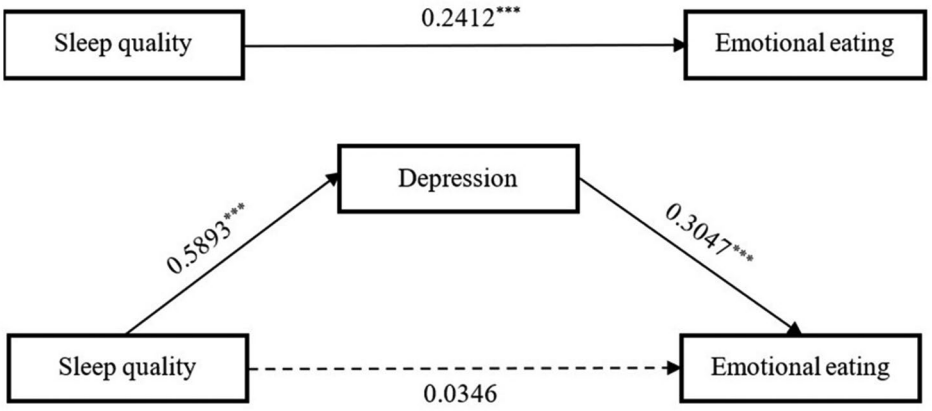

Fig. 2 The mediating effect in the association between sleep quality and emotional eating. ***$P < 0.001$

Table 2 Moderated mediation effect

Predictors	Depression		Emotional eating	
	β	t	β	t
Sex	0.0715	1.136	0.3166	4.3501***
Age	0.0344	1.349	0.0514	1.7565
BMI	0.0174	1.9425	0.0368	3.5623***
Sleep quality	0.5893	20.7369***	0.0387	0.9585
M: Depression			0.3543	8.2231***
W1			0.0140	0.1441
W2			-0.0646	-0.6567
M*W1			-0.2338	-2.1974*
M*W2			-0.3378	-2.8054**
R-sq	0.3575		0.1652	
F	112.3862***		17.6528***	

BMI, Body Mass Index; M, mediator; W1, moderate levels of physical activity with low levels of physical activity as the reference group; W2, high levels of physical activity with low levels of physical activity as the reference group. *$P<0.05$; **$P<0.01$; ***$P<0.001$

Discussion

Our research constructed a moderated mediation model to examine the association between sleep quality and EE among Chinese college students. The results showed a mediating effect of depression in the relationship between sleep quality and EE. Individuals with poor sleep quality reported higher levels of depression, and they may turn to food for comfort. Apart from that, we found that physical activity levels moderated the association between depression and EE. Depression was significantly associated with EE only in participants with low levels of physical activity but not in those with moderate or high levels of physical activity. Overall, our findings contribute to the existing literature by demonstrating the underlying mediators and moderators of the association between sleep quality and EE.

The effect of sleep quality on EE

Our study found that poor sleep quality was significantly linked to a higher emotional eating score, which was consistent with previous research [46, 47]. Research reported that sleep problems may make people more sensitive to negative emotions and, thus, affect the process of attention deployment in emotional eating [48], causing people to shift their attention to enjoyable foods in an attempt to relieve the negative mood. It follows that good sleep quality is beneficial to develop healthy eating behaviors and prevent adverse health outcomes.

Mediating effect

The study indicated that depression played a primary mediating role in the relationship between sleep quality and EE, which is in line with previous research. For example, Latino adults with poor sleep quality have been found to have an increase in negative emotions, which seems related to EE [18]. The relationship between insomnia and eating psychopathology is mediated by depression among American female college students [29]. A similar result has been found among Chinese Tibetan students, but the study did not take eating disorder subtypes into account [49]. It can be seen that the associations have been validated across ethnic groups and patients.

This connection may stem from the following facts. To be specific, sleep problems can increase the susceptibility to psychiatric disorders and result in poorer emotional responses and emotional regulation [50, 51]. People with emotional dysregulation may suffer from more psychological distress, which, in turn, impairs self-control and coping skills, leading to EE as a nonadaptive emotion regulation strategy [9, 20]. Besides, food intake is reported to have a pleasurable and rewarding effect [52], and depressed students tend to consume too much high-calorie food to relieve their negative emotions. However, EE can increase people's body dissatisfaction and contribute to more negative feelings, which forms a bad circle [9]. Therefore, solving sleep problems and negative emotions is necessary and urgent for students, especially among

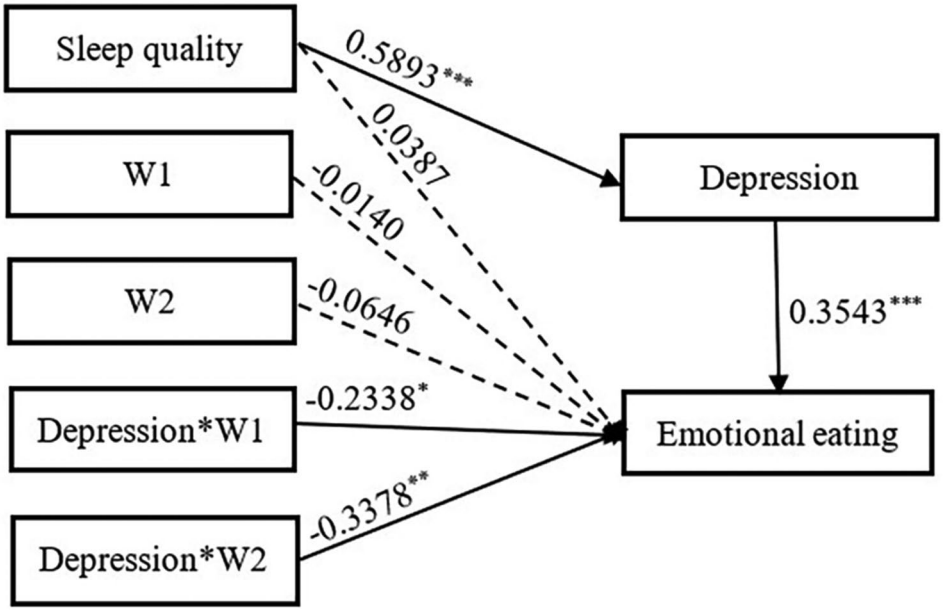

Fig. 3 The moderating effect of physical activity levels on the relationship between sleep quality and emotional eating. W1, moderate levels of physical activity with low levels of physical activity as the reference group; W2, high levels of physical activity with low levels of physical activity as the reference group. $^{*}P<0.05$; $^{**}P<0.01$; $^{***}P<0.001$

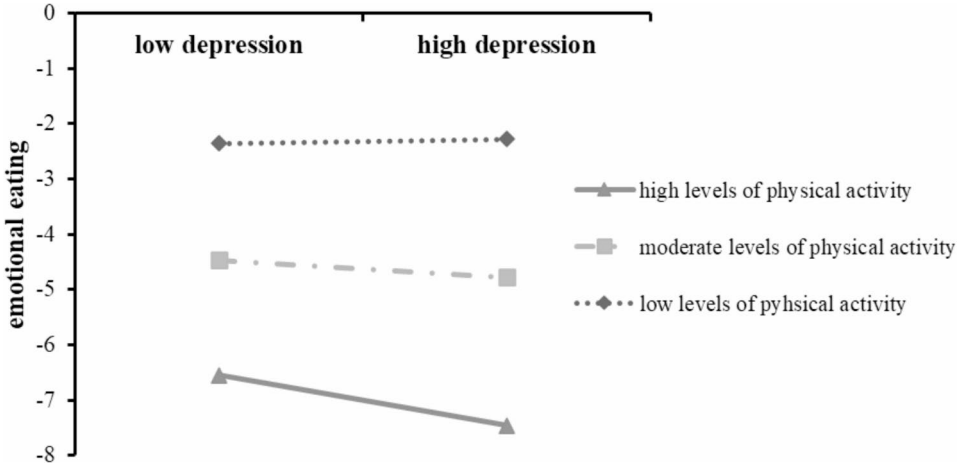

Fig. 4 Association between depression and emotional eating at different levels of physical activity

college students with EE. Considering the complexity and multi-dimensional nature of sleep problems and eating disorders, it is essential to explore the relationship between them from a more granular perspective in the future, and explore whether other variables also play a mediating role.

Moderated mediating effect

The study further found that physical activity levels moderated the relationship between depression and EE after control sex, age and BMI. Depression was only positively associated with EE in students with low levels of physical activity, which suggested that an increase in physical activity may mitigate the adverse effects of depression on eating behaviors. The latest review indicated that exercise ameliorated depressive symptoms and had become an adjunctive treatment for depressed patients [53]. Physical activity of 6–9 Mets intensity was verified to improve depression more significantly than physical activity of 3–6 Mets [54]. Physical activity also can increase people's self-esteem, social support, and self-efficacy [55], and good psychosocial health may have the potential to improve EE [56, 57]. In addition, regular physical exercise was verified to be negatively associated with the occurrence of EE and may lead to healthy eating habits [32, 58]. Therefore, maintaining moderate or high levels of physical activity could weaken the link between sleep quality and EE by reducing depression. A randomized controlled

trial confirmed that negative moods and EE sequentially mediated the relationship between physical activity and weight [59], which also could explain our findings. In a word, it is plausible that moderate or high levels of physical activity may reduce the risk of experiencing negative emotions, and then curb EE.

Notably, after grouping by sex, the moderated mediating effect was not significant in males. The possible reason is that males have better physical and mental health and the moderated mediating effect is not easy to be observed. Compared with females, the proportion of males in the moderate or high levels of physical activity was significantly higher, and the score of EE was significantly lower. In addition, the difference in the sample size of males and females may also affect the construction of the moderated mediating model. It's worth noting that other studies have also found sex differences in the relationship between sleep, negative emotions, eating disorders and physical activity, which differ from us. Research found that sleep quality could indirectly moderate the relationship between perceived stress and dietary risk through emotional eating, but the relationship was only present in females [60]. Another research reported physical activity had a main effect on emotional eating among male students, but among females, physical activity was positively associated with cognitive restraint [61] Given that the differential patterns of responses across males and females, it would be helpful to conduct multi-site, large-sample studies to verify the sex differences between the relationship of sleep quality, negative emotions, EE, and physical activity in the future.

Limitations and implications for practice

Although our study offers new evidence in this field, it also contains some limitations. First, the cross-sectional design makes it difficult to infer the causal relationship between the variables. Second, our study population was students from a university in eastern China, and the proportion of female students was relatively high, so the results need to be carefully generalized to other groups. Large, multi-center studies are necessary to verify our conclusions. However, a systematic review showed that emotional eating played a significant role in the relationship between inadequate sleep and obesity, especially in women [62], so our study still has some guiding effect. Third, all of the data came from participants' self-reports, which may contain subjective bias. However, we used scales with high reliability and validity to minimize this bias as much as possible. Future research should apply objective instruments to allocate data.

Our study offers some theoretical and practical implications that help us understand the development and prevention of EE. From a theoretical perspective, our study clarified the underlying mechanisms of how sleep quality affects EE via depression. In particular, we have taken the moderating role of physical activity on the relationship between them into account and, thus, complemented the existing research findings. In a practical sense, our results emphasized the importance of alleviating sleep disturbances and psychological problems among college students. Offering sleep hygiene education, mental health education courses or professional psychological counseling in college may be key to curbing the adverse consequences of sleep disorders and EE. Furthermore, our findings indicate that increasing physical activity may weaken the effects of depression on emotional eating among college students.

Conclusion

In conclusion, our study constructed a moderated mediation model to examine the relationship between sleep quality and emotional eating. Depression is a primary mediator of the relationship between them. In addition, physical activity levels can moderate the effect of depression on emotional eating. These findings suggest that future research investigating whether interventions for sleep quality and physical activity can reduce emotional eating are warranted.

Abbreviations

EE	Emotional eating
BMI	Body mass index
CPSQI	The Chinese version of Pittsburgh Sleep Quality Index
PHQ-9	The patient Health Questionnaire with nine items

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Author contributions

ZJX, CYS, JSQ: Formal analysis, Writing – original draft, Writing – review & editing., LWY, FXX, WXP, ZZM: Data curation, Writing – review & editing. QJC, BY: Methodology, Writing – review & editing. LYB: Writing – review & editing.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The data collection for this study was approved by the Ethics Committee of the School of Nursing and Public Health at Yangzhou University (No. YZUHL20220042). All participants provided informed consent online.

Consent for publication
Our work has not been published previously and its publication was approved by all authors.

Competing interests
The authors declare no competing interests.

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