The effect of sleep quality on social anxiety among college students: mediating effects of regulatory emotional self-efficacy and dormitory interpersonal distress

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Abstract. Chinese college students need to live in dormitories with others for long periods of time, often leading to sleep and social inconvenience. According to the cognitive model of insomnia and social anxiety, the current study aimed to investigate whether emotion regulation self-efficacy and dormitory interpersonal relationships jointly play a chain mediating role between sleep quality and social anxiety. 922 Chinese students completed Pittsburgh Sleep Quality Index, Regulatory Emotional Self-Efficacy Scale, Dormitory Interpersonal Relationship Diagnostic Scale, and Interaction Anxiousness Scale. We adopted structural equation modelling (SEM) to analyze whether the chain mediation model is valid. The results shed light on that the better the quality of sleep of college students, the higher the self-efficacy of regulating emotions, the less interpersonal conflict in the dormitory, and the lower the level of social anxiety. This study provides a new perspective for college educators to consider when dealing with students' psychological issues. We suggest that college educators can understand the situation from students' sleeping conditions and dormitory interpersonal relationships when dealing with college students' social anxiety, consequently enhancing students' ability to manage their emotions in their daily education.

Keywords: Chinese college students, sleep quality, social anxiety, regulatory emotional self-efficacy, dormitory interpersonal relationships, Chain mediation model

1 Introduction

Sleep is one of the most crucial circadian rhythms in humans, and several meta-analyses have established a strong link between sleep and mental health[1]. While nowadays, low sleep quality for college students has become a hot topic, including sleep disturbance and deprivation. In a recent meta-analysis on sleep problems among Chinese college students, 25.7% of participants reported having sleep disorders, and 43.9% of them admitted that they slept for fewer than seven hours per night[2].

Although students are often told that "life will be much easier after the entrance exams" when they were in high school, this is, in fact, not the case. In university, in addition to fulfilling academic requirements, they would also need to properly deal with

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a variety of new challenges. For example, on one hand, since it is usually the first time that they leave their family, they would have to start to learn to live independently. On the other hand, fitting into new social roles and sustaining positive interpersonal connections also demand extra time and effort[3]. Among all the social occasions, the dormitory is the place where a student would spend the most time, leading to the fact that communication with roommates is one of the main sources of pressure and anxiety.

In Chinese universities, usually, four to eight students share a small room together. Therefore, they must get accustomed to other people's existence all the time, even when sleeping, and they would usually experience lacking privacy and redundant social burdens. At the same time, people always have different daily routines and habits, resulting in additional noises, which would also affect sleep quality and mood swings. In conclusion, sleep problems and social anxiety in dormitory life deserve the attention and research of college educators.

1.1 Sleep quality and social anxiety

Insomnia, one of the most common sleep orders, with symptoms such as difficulties with falling asleep or staying asleep, was also found to cause excessive and uncontrollable worries in patients, and these worries do not only happen before sleep but also during daytime when people are just dealing with routine daily tasks, ultimately leading to mental problems, like social anxiety disorder[4].

Social anxiety disorder (SAD) is a common and pervasive anxiety disorder characterized by a persistent fear or concern about situations involving socially-oriented interactions and behaviors that may be censored by others[5]. Several studies have confirmed an association between sleep and social anxiety[6-8]. A study that reviewed archival data from patients with SAD treated with cognitive behavioral group therapy confirmed the co-existence of sleep difficulties with SAD and suggested that sleep difficulties can predict the severity of SAD regardless of the severity of depression[9].

In a recent cognitive model of insomnia, it was pointed out that there is a symbiotic relationship between anxiety and sleep, where they both influence each other. The model argues that individuals are monitoring internal (i.e., emotion regulation self-efficacy, body sensation, mood states, etc.) and external (i.e., natural or social environment) sleep-related threats, causing the consistent feeling of fear and concern.

Internally, patients with insomnia can become overly worried about the negative consequences of sleep deficit, triggering emotional distress. If such emotional distress is not relieved and the individual dwells on the cognitive distortions of not getting enough sleep and performing poorly during the day, then more severe autonomic arousal and anxiety will appear successively, which was supposed to be the appropriate response to the threat faced by humans in the past, putting the individual in a state of physiological arousal. Instead, when we try to sleep, this arousal is useless and can even be disastrous, making it difficult for the individual to fall asleep[10]. Overall, insomnia and anxiety at this time form a vicious cycle: the physiological arousal state triggered by anxiety causes the individual to have difficulty falling asleep at a time when he or she should be asleep and remain awake continuously. The lack of sleep increases the

individual's concerns about daytime performance, further worsening the individual's anxiety.

The detection of threats from the external environment (e.g., sleeping room, neighborhoods, and natural environment to which the house is connected, etc.) can also cause individuals to worry not only about sleeping but also about managing their interpersonal relationships. For Chinese college students, the dormitory is the primary environment for sleep and social interaction. The complexity of the dormitory environment makes the individual more likely to feel threatened, which in turn triggers sympathetic nervous system activation so that the individual has difficulty in sleep. For people with social phobia, excessive negative cognitive distortions can lead them to believe that they do not perform as well as they do and show a greater tendency to withdraw from social activities, which in turn affects their interpersonal relationships[11].

Based on the idea of "detecting threats" mentioned in the new cognitive model, we hypothesized that a decrease in perceived threats, both internal and external, would lead to changes in sleep quality and social anxiety. Based on these theoretical backgrounds, the current study sought to investigate the relationship between sleep quality and social anxiety in terms of both internal (cognitive influences) and external factors (environmental influences). Therefore, emotion regulation self-efficacy and interpersonal relationship distress in the dormitory were chosen as the study variables.

1.2 The mediating role of regulatory emotional self-efficacy

Self-efficacy was a concept developed by the renowned psychologist Bandura in the late 1970s, referring to people's beliefs about their abilities, which determine how they feel, think, motivate, and behave[12], and extended to the field of emotion regulation by the Italian psychologist Capara in 1999. Regulatory emotional self-efficacy is considered to be a specific social cognitive variable, defined as people's confidence in their ability to regulate and manage negative emotions (e.g., anger, irritation and frustration, pain) when they encounter stressful or adverse situations[13].

To start with, numerous studies have pointed out a strong correlation between sleep and emotion regulation or regulatory emotional self-efficacy[14,15]. From the perspective of imaging physiology, in an experiment conducted by yoo et al., participants received and rated a series of picture stimuli ranging from neutral mood to increasing disgust. Cognitively, subjects in the sleep deprivation group assessed more stimuli as negative compared to the control group. Also, when the emotional values of the pictures had negative potency and with a high arousal level, the amygdala activation was significantly increased by 60% in the sleep-deprived subjects, much higher than in the control subjects[16]. In other words, sleep deprivation may cause a more emotionally unstable mental state and lead to prolonged amygdala activation. According to the cognitive model of insomnia, when individuals perceive a prolonged activation of the amygdala as a "threat" from the inside of the body, this threat leads them to further worry: "Can I overcome this difficulty and better regulate my emotions?". Apparently, the exaggerated negative cognitive activity that has been ingrained in the minds of insomniacs, that is, the fear of the horrible consequences of sleep deficit can make them inclined to say" No, I cannot do that."[10].

Furthermore, Ronald et al. proposed a model of anxiety experience in a social/evaluative situation for people with social phobia, arguing that emotional over-reactivity, and mood dysregulation were also considered to be central features of social anxiety disorder[17,18] . In an emotion regulation interview for patients with social anxiety disorder, it was found that compared to controls, patients with social anxiety disorder had lower self-efficacy in cognitive reappraisal and expression suppression, which means a greater tendency to consciously repress the expression of their emotions[19]. It was also indicated that when individuals have low self-efficacy for emotion regulation and believe they are not in control of their emotional responses, they trigger selective attention and monitoring toward internal and external threat cues, which in turn exaggerates the negative consequences of not being able to regulate emotions effectively. On the other hand, in order to avoid social incidents, people with social anxiety disorder turn to maladapting response strategies, including avoidance and safe behavior. There is also evidence suggesting that when prompted, people with social anxiety disorder could implement cognitive reappraisal that can reduce their negative emotional experiences[20]. When they reflect on it afterwards, underestimation of social performance can lead to further social anxiety[21]. To summarize, several studies have confirmed the correlation between emotion regulation self-efficacy and social anxiety[22,23].

Thus, regulatory emotional self-efficacy may be a mediating variable between sleep quality and social anxiety.

1.3 The mediating role of dormitory interpersonal relationship distress

Dormitory interpersonal relationship refers to social relationships formed among roommates in a dormitory based on their frequent daily emotional interactions. For Chinese college students, the dormitory members are relatively fixed across the 4 years. In other words, they are forced to encounter everyday contact with each other, hence, would unavoidably deeply influence each other from all perspectives. Therefore, a dormitory is not only a place to rest, but also becomes a small family, a micro-society, and a crucial social environment.

Studies have confirmed that roommate activities are the most common source of perceived noise, affecting sleep duration and quality of college students[24], therefore, different sleep habits among roommates can also be a common reason for interpersonal conflicts in a dormitory[25]. All the redundant noise or activities during sleep from the external environment can induce a feeling of sleep-related threat which disturbs regular sleep circadian rhythm, leading to excessive negative tonal cognitive activity. This fits the theory proposed by the cognitive model of insomnia, which assumes that distorted perceptions of sleep and daytime deficits trigger excessive worry and physiological arousal as well as emotional distress, for example, anxiety or depression. Furthermore, anxiety states and the abnormal attention processes it triggers can trick individuals into suffering a "distorted perception of reality", believing they are getting even significantly less sleep than they actually are, and overestimating the negative impact of sleep on daytime performance. Such a distorted perception may have two effects. On one hand, this distorted perception would cause them to attribute their poor daytime perfor-

mance to discordant dormitory life, complain about their noisy roommates, and inevitably cause interpersonal conflict. On the other hand, the underestimation of daytime functioning can also cause them to lose confidence in being able to regulate interpersonal conflicts, resulting in further worsening of interpersonal relationships.

The cognitive-behavioral model for social anxiety holds that social anxiety is an individual's response to a perceived threat. When an individual perceives the existence of an "audience" that may pay attention to his or her behavior, they make judgements about the probability that the audience might make negative evaluations through verbal or nonverbal signals, which can be distorted because of the indirect and ambiguous nature of social interactions. The negative evaluation of the audience becomes the main threat stimulus for the individual, and the distortion can cause individuals to exaggerate the likelihood of negative evaluations and the social consequences of negative evaluations, which in turn can cause cognitive symptoms of anxiety[17]. If a conflict arises within the dormitory, students would perceive a greater threat from the dormitory related to socialization. A study of adolescents showed that multiple aspects of adolescent social relationships uniquely contributed to feelings of internal distress and that peer group relationships predicted social anxiety[26]. Previous studies have also confirmed the protective effects of good sleep quality on interpersonal relationships in dormitories[27], and that positive dormitory relationships also have a protective effect on social anxiety, forming a reciprocal relationship[28]. Therefore, dormitory interpersonal relationship distress, on one hand, gets affected by sleep quality, and, on the other hand, affects anxiety states.

1.4 The Present Study

Although previous studies have discussed the relationship between four variables: sleep quality, regulatory emotional self-efficacy, dormitory relationship distress, and social anxiety. Yet, the role of two factors, regulatory emotional self-efficacy and dormitory relationship distress, in the relationship between sleep quality and social anxiety has not been investigated. Therefore, in the specific context of Chinese college students' dormitory life culture, we will investigate the relationship between sleep quality and social anxiety from a more holistic and comprehensive perspective, with the aim of exploring the mediating role of regulatory emotional self-efficacy and interpersonal relationships in the dormitory.

The current study raises the question: what is the relationship between sleep quality and social anxiety? How do regulatory emotional self-efficacy and dormitory interpersonal distress mediate the relationship between sleep quality and social anxiety?

The following hypothesis served as a guide for this study:

H1: Regulatory emotional self-efficacy may mediate the relationship between sleep quality and social anxiety.

H2: Dormitory interpersonal distress may mediate the relationship between sleep quality and social anxiety.

H3: Regulatory emotional self-efficacy and dormitory interpersonal distress jointly play a chain mediating role in the relationship between sleep quality and social anxiety.

2 Methods

2.1 Participants

In total, 922 students from the university (undergraduate and graduate students included) participated in this study. Among all participants, 610 were male, (66.10%) and 312 were female (33.80%). 100 students were first-year students (10.80%), 299 students were second-year students (32.40%), 321 students were third-year students (34.80%), 143 students were fourth-year students (15.50%), 10 students were fifth-year students (1.00%), and 49 students were graduate students (5.10%). The mean age was 21.78 years with a standard deviation of 2.52. The basic information of the participants were summarized in Table 1.

Table 1. The distribution characteristics of the participants

	M±SD/ Number(percentage)
Age	21.78±2.52
Sex	
Male	610 (66.10%)
Female	312 (33.80%)
Grades	
First-year	100 (10.80%)
Second-year	299 (32.40%)
Third-year	321 (34.80%)
Fourth-year	143 (15.50%)
Fifth-year	10 (1.00%)
Graduate	49 (5.10%)

2.2 Measurements

Pittsburgh Sleep Quality Index (PSQI).

The PSQI was developed to assess the quality of sleep. The scale was developed by Dr. Buysse, a psychiatrist at the University of Pittsburgh, in 1989, and the Chinese version, translated by Xianchen Liu et al. in 1996, was used in the current study. The scale has 18 entries, including 7 components: sleep quality, time to fall asleep, sleep duration, sleep efficiency, sleep disorders, hypnotic drugs, and daytime dysfunction. Each component is scored on a scale of 0 to 3, with a total score range of 0 to 21, with higher scores indicating poorer sleep quality[29]. The Cronbach's α of the scale in this study was 0.86. Confirmatory factor analysis was as follows: $\chi 2/ df = 4.80$, IFI=0.93, TLI=0.92, CFI=0.93, RMSEA=0.06. This questionnaire had good reliability and validity in this study.

Regulatory Emotional Self-Efficacy Scale (RES).

RES is used to assess the degree of self-confidence of individuals in their ability to effectively regulate their emotional state. The scale was developed by Caprara and revised in 2008.The Chinese version, translated and revised by Guoliang Yu in 2009, was used in this study.The 12-item scale contains three dimensions of self-efficacy for regulating positive emotions, regulating frustrated/painful emotions, and regulating angry/irritable emotions. The scale is scored on a 5-point scale (1=very poorly, 5=fully), with a total score. The higher the score, the higher the degree of self-efficacy in regulating emotions[30]. The Cronbach's α of the scale in this study was 0.89; Confirmatory factor analysis was as follows: $\chi 2/ df = 5.86$, IFI=0.95, TLI=0.93, CFI=0.95, RMSEA=0.07. This questionnaire had good reliability and validity in this study.

The Dormitory Interpersonal Relationship Diagnostic Scale.

The Dormitory Interpersonal Relationship Diagnostic Scale is used to assess events or emotional experiences that occur in the dormitory or among roommates. The scale was adapted by Rong Yang from the "Comprehensive Interpersonal Relationship Diagnostic Scale" developed by Rizheng Zheng et al. The rating table consists of 28 subjects, using a five-level rating system, with a total of 28 points. The higher the score, indicates that the worse the interpersonal behavior in the dormitory[31]. The Cronbach's α of the scale in this study was 0.94. Confirmatory factor analysis was as follows: $\chi 2/ df = 5.55$, IFI=0.92, TLI=0.90, CFI=0.92, RMSEA=0.07. This questionnaire had good reliability and validity in this study.

Interaction Anxiousness Scale (IAS).

The IAS is used to rate the tendency to experience subjective social anxiety independent of behavior. The scale was developed by Leary and Kowalski in 1983, and the Chinese version, revised by Chunzi Peng in 2004, was used in the current study. The IAS contains 15 self-reported entries that are answered on a 5-point scale. (1=not at all in line with me; 5=very much in line with me). Their overall score ranges from 15 (the lowest level of social anxiety) to 75 (the highest)[32]. The Cronbach's α of the scale in this study was 0.84. Confirmatory factor analysis was as follows:$\chi 2/ df = 4.40$, IFI=0.92, TLI=0.91, CFI=0.92, RMSEA=0.06. This questionnaire had good reliability and validity in this study.

2.3 Procedure

We recruited a sample of college students by posting information online and on social media. Participants were aware of the purpose and anonymity of the study and signed an informed consent form before completing the questionnaire. After receiving 1271 questionnaires, we removed 141 answers with wrong formats and 206 answers that did not conform to realistic logic, eliminated a total of 347 invalid questionnaires, and finally obtained 922 valid questionnaires.

2.4 Data Analysis Strategy

For data analysis, descriptive statistics were first performed and reported by SPSS 27.0, continuous variables were expressed as mean ± standard deviation, and correlations were calculated with Pearson correlation analysis. Secondly, the Haman Single-Factor Test was used to test the bias of common methods (CMB)[33]. Thirdly, the significance of the mediated effects was tested using a bias-corrected percentile Bootstrap sample of 5000 in the PROCESS 4.2 program developed by Hayes[34]. The effect was considered significant when the 95% bias correction confidence interval (CI) did not include zero[35]. Finally, AMOS 27 was used to test the fit of the chain mediating effect model.

3 Results

3.1 Common Method Bias Test

Twelve factors with eigenvalues larger than 1 were identified via exploratory factor analysis. The first factor explains 25.81% of the variance, which is less than the threshold criterion of 40%. The results indicated that there is no more critical common method bias in this study.

3.2 Descriptive statistics and correlation statistics

The analysis of correlations among the variables revealed that sleep quality, emotional regulation self-efficacy, dormitory interpersonal distress, and social anxiety were significantly correlated, as shown in Table 2.

Table 2. Descriptive statistics and correlation statistics of sleep quality, regulatory emotional self-efficacy, dormitory interpersonal distress, and social anxiety

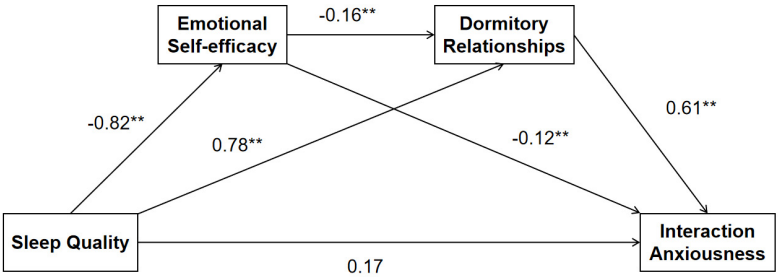
	M±SD	1	2	3	4
1 Sleep quality	12.34±2.96	1			
2 Regulatory emotional self-efficacy	44.00±8.62	-0.281**	1		
3 Dormitory interpersonal distress	7.09±4.64	0.576**	-0.430**	1	
4 Social anxiety	43.77±9,19	0.267**	-0.269**	0.393**	1

3.3 Mediation of regulatory emotional self-efficacy and dormitory interpersonal distress

We implemented the PROCESS model 6 in SPSS, applying sleep quality as an independent variable, emotional regulation of self-efficiency and interpersonal relationships as intermediate variables, and social anxiety as a dependent variable.

The results showed that the effect of sleep quality on the total effect of social anxiety was significant before the inclusion of intermediate variables. While after the inclusion of intermediate variables, the direct effect of sleep quality on social anxiety was non-significant (β=0.17, t=1.48, 95%CI: -0.0555, 0.3932). Sleep quality was a significant negative predictor of regulatory emotional self-efficacy (β=-0.82, t=-8.88,95%CI：-0.9980, -0.6366), while would significantly and positively predict interpersonal relationship distress in dormitories (β=0.78, t=18.74, 95%CI：0.6932, 0.8553). Regulatory emotional self-efficacy significantly and negatively predicts interpersonal relationship distress in dormitories (β=-0.13, t=-11.05, 95%CI: -0.1847, -0.129) and social anxiety (β=0.78, t=-3.61,95%CI: -0.1983, -0.0587). Interpersonal relationship distress in dormitories significantly and positively predicts social anxiety (β=0.61, t=7.91, 95%CI: 0.4618, 0 .7665).

In conclusion, it was indicated that regulatory emotional self-efficacy and dormitory interpersonal distress played a significant full mediating role in sleep quality and social anxiety among college students, respectively, and regulatory emotional self-efficacy and dormitory interpersonal distress also play a significant chain mediating role between sleep quality and social anxiety (Figure 1).



Note: ***P<0.001

Fig. 1. The mediating roles of regulatory emotional self-efficacy and dormitory interpersonal distress between sleep quality and social anxiety

To further test the significance of the mediating effect of regulatory emotional self-efficacy and interpersonal relationship distress in the dormitory, we performed a bootstrap analysis, repeated sampling 5000 times and calculated the 95% CI. As shown in Table 3, the results demonstrated that the 95% confidence intervals of all three mediated effect paths did not include 0, indicating that all three mediated effects reached a significant level. The mediating effect of sleep quality on social anxiety among college

students was generated through three mediating chains. First, sleep quality→regulatory emotional self-efficacy→social anxiety (β=0.11, Sides of effect: 12.68%, 95%CI: 0.05, 0.18). Second, sleep quality→dormitory interpersonal distress→social anxiety (β=0.48, Sides of effect: 57.41%, 95%CI: 0.35, 0.62). Third, sleep quality→regulatory emotional self-efficacy→dormitory interpersonal distress→social anxiety (β=0.08, Sides of effect：9.50%, 95%CI: 0.05,0.11).

Table 3. Bootstrap analysis of the mediating model.

Effect	Path	*β*	Sides of effect	95% *CI*	
				Low	Up
Direct effect	sleep quality →social anxiety	0.17	20.39%	-0.06	0.39
Indirect1	sleep quality →regulatory emotional self-efficacy →social anxiety	0.11	12.68%	0.05	0.18
Indirect2	sleep quality →dormitory interpersonal distress →social anxiety	0.48	57.41%	0.35	0.62
Indirect3	sleep quality→regulatory emotional self-efficacy→dormitory interpersonal distress→social anxiety	0.08	9.50%	0.05	0.11
Total indirect effect		0.66	79.61%	0.51	0.82
Total effect		0.83		0.63	1.02

Finally, to test the compatibility of the intermediate model, we further tested it with the AMOS27.0 software. Referring to Hu and Bentler, RMSEA less than 0.08 and CFI and TLI scores above 0.90 indicate an adequate model fit[36]. After testing, the mediated model fitting parameters for this study were$\chi 2$/ df=6.112, IFI=0.918, TLI=0.901, CFI=0.917, and RMSEA=0.075. Hence the mediated model fit of the current study is considered acceptable.

4 Discussion

The aim of this study was to explore the impact of sleep quality on social anxiety considering regulatory emotional self-efficacy and dormitory interpersonal distress as intermediate variables. Our findings supported that regulatory emotional self-efficacy and dormitory interpersonal distress both mediated the relationship between sleep quality and social anxiety. Moreover, regulatory emotional self-efficacy and dormitory interpersonal distress jointly played a chain mediating role in the relationship between sleep quality and social anxiety. These findings suggested that when having better sleep quality, college students will show higher regulatory emotional self-efficacy, less interpersonal conflict in the dormitory and lower levels of social anxiety.

First, our results verified the significant association between sleep and social anxiety. Based on the three-factor model of insomnia, it was proposed that the occurrence of acute insomnia was associated with predisposing, precipitating and perpetuating factors. Among these factors, the predisposing factors encompass biological, psychological, and social factors. Respectively, biological factors include high arousal/high reactivity, psychological factors include a tendency to worry or overthink, and social factors include significant life events experienced by the individual[37]. In the current study, we mainly considered psychological (emotional self-efficacy) and social factors (dormitory interpersonal distress) as intermediate variables.

In the first stage of the chain-mediated process (sleep quality→regulatory emotional self-efficacy), it was found that individuals with higher quality sleep have higher regulatory emotional self-efficacy, which is consistent with the previous findings about psychological factors for sleep[38]. Long-term poor sleep experiences can lead to impaired personal social functioning during the day, including tendency to worry and biased negative social evaluation, usually related with regulatory emotional self-efficacy. The high-awareness and excessive tendencies to worry caused by insomnia not only contribute to the biological well-being of people but also have an impact during the day when they are socializing with others, contributing to excessive negative cognitive activity[37]. Also, when socializing during the day, people perceive external feedback from verbal and nonverbal signals of the audience and tend to bias this feedback, believing that the audience has a negative evaluation of them, which in turn triggers cognitive and physiological anxiety. Escalating anxiety can bring about excessive and increasingly catastrophic worry, physiological arousal, and painful subjective feelings, which in turn affect the persistence of insomnia while daytime functioning may again be hindered. Hence, this impairment of personal social functions can reduce their confidence as well as their ability to effectively manage emotions.

In the second stage of the chain-mediated process (regulatory emotional self-efficacy → dormitory interpersonal distress), regulatory emotional self-efficacy was found to be significantly and negatively related to dormitory interpersonal distress among college students. The higher the sense of self-efficacy in regulating emotions, the less behavioral distress in interpersonal relationships in dormitory life[14,39]. On one hand, college students with high emotion regulation self-efficacy are likely to be more confident in regulating their emotions, so they would be able to manage negative emotions effectively and avoid irreversible effects on interpersonal relationships[14]. On the other hand,

some studies have reported that regulatory emotional self-efficacy is positively related to interpersonal relationship efficacy[40]. The higher the interpersonal relationship self-efficacy is, the more they believe themselves to be able to cope better with the interpersonal environment, and the stronger their ability to handle interpersonal relationships, and thus obtain more pleasant interpersonal relationships.

In the third stage of the chain-mediated process (dormitory interpersonal distress → social anxiety), our findings revealed that the more severe the interpersonal behavioral distress in the dormitory life, the degree of social anxiety will also be more severe, which is in line with the results of the previous studies[28]. If individuals fail to have good interpersonal relationships in the dormitory and are exposed to a tense atmosphere for a long time, anxiety will remain constant or even increase with repeated exposure to stressful social situations[41].

The results of this study also proved that the relationship between social anxiety and sleep quality is chain mediated by regulatory emotional self-efficacy and dormitory interpersonal distress. On one hand, sleep restriction does have certain effects on an individual's physiological status and daytime performance. But more importantly, individuals with sleep problems often overestimate the effects of sleep deficits and underestimate their daytime performance, and their worries about being able to cope with different things increase along with this effect, leading to even higher levels of anxiety[10].

Therefore, sleep deficits caused individuals to feel less self-efficacy in regulating their emotions and more distress in dormitory interpersonal relationships. We can in turn speculate that if individuals have increased self-efficacy in emotion regulation, they would obtain more confidence in the emotion regulation during daytime socialization and better suppression of negative emotional expressions. Positive social status may lead to more support from their peers[42], which would be beneficial for them to reduce their anxiety. In addition, if interpersonal relationships in the dormitory are improved, individuals would feel less threatened by "scrutiny", and thus have less distorted perceptions of social feedback, which would also have a positive impact on reducing their sleep problems and alleviating social anxiety.

In this study, we aimed to examine the relationship between sleep, emotion regulation self-efficacy, dormitory interpersonal distress, and social anxiety from a cognitive perspective, emphasizing the important role of cognitive factors in this mediating model. Given that cognitive reconstruction is central to cognitive behavioral therapy for insomnia and social anxiety[43-45], We recommend cognitive behavioral therapy for patients with co-morbid social anxiety and insomnia, and several trials have also demonstrated the superior effectiveness of this therapy[46,47]. In a study using sleep quality as a predictor of outcome in CBT for social anxiety disorder, results also showed that subjects who felt more rested after receiving treatment presented lower social anxiety symptoms and severity[48]. In addition, considering the specificity of the dormitory environment and culture, college students who live with others are different from other social groups. Therefore, the traditional type of cognitive behavioral therapy may not be fully adapted to their actual situation. Group therapy may be a promising treatment approach, preventing individuals from avoiding their problems, increasing their motivation to change, and saving counselor resources in university[49]. The effectiveness of

CBT group therapy for college students with insomnia and social anxiety remains to be tested by more trials.

5 Implication

In China, dormitories are the main activity zones for college students. Dormitory conflicts have always been a plague for college educators, and there is an urgent need for measures to improve the quality of dormitory life, which can help college students to better adapt to college life, cultivate positive peer relationships, and enjoy their college life.

This study explored the effects of sleep quality on social anxiety among college students from the perspectives of regulatory emotional self-efficacy and interpersonal relationship distress in dormitories, providing theoretical support and practical guidance for the school on how to actively cultivate the quality of college student mental health issues.

Therefore, we call on colleges and universities to be more concerned about students' dormitory relationships and emotional regulation efficacy. Firstly, a survey on students' routines and habits can be conducted before enrollment, so that students with similar habits can be arranged in the same dormitory, to reduce friction in life habits and further alleviate conflicts. Secondly, universities should provide them with more useful communication techniques so that they can learn how to resolve disputes in dorms. In addition, it is also essential to improve self-efficacy in emotion regulation. The college staff can provide specific training or courses to assist college students in developing their capacity to control both positive and negative emotions, communicate their feelings, react appropriately to others' emotions, and adopt effective regulation techniques. Based on the significant correlations found in this study, we suggest that college educators, when dealing with college students' social anxiety, could first identify whether sleep problems and the dormitory environment have affected their socialization. This may provide a new perspective for college educators to think about students' psychological issues.

6 Limitation

First, the generalizability of the research results has yet to be confirmed by a broader study with a larger sample, and more samples from countries with dormitory cultures are needed. Second, the study was only targeted at college students, and whether the same mediating effect exists in other populations is not known yet, so further research is needed. Third, there may be response bias in the results assessed by the self-assessment scale, so in future studies, sleep diaries, PSG and other objective methods can be used to evaluate sleep quality in a more detailed and accurate way.

7 Conclusion

Overall, this study contributes to the understanding of the mechanisms by which sleep quality affects social anxiety in college students. Sleep quality of college students can predict social anxiety through the mediating role of regulatory emotional self-efficacy and interpersonal distress in the dormitory.

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