

# The Relationship Between Anxiety Level and Sleep Status Among Uyghur High School Students in Kashgar, Xinjiang: the Mediating Role of Rumination

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**Abstract.** This study explored the relationship between anxiety and sleep and the mediating role of rumination among Uyghur high school students in Kashgar, Xinjiang, using anxiety level as the independent variable, sleep status as the dependent variable, and rumination thinking as the mediating variable. The State-Trait Anxiety Inventory (STAI), the Ruminative Responses Scale (RRS), and the Pittsburgh Sleep Quality Inventory (PSQI) were used to assess the anxiety level, ruminant thinking, and sleep status of a total of 561 students in three high schools in Yecheng County, Kashgar, Xinjiang. There were 155 participants (27.63%) with sleep quality problems; there was a significant positive correlation between anxiety level and sleep status ( $t = 0.59, P < 0.01$ ), a significant positive correlation between anxiety level and ruminative thinking ( $t = 0.61, P < 0.01$ ), and a significant positive correlation between ruminative thinking and sleep status ( $t = 0.62, P < 0.01$ ). Mediated effects analysis revealed direct and indirect effects of anxiety level on sleep status. The direct effect accounted for 46.14% of the total effect and the indirect effect through rumination accounted for 53.86% of the total effect. Anxiety levels play a significant predictive role for sleep status; ruminative thinking partially mediates the relationship between anxiety and sleep. These findings help to improve students' sleep status by reducing anxiety levels and ruminant thinking levels.

**Keywords:** anxiety levels; ruminative thinking; sleep status; Uyghur high school students; mediating role.

## 1. Introduction

Sleep is a very important factor for people to maintain their energy, and improve their health. It is also an important physiological need that is indispensable for everyone and has a close relationship with individual memory, thinking, cognition and learning[1]. However, high school students in the critical period of their psychological development are subject to multiple influences from themselves and the external environment, and the lack of sleep time and the worrying sleep condition is a long-standing problem to be solved[2]. A number of domestic and international scholars have conducted a series of studies on the sleep problems and anxiety levels of high school students[3-12], however, it is unclear whether the anxiety levels of high school students directly or indirectly affect sleep status through certain mediating factors.

There are many factors that influence sleep status. Allison et al. showed that increased anxiety and discomfort before going to sleep may be detrimental to optimal sleep conditions[13]. And even after controlling for depression, elevated levels of both state and trait anxiety were associated with increased levels of arousal after going to sleep[14]. Rector et al. showed that people who experience anxiety will frequently engage in rumination, and similar behaviors may affect sleep[15]. It can be seen that rumination is likely to play a mediating role in the impact of anxiety levels on sleep status. However, no studies have yet explored it. As a unique group, Uyghur students have characteristics that are different from other ethnic groups in terms of language, culture, religion, and regional atmosphere. There is no mediation analysis on the relationship between anxiety and sleep among high school students from ethnic minorities in the borderlands of China. In this study, we constructed a relational model of the anxiety-rumination-sleep relationship

with anxiety as the independent variable, sleep status as the dependent variable, and rumination as the mediating variable, and expected our results to provide support for the mediating role of rumination in this relational model and provide a theoretical basis for improving the sleep status of Uyghur high school students.

## **2. Methods**

### **2.1 Research Objectives**

To explore whether anxiety levels affect the sleep status of high school students and to discuss the role that ruminative thinking plays in how anxiety levels affect sleep status.

### **2.2 Study on objects**

The population of this study was a group of high school students. We adopted a randomized whole-group sampling method to randomly select three high schools in Yecheng County, Kashgar, Xinjiang, from which 850 students were randomly selected to conduct a questionnaire survey. A total of 680 valid questionnaires were collected, and the effective rate was 80%. After data screening, this study was finally conducted on 561 of these high school students. All of them were aged 16-19 years old, of which 200 (35.70%) were male students and 361 (64.30%) were female students; the number of sophomores was 277 (49.40%) and 284 (50.60%) were seniors.

### **2.3 Methodology**

The questionnaires were distributed in the class, and before administering the test, the test leader explained to the students the purpose of the test, the way of answering, the principle of confidentiality, the freedom to choose whether to withdraw from the test, and other principles of administration. Students were required to complete the test continuously and all questionnaires were collected on the spot. After eliminating invalid questionnaires, the valid data of this test were constituted.

State-Trait Anxiety Inventory (STAI): The Chinese version of the STAI, compiled by Li Wenli in 1995[16], The internal consistency coefficients for the total scale, the state anxiety scale, and the trait anxiety scale in this study were 0.91, 0.85, and 0.81, respectively.

Ruminative Responses Scale (RRS) The RRS scale was developed by Nolen-Hoeksema[17] in 1991 to describe concerns about individual depressive symptoms; Yiqun Gan and Xiuqiong Shen first introduced a scale related to ruminant thinking to China in 2005. Yang Juan et al. used a group of high school students aged 14-16 as subjects, which provided the basis for the application of the scale among adolescents in China[18]. The internal consistency coefficient in this study was 0.95.

Pittsburgh sleep quality index scale (PSQI): This scale was developed by Buysse et al. in 1989 as a self-assessment scale of sleep quality[19]. The scale was revised by Liu Xianchen in 1999[20] according to the actual situation in China to measure the sleep quality index in the last 1 month. Globally, a total score of 6 or more is defined as the threshold for determining poor sleep quality, and 7 is used as the threshold in China[20]. In this study, poor sleep quality was defined by a PSQI score of  $\geq 7$ ; time to fall asleep of less than 30 minutes and sleep efficiency of more than 85% were used as criteria for better sleep quality[21]. The internal consistency coefficient in this study was 0.89.

### **2.4 Study procedures and data analysis**

Structural analysis of structural equations (AMOS, version 24.0) and SPSS 26.0 software were used to analyze the data. Independent samples t-test was used to analyze differences in each variable and its dimensions, Pearson correlation was used to correlate each variable and its dimensions, and stepwise multiple regression analysis was used to explore the predictive effects of anxiety on rumination, and anxiety and rumination on sleep status. The mediating effect was tested

using a bias-corrected Bootstrap method with parameters set at 5000 times. Indirect effects were considered significant at the  $p < 0.05$  level when the confidence interval did not contain 0. In structural equation modeling (SEM), The chi-square ( $\chi^2$ ) statistic is not significant in the model, but it is strongly influenced by the sample size[22, 23] .  $\chi^2/df < 5$ , values of  $RMSEA \leq 0.08$  and  $RMR \leq 0.05$  are considered adequate model fit values. The remaining indices (e.g., GFI, TLI, and CFI)  $\geq 0.90$  indicate an adequate model fit[24-27] .

### 3. Results

#### 3.1 Correlation analysis of anxiety level, ruminative thinking, and sleep status of high school students

To investigate whether there is a significant correlation between anxiety level, ruminative thinking and sleep status of high school students, Pearson correlation analysis was used to examine the overall level of anxiety and its two dimensions of symptomatic state anxiety and trait anxiety, ruminative thinking and its three dimensions of reflection、brooding and repression, and the overall level of sleep status and its seven factors of sleep quality、time to sleep、sleep duration、sleep efficiency、sleep disorder、sleep medication、and daytime dysfunction. Afterwards, combined with the regression analysis, Pearson correlation analysis was used to test the correlation between the overall level of anxiety and its two dimensions of symptomatic state anxiety and trait anxiety, ruminative thinking and its repression and reflection dimensions and the overall level of sleep status of high school students, and the following correlation matrix was obtained for the level of anxiety, ruminative thinking and sleep status of high school students. All variables were significantly and positively correlated ( $P < 0.01$ ); the results of the correlations are shown in Table 1.

Table 1 Correlation matrix of anxiety level, ruminative thinking and sleep status of high school students (N=561)

	Mean±SD	1	2	3	4	5	6	7
Anxiety level	89.39±16.53	1						
Rumination	43.16±12.94	.608**	1					
Sleep status	4.93±3.28	.588**	.616**	1				
State Anxiety	44.42±8.94	.968**	.604**	.582**	1			
Trait Anxiety	44.97±8.19	.962**	.567**	.551**	.862**	1		
Reflection	9.77±3.17	.504**	.898**	.556**	.518**	.452**	1	
Repression	22.93±7.14	.644**	.974**	.627**	.633**	.608**	.821**	1

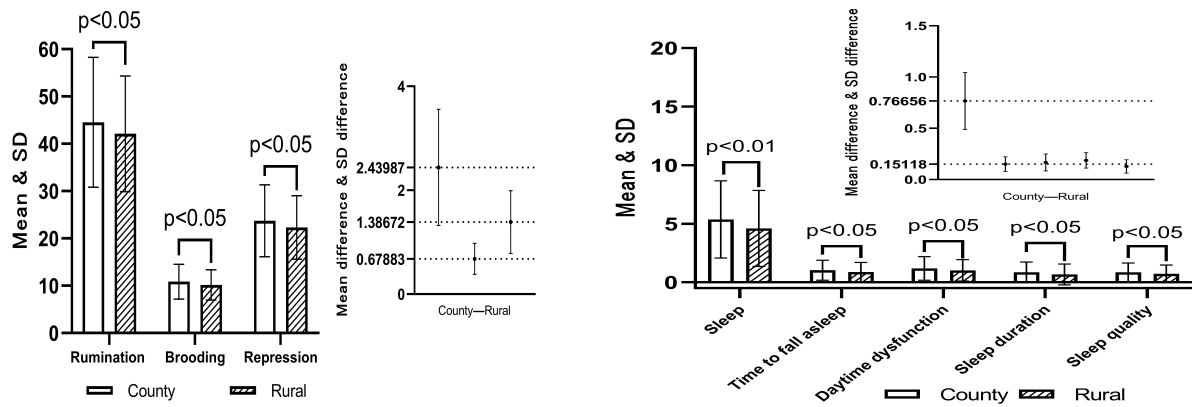
Note: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ , same below.

#### 3.2 Analysis of differences in anxiety level, ruminative thinking, and sleep status of high school students

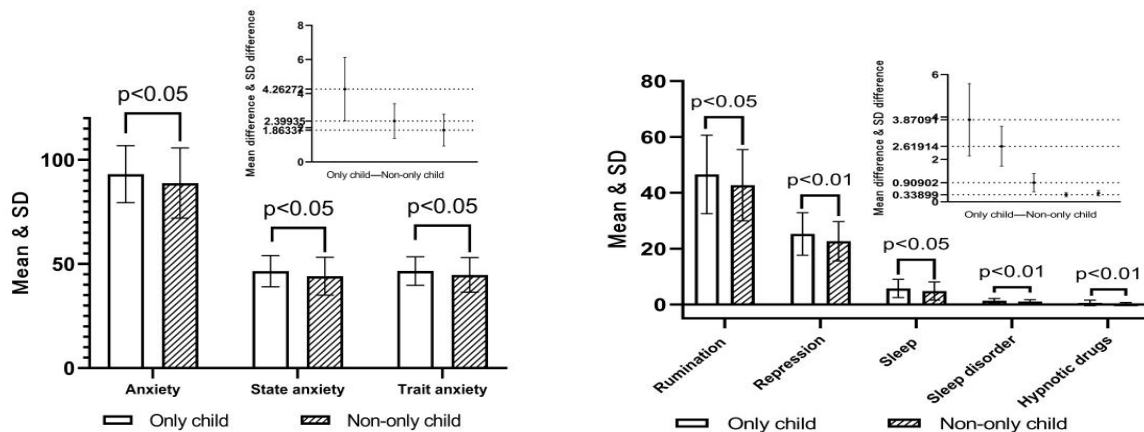
3.2.1 Differences in anxiety levels, ruminative thinking and sleep status and their dimensions by gender, grade, whether or not they were only child, and place of residence

Differences in anxiety levels, ruminative thinking and sleep status, and their dimensions on residency were analyzed. The results of the independent samples t-test showed that rumination ( $P < 0.05$ ,  $P = 0.029$ ) and its brooding ( $P < 0.05$ ,  $P = 0.023$ ) and repression ( $P < 0.05$ ,  $P = 0.023$ ) dimensions, sleep status ( $P < 0.01$ ,  $P = 0.006$ ) and its time to fall asleep ( $P < 0.05$ ,  $P = 0.034$ ), daytime dysfunction ( $P < 0.05$ ,  $P = 0.043$ ), sleep duration ( $P < 0.05$ ,  $P = 0.013$ ), and sleep Quality ( $P < 0.05$ ,  $P = 0.049$ ) dimensions differed significantly by place of residence, and students in the county had significantly

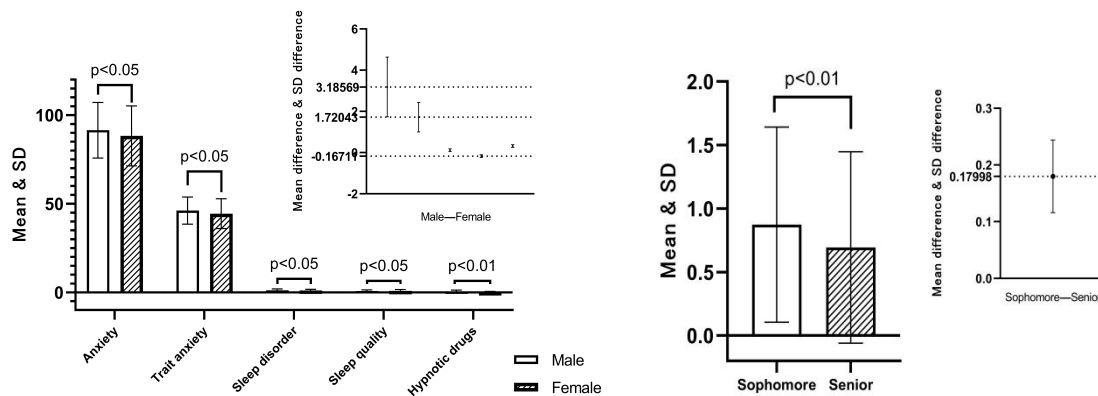
higher mean scores on all of these dimensions than students in the rural areas, and the most significant differences were found in the rumination and its repression dimensions by place of residence; see Tables 2 and 3 for details.



Differences in anxiety levels, ruminative thinking and sleep status, and their dimensions were analyzed on whether they were only children or not. The results of independent samples t-test showed that anxiety level ( $P < 0.05, P = 0.024$ ) and its two dimensions of state anxiety ( $P < 0.05, P = 0.021$ ) and trait anxiety ( $P < 0.05, P = 0.047$ ), rumination ( $P < 0.05, P = 0.023$ ) and its repression dimension ( $P < 0.01, P = 0.005$ ), sleep status ( $P < 0.05, P = 0.036$ ) and its sleep disorder ( $P < 0.01, P = 0.001$ ) and hypnotic medication ( $P < 0.01, P = 0.001$ ) dimensions were significantly different on whether or not they were only children; the mean scores of all the above dimensions were significantly higher for only-child students than for non-only-child students, and the differences were most significant for anxiety level and its state anxiety dimension, and rumination and its repression dimension on whether or not they were only children; see Tables 4 and 5 for details.



The differences in anxiety level, ruminative thinking and sleep status, and their dimensions in terms of gender were analyzed. The results of independent samples t-test showed that anxiety level ( $P < 0.05, P = 0.029$ ) and its trait anxiety dimension ( $P < 0.05, P = 0.017$ ), and sleep status of sleep disturbance ( $P < 0.05, P = 0.07$ ), sleep quality ( $P < 0.05, P = 0.013$ ), and hypnotic medication ( $P < 0.01, P = 0.000$ ) dimensions differed significantly by gender; except for sleep quality, the mean scores of all the above dimensions were significantly higher in male than in female, and the difference in anxiety level and its trait anxiety dimension was most significant in gender; see Table 6 for details.



Analyses were conducted on anxiety levels, ruminative thinking and sleep status, and the differences in their dimensions by grade level. The results of the independent samples t-test showed that the sleep quality ( $P<0.01$ ,  $P=0.005$ ) dimension of sleep status differed significantly by grade level; the mean sleep quality scores of sophomores were significantly higher than those of juniors; see Table 7 for details.

### 3.3 The mediating role of ruminative thinking in the relationship between the effect of anxiety level on sleep status in high school students

The mediating model was tested using structural equation modeling. Anxiety, rumination and sleep were modeled according to latent variables to examine the predictive effect of anxiety on sleep and its plausibility. Combined with the results of univariate correlation analysis, state anxiety and trait anxiety were selected as two observed variables of anxiety level into the model, repression, brooding and reflection as three observed variables of ruminative thinking, and sleep duration, subjective sleep quality, time to fall asleep, sleep disturbance and daytime dysfunction as five observed variables of sleep status, and the mediating model was established according to the above variables according to the requirements of structural equation modeling. Among them, the index of the predictive effect was mainly the path coefficient of anxiety on sleep quality, and the index of reasonableness was the main fitting index of the path analysis model. In the model of the predictive effect of anxiety on sleep quality, the exogenous variables included 1, i.e., ruminative thinking, and the observed indicators of ruminative thinking included repression, brooding and reflection. The results showed a good fit of the model, as detailed in Table 8, and the specific path coefficients are shown in Table 9.

Table 8 Model fit indices

Statistical test volume	$\chi^2$ degrees of freedom ratio	RMSEA	RMR	GFI	AGFI	CFI	NFI	TLI	IFI
Threshold value	<5.00	<0.08	<0.05	>0.90	>0.90	>0.90	>0.90	>0.90	>0.90
Value	3.89	0.07	0.03	0.97	0.93	0.97	0.96	0.96	0.97

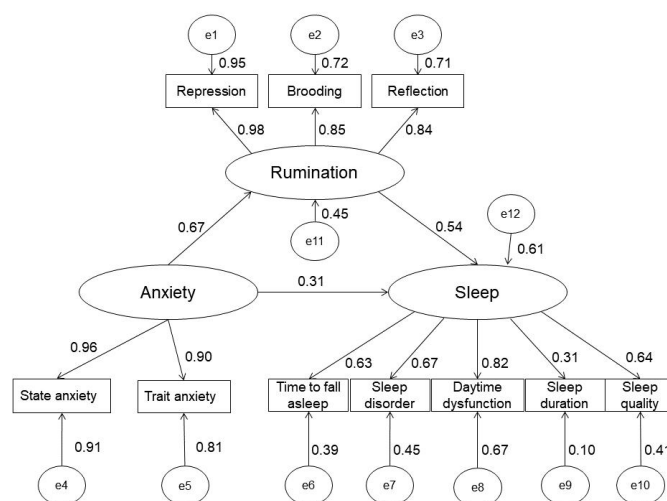
From the above intermediary model fit index results, it can be seen that the RMSEA value is 0.07, which is less than 0.08; the RMR value is 0.03, which is less than 0.05; indicating that the model fit is reasonable, and the GFI, AGFI, CFI, and NFI are all greater than 0.90, which can indicate that the constructed model can be accepted and the model fit is good.

Table 9 Standardized path coefficients

Paths	Standardized				
	Estimate	S.E.	C.R.	P-value	Estimate

Total regurgitation score <-- total anxiety score	0.630	0.670	0.035	17.888	***
Total sleep score <-- total regurgitation score	0.040	0.540	0.004	9.381	***
Total sleep score <-- total anxiety score	0.022	0.310	0.004	5.829	***

From the results of the standardized path coefficients, there was a significant positive correlation between anxiety and sleep scores, a significant positive correlation between anxiety and rumination, and a significant positive correlation between rumination and sleep scores, that is, the higher the anxiety and rumination scores, the higher the sleep scale scores, and the worse the sleep status; thus, it can be indicated that rumination partially mediates the effect between anxiety and sleep. The mediation effect of the model was tested for significance using the bootstrap method, and the mediation effect of the model in this study did not contain 0 at the 95% confidence interval (BootLLCI=0.038, BootULCI=0.0591), so the mediation effect was significant[28, 29]. The results of the mediation model analysis were that the total effect  $c = 0.6718$ , the direct effect  $c' = 0.31$ , and the indirect effect  $a*b = 0.3618$ , so the indirect effect accounted for  $a*b/c * 100\% = 53.86\%$  of the total effect, indicating that rumination partially mediates the pathway of anxiety to sleep, with a mediation effect of 53.86%.



## 4. Discussion

The present study found that ruminative thinking mediated the relationship between anxiety levels and sleep status among high school students in Kashgar, Xinjiang, a border area in northwest China. In our study, up to 27.63% of high school students in Yecheng County, Kashgar, Xinjiang, had sleep problems that affected their daily learning and life. It indicates that sleep quality problems among the Uyghur high school student population in Kashgar, Xinjiang should be of great concern. The results of the study provide a basic theoretical basis for the process of improving sleep by reducing anxiety levels and ruminative thinking, which is of great importance for high school students with high levels of pressure to advance to higher education.

### 4.1 Analysis of the characteristics of anxiety, rumination, and sleep among Uyghur high school students

The results showed that the anxiety situation of Xinjiang Uyghur high school students is not optimistic[30]. One possible reason for this difference may be the lack of communication and companionship from siblings and the relatively isolated environment in which only children grow up, which makes them more likely to feel lonely and helpless than non-only children. The more

lonely adolescents are, the more likely they are to develop and feel anxiety[31] . The overall level of anxiety and the level of trait anxiety were significantly higher for male than for female high school students in Xinjiang Uyghur ( $p < 0.05$ ), a result that is inconsistent with the general findings across countries[32-42] and with the findings of a few scholars[43, 44] . This gender difference is greatly related to the social and cultural practices, social role identity and education of male and female students in Xinjiang Kashgar Uyghur[45] , which in Islamic culture has higher requirements and expectations for boys, and the basic duties and primary obligations of women are in the family[34, 46] .

The overall ruminant level was high. The difference between the two dimensions of gender and grade level on ruminant thinking scores was not significant ( $p > 0.05$ ), while the difference between the two dimensions of being an only child and place of residence on ruminant thinking scores was significant ( $p < 0.05$ ). This finding is inconsistent with the results of the study conducted by Han Xiu[47] (2010) on the effect of gender differences on ruminant thinking, which found that females tend to ruminate more than males, and is consistent with the finding that there is no grade difference in ruminant thinking and no urban-rural difference. This finding is inconsistent with the trend of urban-rural differences and one-child status not affecting ruminant thinking in the study of ruminant thinking characteristics conducted by Hengzeng Miao[48] . One possible reason for this is that students in the county, especially those from only-child families, have grown up with a more privileged life, and their parents' excessive attention may lead to their sensitive hearts, which cannot regulate themselves well when they encounter negative things. Compared with the open-mindedness of rural students and non-only-child students, county and only-child students are more likely to fall into a dead-end cycle of thinking, which leads to regurgitated thinking[49] . In addition, some studies have shown that the family backgrounds of urban and rural students in Kashgar differ significantly, with urban students' parents generally having higher educational attainment than rural students' parents, and urban students' parents generally having higher educational expectations for their family children than rural families; this is undoubtedly a reasonable explanation for this difference as well[50] .

The overall trend of sleep status was good, but the number of subjects with sleep problems was 155 out of 561 (27.63%), with a high rate of sleep problems . The sleep status of only children and their sleep disorder and hypnotic drug dimension scores were significantly higher than those of non-only children, the sleep status of urban students and their sleep time, daytime dysfunction, sleep duration and sleep quality dimension scores were significantly higher than those of rural students, and the sleep disorder, sleep quality and hypnotic drug scores of male students were significantly higher than those of female students, and according to our previous analysis of the differences in anxiety and rumination, these results were not new. What surprised us was that sophomores reported significantly higher sleep quality scores than juniors, meaning that juniors facing the pressure to advance to higher education felt better about their sleep than sophomores who had already adapted to a year of high school life, which is inconsistent with existing studies on sleep quality in the senior class that found significant grade differences in sleep quality, with juniors in high school having the worst sleep quality[51] ; a possible explanation is that seniors have a greater sense of time urgency to study and are more able to focus on their studies; whereas students who have just entered their sophomore year do not yet have the immediate pressure of going to school and have more time to be distracted by other things, such as electronic devices; some studies suggest that one of the causes of widespread sleep deprivation among adolescents may be the widespread use of screen media, with higher levels of time spent using screen media by adolescents more likely to cause greater sleep disorders[52, 53] .

## 4.2 Relationship between anxiety and sleep status

Previous studies have demonstrated the relationship between anxiety and sleep[54-61] , and the present study also found a direct effect of 0.31 for the effect of anxiety on sleep, with the direct effect accounting for 46.14% of the total effect; the results of the standardized path coefficient showed a significant positive correlation between anxiety and sleep scores, i.e., the higher the level of anxiety, the higher the sleep status score and the worse the sleep status, which is consistent with the findings of previous researches[62] [51] . Anxiety can lead to impaired sleep initiation, reduced rapid eye movement and slow wave sleep, and increased rapid eye movement latency[63] , which in turn reduces sleep quality and worsens sleep status. Sleep deprivation in adolescents may cause other problems associated with impairments such as decreased attention, impulsivity, behavioral problems, and lower academic performance[62, 64] . Moreover, numerous studies at home and abroad have shown that anxiety is one of the most important factors affecting sleep quality, and that reducing anxiety levels and regulating negative emotions can help promote positive emotions and contribute to better sleep conditions.

## 4.3 The mediating role of rumination

Results shown that ruminant partially mediates the effect between anxiety and sleep. The effect of anxiety on sleep can be partially explained by ruminative thinking, with anxiety and rumination being able to predict each other, with anxiety being associated with more ruminative thinking, which in turn is associated with poorer sleep[65] . People experiencing anxiety may engage in negative self-focus, recurrent thoughts about their anxiety[66] , and they tend to remember and recall negative information consistent with their mood[67] . Nolen-Hoeksema's research suggests that ruminative thinking predicts anxiety symptoms[68] , and the higher the tendency to ruminative thinking, the more pronounced the individual's anxiety symptoms[69] , while anxiety may trigger insomnia. In addition, rumination may trigger sympathetic nervous system arousal and emotional distress to perpetuate sleep problems[70], Studies of sleep-related cognitive arousal and sleep disorders have shown that rumination on negative content is highly disruptive to sleep[71, 72] . Many studies have shown that by enriching students' extracurricular activities, providing specific physical activities to guide students to physical activity[73-75], In addition, we can set up classes to teach students to practice tai chi[76, 77]、Yoga practice[78] and positive thinking exercises[79, 80] and incorporating slow and deep breathing exercises into students' daily activities[81] can be effective in reducing anxiety. Students can also develop a positive and optimistic mindset and learn to adapt to anxiety[82] .A warm and positive atmosphere for learning and living can be an effective way to reduce anxiety. A warm and positive learning and living environment can promote effective emotional regulation, which in turn can reduce sleep problems and improve sleep.

## 4.4 Shortcomings and Prospects

Some limitations should also be considered when interpreting the results of this study. First, this was a cross-sectional study with simultaneous data collection on the main study variables. While the analysis was able to confirm the study hypothesis, it was not able to demonstrate a causal relationship. Future longitudinal studies, behavioral experiments, and other methods could be designed to further explore the mechanisms underlying the effects of anxiety levels on sleep status. Second, some studies suggest that trait anxiety may have an effect on sleep through state anxiety, and the next study will provide a more in-depth analysis of the effects of trait and state anxiety on sleep to provide a support for such studies. Third, only sophomores and juniors in Yecheng County, Kashgar, Xinjiang were selected, which may not be universally representative of the sample. Future studies could expand the sample selection to increase its external validity. Fourth, brain activity and functional connectivity may also affect sleep quality, which should also be considered in future studies. Fifth, this study is a survey of high school students in the poorer areas of Xinjiang Uyghur, and later studies can do a comparison of this situation among high school students in Uyghur and Han Chinese big cities, as well as longitudinal tracking of their situation after they enter university.



Sixth, the questionnaire is subjective, and some students may be concerned about forming a negative impression of their teachers and causing deviations from the truth. Therefore, future research could include multiple methodological approaches such as physiological measures of sleep.

## 5. Conclusion

The above findings illustrate the two-by-two correlation between anxiety level, rumination, and sleep status, and also reflect the mediating role of the trait of rumination in the relationship between anxiety and sleep in high school students. Overall, this paper conducted an empirical study on the role of rumination and clarified that rumination can play a mediating role in anxiety and sleep status of high school students. This study can provide some ideas for counseling to prevent and address sleep problems in high school students. It is suggested that schools should conduct more outdoor activities with various themes to guide students to focus on their studies while conducting timely counseling activities to cultivate a positive and optimistic mindset, improve students' sleep status, and help them to be more comfortable in arranging and dealing with their studies and life, etc. This study contributes to the ultimate goal of improving sleep quality by improving ruminative thinking, which in turn relieves anxiety in high school students.

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